Chapter 14
The Influence of and Interactions Between Different Contexts in the Learning and Development of Mathematics Teacher Educators

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14.1 Introduction

Just as sociocultural theories of learning, first developed in the quest to make sense of young children's experience, have subsequently been applied to the professional learning of their teachers, so too can the chain be extended to consider the development of those responsible for supporting teachers' professional growth: the teacher educators. This chapter is co-written by two university-based teacher educators involved in teaching and supervision on the part-time Master's programmes to which it refers and by three participants in those programmes, each specifically seeking to develop their practice as a mathematics teacher educator (MTE). We examine the interplay between context and learner with reference to two theoretical models of professional learning. The first is the "interconnected model of professional growth", developed by Clarke and Hollingsworth (2002), to which the participants were deliberately introduced within their Master's programmes and on which they subsequently drew in reflecting on their experiences. The second is Goos's (2013) adaptation of Valsiner's (1997) "zone theory" of development, which

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we use as a lens through which to examine the way in which professional growth necessarily changes the context in which that growth occurs.

The chapter was constructed through an iterative process that began with the three participants in the Master's level programmes (Clare, Colin and Jen) drafting reflections on the nature and impact of their individual contexts on their learning as MTEs within their particular programme. They were asked to review what and how they had learned – with learning understood to encompass changes in knowledge and beliefs as well as in their professional practice and in their goals as teacher educators. Jenni and Katharine read these reflections, along with extracts from the participants' final research and development projects. They responded by posing two or three specific questions to each MTE about influences on their development to which they had alluded and by inviting them all to relate their reflections to the Clarke and Hollingsworth (2002) model to which Jen had, in her first reflection, already referred. All the participants' initial reflections and subsequent responses were then analysed by Jenni and Katharine, along with the extracts from the participants' research and development projects. The emerging drafts developed through this process were then worked on together and successively refined by all five authors.

14.2 Teacher Education Policy and Practice in England

Since two of the MTEs were working in England, one within higher education and the other in a school-based role, while the third had only recently moved from an advisory role in England to become an educational consultant in the Middle East, we begin with a brief description of teacher education policy and practice in England. This serves both to illuminate the nature of the Master's programmes and to contextualise the specific settings within which the MTEs were working.

From the mid-1980s until the accession of the coalition government in 2010, entry to the teaching profession in England was usually through one of two main training routes: a 1-year postgraduate programme leading to a Postgraduate Certificate in Education (PGCE) for primary and secondary teachers or a 4-year undergraduate Bachelor's degree in Education (BEd) offered only to primary teachers. In both cases candidates applied for places to higher education institutions that worked in partnership with schools. It is important to note that since the early 1990s, the *minimum* proportion of time that prospective teachers within the PGCE route spend in school has been set by statute (DFE, 1992) and now stands at 67% for both primary and secondary teacher education. The fact that prospective teachers spend 24 weeks of a 36-week teacher education programme in schools has had two important implications for the work of teacher educators. The first is the diminished status of *university-based* teacher educators, many of whom (in some institutions) may be employed part-time, or as "teaching-only" staff with little or no obligation to engage in research or to have undertaken previous postgraduate study. The second is the corresponding fact that there are many well-established roles for *school-based* teacher educators, acting either as programme coordinators within a particular

school or as mentors at subject or class level. It was with these two groups of teacher educators in mind that the Master's in Teacher Education (MTEd) – undertaken by Clare and Colin – was first conceived. In its structure and delivery, it drew heavily on experience within the same university of running a part-time Master's in Learning and Teaching (MLT) – the course undertaken by Jen – which had itself been designed to allow qualified teachers to engage more fully with research than had been possible within their initial training.

The MTEd was given further impetus by two, more recent, government policies. The first was the launch of a new "School Direct" route (DFE, 2011) whereby a majority of teacher training places were allocated directly to designated teaching schools who selected their own partners. If such schools chose to award only Qualified Teacher Status, without a PGCE qualification, they did not need to work with universities at all. Although the ideological attack on universities with which this policy was originally associated (Brown, Rowley, & Smith, 2016) has since been tempered (Tatto, Burn, Menter, Mutton, & Thompson, 2018), the future of direct university involvement in initial teacher education appeared, for some years, to be in doubt. This made it even more important to ensure that teachers assuming significantly enhanced roles as school-based teacher educators had the opportunity to undertake a research-based postgraduate qualification in preparation for the role. The second involved the progressive dismantling of local government responsibility for education, as schools were variously encouraged or compelled to assume a new "Academy" status, independent of locally elected councils. Deprived of funding, as financial resources were transferred from central government directly to individual schools (or to groups of schools operating as multi-academy trusts), these authorities ceased to provide support services, such as specialist subject advisors. Schools seeking advice or professional development for their staff have therefore turned increasingly to one another or to private educational consultants, a role (like that of the former advisors) for which no particular postgraduate qualifications are formally required.

The professional contexts of the three participant authors reflect these developments in different ways. Clare had worked for many years as a university-based primary teacher educator before undertaking a Master's level qualification. Colin, who had previously been employed by a local education authority as an advisory teacher, had recently left England to assume a consultant role in the Middle East. Jen, who had qualified as a secondary mathematics teacher only a few years earlier, was already part-way through the MLT programme when her head teacher invited her to take on a new role at the primary school within their multi-academy trust, supporting the professional development of those teaching mathematics at that level.

14.3 Analytic Framework

Our initial decision to use Clarke and Hollingsworth's (2002) "interconnected model" as an analytical framework was influenced by Jen's explicit reference to it within her first reflective account. She regarded it as a valuable tool that had shaped her thinking

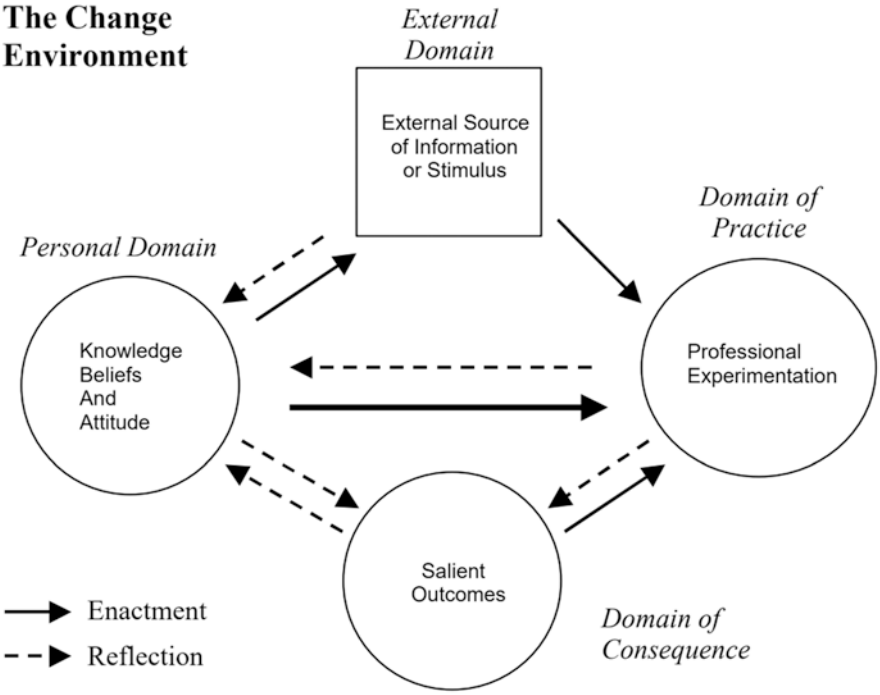

Fig. 14.1 Clarke and Hollingsworth's (2002) interconnected model of professional growth

both about the programme she developed for the primary mathematics teachers and about how to evaluate its impact. Since the model, shown in Fig. 14.1, had also been explicitly introduced to Clare and Colin and featured in both of their projects, there was evidence that all the participants had found it helpful in alerting them to the complexity of professional learning and to their scope for action in promoting it.

The interconnected model recognises the complexity of professional growth, acknowledging four distinct domains within which change may occur and identifying the mediating processes of "enactment" and "reflection" as the means by which change in one domain may be translated into change in another, along different pathways with different starting points. The "external domain", as the source of new information or stimuli, is clearly located outside the MTE's personal world. The other three domains together constitute the individual MTE's professional world of practice, encompassing his or her professional actions, the consequences that he or she infers as arising from those actions and the knowledge and beliefs that prompt and respond to those actions. Clarke and Hollingsworth (2002) chose the term "enactment" to represent the deliberate putting into action of a new idea or belief or newly encountered practice. "Reflection" carries the connotation that Dewey (1910) associated with it: that of "active, persistent and careful consideration". The model's clarity about these two mediating processes resonated powerfully with the way in which the participants reported on the developmental processes in which they had

engaged as Master's students and as MTEs seeking to improve their professional practice and thus supported our assumption that it might provide an effective framework for analysis.

Two other important features made the interconnected model a particularly valuable analytical tool. The first is its acknowledgement of the possibility of several different patterns of interaction between the different domains, which also allows for clear distinctions to be drawn between simple "change sequences" and more sustained "growth networks". The term "change sequence" is used by Clarke and Hollingsworth (2002) to describe those instances where change in one domain can clearly be seen to lead to change in at least one other domain, but where there is no evidence of those changes becoming securely embedded. Where there is evidence of ongoing or enduring change, usually indicated by more complex patterns of enactment and reflection, then these mediating processes can be seen to establish a more powerful "growth network". The second important feature derives from the significance that the model ascribes to the "change environment": the wider contextual factors that shape and constrain each individual MTE's scope for action.

As teacher educators and part-time Master's students, Clare, Colin and Jen were each simultaneously working within two different contexts: the individual professional context of their work as MTEs and the academic context created by their Master's program, which required engagement with – and conduct of – research related to their MTE role. Within the interconnected model, the specific contexts within which they were working can most obviously be understood as constituting the change environment, giving each MTE varying scope to reflect on new ideas (and indeed on those previously held in the light of new information) and to enact and evaluate new practices. The Masters' programmes in which they were each engaged can most readily be equated with the model's external domain, introducing the MTEs to a variety of different kinds of stimuli (through directed readings, taught sessions, structured tasks and dialogue with fellow students). It is important to acknowledge, however, that the MTEs' professional contexts also provided other kinds of stimuli. These arose, for example, from the particular needs of teachers with whom they were working or from the demands of senior management or inspection regimes to which their provision was subject. Moreover, the very fact of enrolling on a Master's programme had its own impact on the MTEs' change environment, creating an expectation (acknowledged by their employers, colleagues and the mathematics teachers for whom they were responsible) of greater experimentation and reflection.

14.4 Specific Professional Contexts and Their Influence on the Change Environment

As noted above, Clare worked in a university setting in England. She had joined the primary teacher education team more than 10 years previously and was responsible for teaching mathematics modules to PGCE and BEd students who were preparing

to teach at different levels across the primary age range (5–11). Clare's approach within university seminars was to explore students' practice as teachers through the subject content, effectively regarding subject knowledge and pedagogical knowledge as intertwined. She also supervised the extensive school-based placements of a number of prospective teachers across the full range of subjects. Beyond her role as a MTE, Clare acted as course leader for the whole primary PGCE program. This position of responsibility, combined with her 10 years' experience, gave her considerable scope to take action within her own seminars and to put forward suggestions for the whole PGCE team. However, the nature of this change environment also meant that any changes Clare made would carry quite high stakes; she therefore needed to feel confident about any new measures that she chose to implement.

Colin had been engaged in mathematics teacher education for over 25 years, in a variety of roles. He was acting as a mathematics consultant when he applied for the Master's, but 5 months into the programme became chief education officer of a group of 23 affordable private schools in Egypt. This role extended far beyond mathematics, making him responsible for providing academic vision, educational strategy and leadership across the whole group of schools, which catered for children from kindergarten to 12th grade (ages 4–19). These students were mostly Egyptian, but mathematics was taught through the medium of English. Just over 200 teachers had some responsibility for teaching mathematics, around 120 of these at primary level. Virtually none had taken part in any pre-service mathematics teacher education, and very few had participated in any subject-specific professional development or received any support since they started teaching. Indeed, there was little time and opportunity for teacher professional development: teachers were generally unavailable during the school day, and family commitments meant that after-school and weekend meetings were impossible. Teachers rarely met together or collaborated. Teacher turnover was extremely high, so many were in the first few years of teaching.

It is clear that despite his previous range of experience, Colin – in contrast to Clare – was new to the specific context in which he was working. The cultural setting of the mathematics teachers whose development he would seek to promote was essentially unfamiliar to him. This lack of familiarity, combined with the range of his responsibilities (many of which were unrelated to being a MTE), seems to have restricted his scope to take action, to experiment with his own practice as a MTE and to reflect on the outcomes.

Jen had worked for 2 years as a mathematics teacher in a comprehensive secondary school in England. Halfway through her 2-year Master's programme, she became primary mathematics achievement lead in her school's feeder primary school. This was initially a 1-year secondment, for 1 day per week. The role was an entirely new one, and Jen was given considerable freedom to make it her own. The school's intention in creating the post was to use the specialist subject knowledge of a secondary teacher in developing the teaching and learning of mathematics across the primary school. Jen was, however, acutely aware of her limited experience at this level. Since the school was also new to her, she deliberately spent her first few weeks getting to know the staff and their teaching styles through learning walks and

informal conversations while familiarising herself with the primary stages of the newly revised National Curriculum. Again, the change environment in which Jen found herself was very different from each of those experienced by Clare and Colin. The freedom she had in developing the new role gave rise to a range of opportunities for action, experimentation and adaptation as she observed how the teachers responded. Yet she was also operating in an unfamiliar context, acutely aware of her own lack of experience in the primary school setting and of the fact that the teachers were much more comfortable and confident within it than she was.

14.5 The Master's Programmes: Operating as External Sources of Stimulus and as Influences on the MTEs' Change Environment

As explained above, Clare and Colin both completed the MTEd, a Master's qualification specifically designed for MTEs, whereas Jen undertook the MLT, essentially intended for practicing teachers. She chose, however, to focus her final-year research and development project specifically on mathematics teacher education. Both courses were part-time programmes, designed to be compatible with full-time professional commitments, and usually took 2 years to complete. The MTEd was primarily a distance learning course, taught through online tutorials and seminars, although each year included a week-long university-based summer school. The MLT used a form of blended learning, with face-to-face seminars on five weekends across the year, each preceded and followed by a school-based investigative task and a series of associated readings, shared and discussed online. There were fewer taught sessions in the final year, which was entirely focused on students' research and development projects. Academic support took the form of individual supervision, online or face-to-face, depending on the student's location and preference. Within both courses, the students' final research and development projects required them to design, implement and evaluate their own intervention within their roles as MTEs.

Like many experienced university lecturers working in initial teacher education in England, Clare had received limited formal academic preparation for her role beyond the completion of her own BEd. Her route into teacher education had been a professional one, moving from subject leadership (in a middle school, catering for students aged 8–12) into consultancy work to support the implementation of a new National Numeracy Strategy and then into a university role. She believed that the MTEd would give her the chance to look systematically at issues and challenges of which she had become aware in her practice as a MTE. At the start of the course, for example, she was particularly interested to explore ways of promoting greater debate among students who tended to embark on teacher education programmes with deeply rooted beliefs and assumptions about the nature of mathematics and about mathematics teaching and learning. The course would also allow her to

examine beliefs and assumptions embedded in her own practice as a MTE. While she was particularly interested in the opportunity to focus on prospective teachers as teachers of mathematics, her supervisory work on school placements and her wider leadership role meant that she was alert to ways in which she could apply insights from mathematics teacher education more broadly to support prospective teachers' learning across the curriculum and to the development of the primary PGCE programme.

While Clare had a sense of obligation (and indeed pride) as a university-based teacher educator to root her practice in research-based knowledge, Colin's roles as mathematics consultant and then as chief education officer did not carry quite the same kind of expectation. Yet he was similarly inspired by the opportunities within the MTEd both to investigate issues of particular concern in his current practice and to reflect systematically on that practice. Working in the Arab states of the Persian Gulf and then in Egypt – contexts profoundly different from those in which he had taught mathematics – he specifically sought to understand how context might facilitate or inhibit teachers' professional growth. Aware that he had mostly gained his knowledge as a MTE through the practice of being a MTE, Colin now wanted to adopt an analytical approach to understand and improve that practice.

Jen had not been engaged specifically in teacher education when she embarked on her Master's programme. Unlike the MTEd, which focused on teacher education, almost exclusively within the domains of particular subjects (mathematics and science), the MLT had a generic programme at its core, accounting for two-thirds of the face-to-face teaching and half of the prescribed readings. Supervision for assignments and the final research and development project was, however, usually provided by subject specialists. Most of the school-based tasks (intended both to develop research skills and to explore different features of learning and teaching) were conducted within students' own classes – and thus also within their subject. While all Jen's work was concerned with mathematics, only for her final year research and development project did she choose to focus on teacher education, in order to support her new part-time role as primary mathematics achievement lead. She recognised at this point that she had much to learn, not only about primary education and the primary mathematics curriculum but also about the process of leading professional learning.

14.6 Analysis of Each of the Instances of Change Reported by the MTEs

In order to explore the professional growth of the MTEs in relation to their specific professional contexts and as stimulated by their Master's programmes, we focused on each of the instances of change that Clare, Colin and Jen reported in their reflections on their learning, using the Interconnected Model, shown in Fig. 14.1 (Clarke & Hollingsworth, 2002). In each case we sought to identify whether these instances

constituted simple change sequences – in which change in one domain led to change in another, but with no evidence of those changes becoming securely embedded – or more sustained growth networks, for which there was evidence of ongoing or enduring change. While the set readings and small-scale investigative tasks that featured throughout the Master's programme were undoubtedly important stimuli for change, other stimuli also arose from the MTEs' professional work contexts. As the following accounts demonstrate, our analysis revealed that while the course readings and investigative tasks *sometimes* served to set in train patterns of reflection and enactment that formed enduring growth networks, this was not always the case. In contrast, the research and development projects undertaken by each of the MTEs *all* resulted in changes that the participants regarded as having had a sustained impact.

14.6.1 Clare

Clare's reflections included accounts of four specific instances of change stimulated by her work on the MTEd programme (although other external sources of stimulus occasionally also played an important role). The first instance, summarised in Fig. 14.2a, was related to a boost in confidence that derived from some of the set reading. Clare, who had long assumed that many prospective teachers had fixed ideas about mathematics as a subject and about the process of teaching and learning mathematics, was anxious to find ways of stimulating more active discussion – and thereby potential re-evaluation – of their ideas. Further thought about this issue was stimulated by two readings: one that demonstrated how deep-rooted these beliefs are (Liljedahl, 2008) and another which suggested that such beliefs might be held consciously or unconsciously (Thompson, 1984). The reading, as a stimulus in the external domain, prompted Clare to reflect on her existing beliefs (1), which were strengthened, giving her the confidence to suggest changes in practice to her team of tutors. Since Clare did not report specifically on whether or how these particular changes were enacted or any impact that they may have had on her own beliefs or practice or on those of the team, these developments only provide clear evidence of a change sequence.

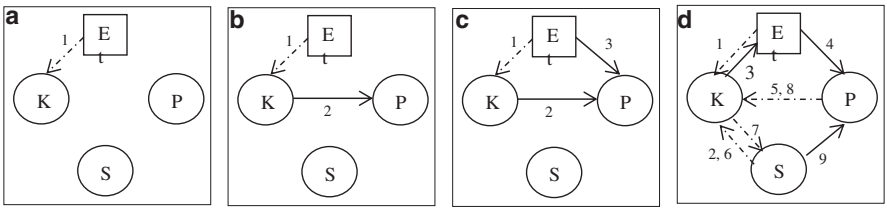

Fig. 14.2 Instances of change in Clare's experience analysed in relation to Clarke and Hollingsworth's (2002) interconnected model of professional growth (E external source of information or stimulus, K knowledge beliefs and attitude, P professional experimentation, S salient outcomes)

The second instance on which Clare reflected, shown in Fig. 14.2b, was also stimulated by reading within the MTEd. She had found her ideas challenged by a convincing line of argument (Watson, 2008), suggesting that school mathematics and the discipline of mathematics were so different that one could not even be considered a subset of the other. Clare had regularly emphasised the need for teachers to encourage their pupils to act like mathematicians, but what she understood by acting like a mathematician began to change when she reflected (1) on Watson's (2008) arguments and on those of Lockhart (2002). Stimulated by this challenge and inspired by the work of Brousseau (1997), Clare began to enact changes in her practice (2), working on transferring the warrant of authority from her as the tutor to the group of prospective teachers. Since she reported finding this change difficult, at times, to maintain, acknowledging that she sometimes reverted to her established ways of working, it did not yet appear to be sufficiently secure to be categorised as a growth network.

The third instance that Clare described, encapsulated in Fig. 14.2c, was, however, undoubtedly an example of sustained growth, prompted not only by shared discussion of particular readings within the MTEd programme but also by another stimulus within the external domain: an inspection visit from Ofsted (the national regulator for initial teacher education). Over the course of the MTEd, Clare had become aware of what she referred to as a "key message", derived from her reading and regularly advanced in discussions with other MTEs, that a teacher educator needed to label and make explicit to prospective teachers the decisions that teachers make (1). She began specifically working on making her own decision-making more explicit to the prospective teachers within her seminars (2), drawing on research by Rowland and Zazkis (2013) which identified and examined contingency subject knowledge and stated that there were three potential options for action "at the point of learning": ignore, acknowledge and set aside or acknowledge and incorporate (1). Clare was already considering how to act on this advice when an Ofsted inspection of the PGCE programme that she led gave rise to a recommendation that the PGCE team should "further develop student assessment/differentiation at the point of learning" (3). Clare took two kinds of action in response. The first was to formalise the process of making Rowland and Zazkis' three options clear to students at contingent moments in her own practice (3) – a sustained transformation that she could illustrate (when writing this chapter) with a fresh example. This had arisen in response to a prospective teacher's question about whether the number of lines of symmetry is always the same as the order of rotational symmetry. Clare reported that she took the opportunity to step aside from the mathematics of the seminar by labelling the prospective teacher's question as a contingent moment, listing the three options, and then exploring with the whole group the potential to enhance learning by amending her plans and taking up the new line of enquiry. That is what she then did, continuing to explore the conjecture using a range of examples identified by the students. Further evidence of the enduring nature of these changes, not only in Clare's practice but in that of her colleagues, could also be found in the proposals that the PGCE team presented to Ofsted. Their action plan set out a commitment to the approach outlined above and also highlighted Clare's second response, which was to allocate one of the course seminars to the work of Rowland and Zazkis (2013), requiring students to respond to it with examples from their own practice.

The final example on which Clare reflected was her research and development project. Here, so many changes could be traced moving from one domain to another, mediated in different ways by the processes of enactment and reflection, as shown in Fig. 14.2d, that the establishment of a growth network was in no doubt. The MTEd obviously required Clare to undertake a specific intervention in her practice, an intervention informed by research and systematically evaluated on the basis of a range of evidence. She chose to focus on a long-standing issue of interest, brought to her attention by two particular observations of prospective teachers: one achieving considerable success and the other much less effective. Clare identified that in both cases, the prospective teachers' choice of examples seemed to be critical to the success of the lesson, but she was also struck by the fact that even the successful prospective teacher could not articulate a rationale for her selection. Clare's reflection on these instances (1) led her to the conclusion that an important outcome of teacher education should be appreciation among new teachers of the critical role played by their choice of examples (2). Since this argument resonated with her reading of work by Watson and Mason (2006), Clare turned to resources explored within the MTEd programme for strategies by which she could help prospective teachers to evaluate different examples (3). Here she found two possible ideas: Ma (1999) suggested to her the potential of comparing textbooks as a way of helping prospective teachers to look systematically at the choice of examples and their effects, while Paine (2002) alerted her to the value of a collaborative approach. Clare therefore began to experiment (4) with a strategy of comparing examples, examining how the responses of a group of prospective teacher volunteers changed over the course of 6-hour-long sessions. In light of the data she collected, she judged that using textbooks in this way did indeed help students to look systematically at examples (5). This finding led her to conclude that ideas recently advanced by Cambridge Assessment (2014, 2016) and the National Centre for Excellence in the Teaching of Mathematics about the value of a good textbook were valid (6), while her observation of the ways in which the students supported one another convinced her about the value of working collaboratively. In reviewing the process, Clare also reflected that the approach (required by the MTEd) of looking systematically at how her students were responding gave her a much better understanding of those students (7). The value of the knowledge she had gained by attending so carefully to their responses prompted her to continue using the same approach even when the project was over (8). She also remained committed to using textbook comparisons as a way of helping prospective teachers to consider the quality of the examples that they were planning to use and of giving them good models of well-chosen examples.

14.6.2 Colin

In looking back over the course of the MTEd, Colin cited fewer specific instances of learning than Clare, with less evidence of sustained changes to his practice. With the exception of his research and development project (designed in response to a

very particular practical concern), the stimuli for his learning were strongly derived from particular readings to which he was referred within the MTEd. The fact that the changes he described tended to follow the implicit model of teacher development – originally challenged by Guskey (1986) and subsequently by Clarke and Hollingsworth (2002) – that is, beginning with changes in knowledge and beliefs and sometimes not moving beyond them (as illustrated in Fig. 14.3a), is essentially unsurprising. Colin had quite consciously embarked on the Master's programme in order to engage with research literature and theoretical insights new to him that would support a more reflective approach to his practice. He drew specifically on Cochran-Smith and Lytle's (1999) distinctions between different kinds of teacher knowledge to explain that the tasks and assignments played an important role in developing his knowledge *of* practice: prompting (or rather "forcing") him to investigate, interrogate and interpret his beliefs and current practice, even if this process did not lead directly to change. Indeed, even when the stimulus provided by particular readings was reinforced by the distinctive features of his own professional environment as a MTE (as illustrated in Fig. 14.3b), Colin still did not necessarily know how to respond to the knowledge he had gained. Set readings about the impact of context on teachers' professional growth (1), fused with personal experience of how his own context was constraining his learning (2), led to a new awareness of the issue, but initially to little more than a sense of frustration. Since none of the literature available to him dealt with contexts that were similar to his own, they could not provide him with relevant models.

It was only when stimulated by a very specific problem in practice, in which he invested considerable time and effort in order to meet the requirements of the research and development project, that Colin's learning could confidently be characterised as a growth network (Fig. 14.3c). One stimulus came from a school visit in which Colin's attention had been directed to concerns about the practice of a recently appointed mathematics teacher. In response, Colin chose to observe a range of lessons across the department (rather than simply focusing on the newcomer), and senior colleagues within the school joined him in doing so. Their observations prompted a request for further support, giving Colin scope to act on previous reading within the course that had struck him as significant (1) about the factors that

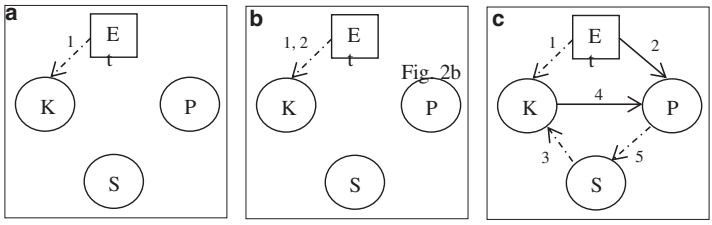

Fig. 14.3 Instances of change in Colin's experience analysed in relation to Clarke and Hollingsworth's (2002) interconnected model of professional growth (E external source of information or stimulus, K knowledge beliefs and attitude, P professional experimentation, S salient outcomes)

impact on teachers' capacity to act in the moment – including "noticing" (Mason, 2002). With encouragement and advice from his supervisor, he set up a video-based, professional development programme for this group of teachers (2), focused essentially on the quality of their interactions in the classroom. Having been prompted by the research and development project requirement within the MTEd to set up this kind of sustained intervention, Colin could now exploit what he had learned about the influence of context (3). Of the aspects identified by Askew (2012) as important in planning for communities of mathematicians – "task, tools and talk" – the last was the only one that he could seek to manipulate (4). The curriculum was tightly prescribed by the Ministry of Education, and the dominance of the textbook was such that (unlike Clare) he could not see any realistic prospect of inviting teachers to reflect critically on the tasks that they set.

The Ministry of Education also disrupted the schedule that Colin had planned for his intervention by moving forward the scheduled end-of-grade exams. As a result, five of the seven teachers who had participated in the first phase of his project, reflecting on their current beliefs and practices in relation to questioning, dropped out before the second phase – the intervention itself. This would have involved video analysis of an alternative, dialogic approach; participation as learners in such an approach; discussion of how they might apply it; and then the opportunity to teach their own class using such ideas and to reflect on it together, using video recording. Even for the two teachers who agreed to continue their participation, Colin had to reduce the planned programme, from 14 hours spread over 2 months to 8 hours spread over 3 weeks. While he was undoubtedly able to learn a great deal from his initial observations of seven teachers about the nature of beginning teachers' questioning (all of those invited to take part were untrained teachers in their first year of practice), he could only examine and reflect on the impact of his intervention as it was experienced by two of the teachers (5). This examination was enough, however, to demonstrate both the kind of changes that were possible and to identify possible causes of the difficulties that persisted, convincing Colin of the value of the way in which he had worked (6).

14.6.3 Jen

Since it was only Jen's research and development project that focused on her work as a MTE, we obviously cannot compare its impact on her professional growth in that role with that of other tasks and set readings. There is, however, no doubt that her engagement in this final project, as summarised in Fig. 14.4, constituted another powerful growth network. We must, of course, acknowledge that analysis of change is somewhat complicated by the fact that Jen had not previously been assigned any formal role as a MTE. She thus had no established practice on which to reflect or with which to experiment, and the vast majority of the action that she took within her new role was construed as part of her project.

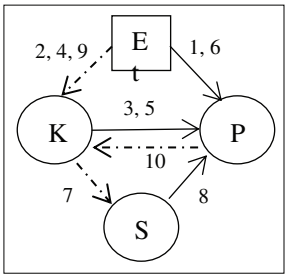

Fig. 14.4 Instances of change in Jen's experience analysed in relation to Clarke and Hollingsworth's (2002) interconnected model of professional growth (E external source of information or stimulus, K knowledge beliefs and attitude, P professional experimentation, S salient outcomes)

The specific focus for her intervention was identified not by Jen but by senior leaders in the primary school, and their choice clearly constitutes an external stimulus. They had highlighted fractions as a topic that seemed problematic across the age range: pupil outcomes as they were formally measured were lower than for other topics, and staff reportedly found fractions challenging to teach. While Jen's position meant she had to respond to the senior leaders' recommendations (1), she welcomed the focus on fractions, a topic in which she had a strong personal interest, based on her experience with low-attaining pupils in the first 2 years of secondary school.

Many of Jen's decisions about how to act were informed not by her reading but by her previous experience as a participant or subject (rather than the leader) of various professional development initiatives. Anxious not to impose on the teachers, she chose to run training sessions within "directed time" (i.e. time that had already been formally assigned to continuing professional development) so that it would not represent an additional burden. She also insisted on working with all teachers in the school, giving teachers across all year groups direct access to the same theoretical and practical input and scope for discussion. Here she was acting on (3) insights from research findings encountered in the course of writing her literature review (2), about the "watering down" that can occur when expert teachers who have received training are expected to share their new knowledge and practice with others (Bobis et al., 2005) While the intervention was therefore mandatory for all staff, participation in the second research phase – which involved video capture of a lesson taught soon after the training and discussed, subsequently, along with artefacts such as the teacher's slides and the pupils' work – was voluntary. In making this decision, Jen was again acting (5) on insights she had gained from Clarke and Hollingsworth's (2002) model itself (4) about the importance of teacher agency.

Jen's decision to use video as both a research and a professional development tool represented a pragmatic response to the fact that she was only in the school 1 day each week and all mathematics lessons were taught simultaneously. But it was also, perhaps, no coincidence that Jen's supervisor was engaged in her own research about the role of video in supporting teachers' professional learning (6). It was, however, Jen's own reflection (7), as a secondary practitioner, on the importance of the understandings about fractions that are established at primary level that prompted her to focus the training that she offered (8) not merely on classroom interactions but more emphatically on the nature and structure of the curriculum and the

teachers' choice of tasks. She particularly emphasised the need to build deeper conceptual understanding through multiple representations and experience with different sub-constructs. In developing this vision of her desired outcomes, Jen was again influenced by the reading about fractions to which she was directed by her supervisor (9). A number of readings, most notably about the "knowledge quartet" elaborated by Rowland, Huckstep and Thwaites (2005), informed her observation and evaluation of the teachers' practice and (more indirectly) her reflection on the value of the strategies she had employed (10).

In her written reflections for this chapter, Jen tended (perhaps unsurprisingly) to focus on what the primary teachers and school leaders had learned from the intervention, noting the school's commitment to a new "mastery" approach to mathematics teaching for the following year. Nonetheless, her own professional growth as a MTE was evident from recommendations she went on to make about the nature of the school's future CPD provision. It was also reflected in her school's decision to second her full-time for another year to the primary school, both to continue the work in relation to mathematics teaching and to implement specific kinds of inquiry-based professional learning for all newly qualified teachers.

14.7 Reflections on the Interactions Between Different Contexts and Their Impact on Individual MTEs' Learning

Our use of Clarke and Hollingsworth's (2002) interconnected model to analyse Clare, Colin and Jen's experience has helped to focus attention on the varied kinds of external stimuli that arise in the context of MTEs' work as well as those that derive from professional Master's programmes. Its application has also allowed us to distinguish between potentially short-lived change sequences and more enduring growth networks. It has first demonstrated that sustained growth can result from many different kinds of stimuli (ranging from prescribed readings of research literature, through focused guidance from knowledgeable supervisors, to the assumption of a new role or the imperious demands of Ofsted) – depending on the individual and their purposes and on the nature of the change environment in which the stimuli are encountered. It has also shown, however, that the particular demands of a research and development project (i.e. a deliberate intervention undertaken with a commitment to inquiry and evaluation) make genuine growth much more likely. As a nervous newcomer, taking on an unfamiliar and under-theorised role, Jen found sufficient structure and support within its framework to enable her to develop and evaluate a new approach to professional learning, subsequently embraced by the whole school. The same framework gave Colin, a much more experienced and senior figure, the impetus necessary to find a new way of working around long-standing obstacles to providing more focused, sustained provision.

Where the interconnected model is perhaps slightly less illuminating as a theoretical framework for analysing the relationship between the different contexts in which MTEs' learning occurs is in the clear distinction that it seems to draw between the professional growth that occurs and the wider change environment within which that growth happens. Although the external domain is represented within the model both as a source of stimuli and as a domain that may be changed as the result of deliberate action (enactment) informed by new knowledge, beliefs or attitudes, the model does not explicitly acknowledge the fact that such changes may, in turn, actually alter the "change environment" itself. Within the model the latter is simply presented as the context within which the growth is happening, a context which shapes and constrains the nature and extent of the changes that can occur, but that does not seem (at least, as it is represented in Fig. 14.1) to be susceptible itself to change. It is for this reason that we turn in the final stages of our reflections to an alternative analytic tool that others have found valuable in relation to the professional growth of MTEs: "zone theory" as developed by Valsiner (1997), particularly as it has been applied by Goos (2013). As she has argued, the particular "contribution of zone theory is to permit analysis of [the] interactions between people and their environments while still emphasizing individual agency" (Goos, 2013, p.523). In focusing specifically, as we have done, on the interaction between the two different contexts within which each MTE was working, it is important not to overlook the agency that each exercised in reshaping those contexts. The interplay that occurred did not simply take place between the specific contexts of each MTE's professional work and their particular Master's programme, nor did it operate as a one-way process, with the contexts essentially determining the outcomes. Those outcomes were negotiated by the MTEs in the interaction that occurred between the two contexts.

This constant interplay and the process of negotiation can be illustrated with particular reference to the dynamic and interrelated complex created by what Valsiner has described as the "zone of free movement" (ZFM) and the "zone of promoted action" (ZPA). In the cases presented here, the ZFM can readily be identified with the MTEs' professional work contexts: the well-established practices and cultural norms that shaped others' expectations of them or, for example, the curriculum and assessment practices that constrained their scope to introduce new practices. The context of their Master's programmes can, within this theory, be similarly equated with the ZPA. The set readings, taught seminars, investigative tasks and final research and development projects all served to promote alternative ways of interpreting or responding to their teachers' (or prospective teachers') particular needs. As Goos has emphasised, however, it is not helpful to regard the ZFM and ZPA as two distinct entities. Valsiner (1997) actually regarded them as "fuzzy abstractions without sharp or continuous boundaries", subject at any moment "to further transformation" (Goos, 2013, pp. 523–4). That transformation might derive from an external source – such as the Ofsted inspection of Clare's PGCE programme – but it might equally arise from within an individual. The most obvious illustration of this fact is the decision made by each of the MTEs to enrol on a Master's programme: a decision deliberately taken (particularly by Clare and Colin)

to provide them with the stimuli and the structured support necessary to reshape their contexts. They hoped that it would give them licence and, indeed, a warrant to undertake new practices and thereby to think of themselves differently. The status of the programme and its academic credibility also conferred a high degree of authority on them, making experimentation not just possible but well regarded. Clare was proud to be able to defend her action plan to Ofsted on the basis of its warrant within the literature.

That is not to suggest that the process of transformation was easy. Particularly for those already employed as teacher educators, choosing to assume the identity of a learner inevitably gave rise to complex and nuanced shifts in identity. Clare was deeply unsettled at first by the challenges to her long-held assumption that pupils could legitimately be urged to act as mathematicians. Colin faced huge – and in some cases insurmountable – difficulties in accommodating the programme's demand for a sustained intervention over time. But in both cases, these were the "productive tensions" described by Valsiner (1997) that give rise to self-initiated change and serve, in turn, to transform the "change environment" itself. While Colin failed to enact the video-based professional development programme that he had planned with all seven original participants, those who withdrew in the face of the new ministry-imposed examination schedule agreed to undertake the course with him the following semester. He had succeeded in creating new ways of working as a MTE.

Some contextual constraints, of course, cannot be overcome – as Colin conceded in choosing to focus on talk rather than tasks or tools – and thus will always shape what it is possible for MTEs to learn, no matter how well-structured or flexible and responsive their professional development programme might be. Yet the very process of embarking on a Master's degree can bring about change within both the ZFM and the ZPA, opening up new powerful new possibilities for individual MTEs. While the status of the degree may play an important role in this respect, the examples that we have presented here suggest that, within a Master's programme, the particular demands of a substantial research and development project appear to offer the best prospects for genuine professional growth.

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