

# Chapter 13

## Shaping our Collective Identity as Mathematics Teacher Educators



Judy-anne Osborn, Elena Prieto, and Edwina Butler

### 13.1 Introduction

Mathematics teacher educators (MTEs) play a crucial role in forming the mathematics teachers of the future and through them the quality of mathematics education in schools. The logic of this claim has two parts: the pivotal significance of mathematics schoolteachers in mathematics education and the importance of mathematics teacher educators in preparing school mathematics teachers.

The first part of our claim, referring to the importance of mathematics schoolteachers to student learning, has been extensively studied. A large body of research that relates teachers and their actions to student learning has emerged (Darling-Hammond, 1999). This includes general meta-analyses linking teacher effects to student learning (Hattie, 2008) and research relating teachers' mathematical knowledge to the quality of their instruction as directly observed and theoretically analysed (Hill et al., 2008).

The second part of our claim, concerning the specific importance of mathematics teacher educators to mathematics teacher learning, is an emerging area of research. Confirmation of this emergence can perhaps be evidenced by the creation of the *Journal of Mathematics Teacher Education* in 1998 and by the presence of policy-shaping works such as *The International Handbook of Mathematics Teacher Education*, Volume 3: Participants in Mathematics Teacher Education: Individuals, Teams, Communities and Networks (Krainer & Wood, 2008) and Volume 4:

---

J. Osborn (✉) · E. Butler  
School of Mathematics and Physical Sciences, Faculty of Science, University of Newcastle,  
Callaghan, NSW, Australia  
e-mail: [Judy-anne.Osborn@newcastle.edu.au](mailto:Judy-anne.Osborn@newcastle.edu.au)

E. Prieto  
School of Education, Faculty of Education and Arts, University of Newcastle,  
Callaghan, NSW, Australia

The Mathematics Teacher Educator as a Developing Professional (Jaworski & Wood, 2008).

Research on mathematics teacher education has illuminated ways in which mathematics teacher educators (MTEs) are both similar to and different from the population of mathematics teachers whom they teach. Jaworski and Wood (2008) note similarities in needed knowledge, including mathematics and mathematical pedagogy, as well as differences, such as the MTE's need for "knowledge of the professional and research literature relating to the learning and teaching of mathematics" (p. 1) and the schoolteacher's need for knowledge of their particular students and schools. Furthermore, Llinares and Krainer (2006) indicate that "a domain which needs closer attention in the future [is] our own learning as teacher educators. It is the field where theory and practice of teacher education inevitably melt together and we thus face the challenge of self-applying our demands on teacher education" (p. 429).

This learning that Llinares and Krainer (2006) refer to can take place individually, or as a collective endeavour in a community of practice (Wenger, 1998). Communities of practice play a double role in mathematics teacher education praxis. The theory provides a lens through which to view and understand existing and emerging communities engaged in the practices of mathematics education and educator development, as well as providing a framework around which to explicitly foster such communities as productive and supportive of teacher learning (Goos & Bennison, 2002; King & Cattlin, 2017). Recent research has applied these dual potentialities of understanding and promoting communities of practice to MTEs specifically and shown it to be effective (Goos, 2014, 2015).

The complexity of communities of MTEs follows in part from diversity of membership. Jaworski and Wood (2008) write: "Mathematics teacher educators are professionals who work with practicing teachers and/or prospective teachers to develop and improve the teaching of mathematics. They are often based in university settings with academic responsibilities" (p. 1). Taking this description as a definition, MTEs include both individuals within Schools of Education specialising in mathematics education and individuals within mathematics discipline groups who teach pre-service teachers and who may or may not specialise in this endeavour.

Diversity of roles also contributes to the complexity of communities of practice of MTEs. Within a Western epistemology of division of labour, individual MTEs may or may not engage in the full range of roles and associated knowledge described by Jaworski and Wood (2008). Indeed, in the Australian context, it is common for pre-service mathematics teachers to study most of their mathematics content in Mathematics Departments and most of their pedagogical content in Schools of Education. Opportunities for pre-service teachers to productively link the two types of knowledge, in what Shulman (1986) seminally termed Pedagogical Content Knowledge (PCK), may be compromised by this dichotomy of presentation. This applies to varying degrees in both postgraduate and undergraduate training programs, depending on local context. The notion of a disciplinary division is part of the mathematics teacher education landscape, yet this is changing, with a gradual

shift in the direction of more effective cooperation (Barton, Oates, Paterson, & Thomas, 2015; Bass, 2005).

In shaping the mechanisms by which a community of practice may operate so that its complexity can be used to enrich the learning experience of its members, the formation of a collective identity is sometimes seen as critical (Hökkä, Vähäsantanen, & Mahlakaarto, 2017). Collective identity is defined in sociology as “the shared definition of a group that derives from its members’ common *interests, experiences, and solidarities*” (Whooley, 2007, p. 586, emphasis added).

We note that the concept of collective identity arose in sociology as part of understanding formation of politically active groups, for example, the Civil Rights Movement (Whooley, 2007, p. 587). According to Melucci (1995, p. 43), it addressed a gap in the literature that had previously taken such groups as starting hypotheses rather than phenomena to be understood.

For further explication of what “interests, experiences, and solidarities” are shared by people holding a collective identity, it is useful to turn to seminal work by Melucci (1995). In this work, framed within a political context, an action system is understood by its actors in terms of “ends, means and field” (p. 44). In our context, the field and end are both mathematics education, and the canonical means are teaching and actions that enable teaching – together these comprise the “common interests” of our definition. The “shared experience” aspect of our definition includes both the field, which includes “rituals, practices, cultural artefacts” (p. 44), and collective action, in which Melucci (p. 45) notes that “process” is key, including interaction, communication, mutual influence, negotiation, and decision-making. Thirdly, we recognise the “solidarity” aspect of collective identity as implied by Melucci’s insistence that both collective action and emotional engagement are necessary parts of collective identity. In terms of the latter, Melucci writes: “Finally, a certain degree of emotional investment, which enables individuals to feel like part of a common unity, is required in the definition of a collective identity” (p. 45).

Identity matters because, as Palmer (2017) claims, “we teach who we are” (p. 1) and because “good teaching comes from the identity and integrity of the teacher” (p. 10). Day, Kington, Stobart, and Sammons (2006) extend the notions of the ways in which identity matters in teaching, in writing:

If identity is a key influencing factor on teachers’ sense of purpose, self-efficacy, motivation, commitment, job satisfaction and effectiveness, then investigation of those factors which influence positively and negatively, the contexts in which these occur and the consequences for practice, is essential. (p. 601)

These works are part of a large literature on the importance of identity in teaching; see, for instance, recent reviews by Beauchamp and Thomas (2009) and Carrillo and Flores (2018).

Collective identity matters in part because it relates to collective agency (Hökkä et al., 2017) and in part because of its impact on individuals (Day, Elliot, & Kington, 2005). This is particularly pertinent in mathematics teacher education because the field of mathematics education in Western countries has been undergoing a sequence of reforms or revisions since at least the 1950s (Davis, 2015, pp. 28–29). Reforms

have been driven by a sense of crisis (Eacott & Holmes, 2010). An ongoing sense of crisis is a double-edged sword, capable of producing both passionate commitment and ennui. The sense of crisis has become a part of the identity of many mathematics teachers and teacher educators, as expressed by Dawson (1999) when she wrote: “this manifestation of in-service culture seems to have the following basic principle: there is something wrong with mathematics teaching world-wide, and that we, as mathematics educators, must fix it” (p. 148).

Relatively little is known about the development of identity amongst mathematics teacher educators working across disciplinary boundaries, though it is known that the nature of disciplines and disciplinary boundaries has an impact (Borwein & Osborn, 2020). Because of the relative paucity of research in our particular area of consideration, two related bodies of work also inform our conceptual framework.

The first related body of work investigates the development of teacher identity within a University context, independent of the discipline. A recent review by van Lankveld, Schoonenboom, Volman, Croiset, and Beishuizen (2017) found a rich and complex picture in which some aspects of University environments were typically conducive to the development of teacher identities and others typically constraining. Van Lankveld et al. contend that teacher identity development in a tertiary context has a specific contextual complexity and explain that this complexity arises from the tensions of combining the teaching and research roles typical in higher education institutions.

The second area for comparison concerns mathematics teacher identity development (as opposed to MTE identity development). This literature addresses the inter-disciplinary divide between mathematics and education. For instance, Adler, Ball, Krainer, Lin, and Novotna (2005) wrote:

An enduring problem in mathematics teacher education is its task to build both mathematics and teaching identities. [...] We do not understand well enough how mathematics and teaching, as inter-related objects, come to produce and constitute each other in teacher education practice. (p. 378)

There are in the literature a number of case studies of identity development of mathematics teachers, such as that reported by Losano, Fiorentini, and Villarreal (2018). This chapter is, we hope, a contribution to the case study literature in the analogous context of identity formation for mathematics teacher educators.

## 13.2 Methodology

### 13.2.1 Methodological Framework

Our methodological approach in this work is a narrative inquiry process (Daiute, 2013) conducted at one node of a large multidisciplinary project. The eight team members at the institution where the study took place had disciplinary identities and backgrounds that included mathematics, statistics, computer science, science, secondary school teaching, and tertiary education; thus a methodology was required

which was amenable to spanning multiple disciplines and which was consonant with the values and epistemologies of all participants.

The suitability of the narrative methodology to our team's diversity emerged from three factors: suitability for identity work, reputability, and intersectionality with values from all represented disciplines/participants. The first is beautifully expressed by Meretoja (2013) in writing: "We orient ourselves in the world by telling stories about who we are" (p. 99). We all felt this suitability, but still would not have chosen the methodology without the reassurance that it is a widely used and legitimate approach (Herman, Manfred, & Marie-Laure, 2010). In this aspect, the whole team relied upon the expertise of those members more closely aligned with the humanities in their daily work.

The team's appraisal of potential methodologies and subjects for investigation included explicit team discussion of the tension between the ideal of objectivity as often associated with science and quantitative research and the valuing of subjectivity, as often associated with the humanities and qualitative research, a tension explicated in Guba and Lincoln (1994). Our collective appraisal in favour of a narrative inquiry approach was concordant with the intraparadigmatic and extraparadigmatic critiques of positivism and its heir, post-positivism, in Guba and Lincoln (1994), in particular the "exclusion of meaning and purpose" and "theory-ladenness of facts", respectively (pp. 106–107).

It is noteworthy that the values and epistemologies that we needed to span did not necessarily fall along stereotypical lines of "qualitative methods with the humanities" and "quantitative methods with science and mathematics". Instead, the kind of difference that was often pertinent was between "experimental" and "theory building" work, with the statisticians and educationalists more commonly inhabiting the former space and the pure mathematicians more at home in the latter. We see narrative study as allowing a pleasing balance of both experiment and theory building.

In this study we focus upon the results of our narrative inquiry that relate to the creation of collective identity. A broader full thematic analysis (Riessman, 2008) of the entire narrative process of our team is given by Butler et al. (2019). In this chapter, we take a different lens inspired in part by similar work by Petersen (2014) and a deeper look at the stories of the people involved as reflected in the narrative process. We note that whilst Petersen draws on post-structural theorising as a broad conceptual framework, we are making a deliberate and more circumscribed use of that theory in the specific context of human subjective experiences and identity. This usage lies within existing traditions, as noted by Meretoja (2013), when she distinguishes between the use of narrative as a cognitive instrument and one with ontological significance.

Our conceptual framework allows us to use some of the quality criteria natural to a constructivist ontology, in the circumscribed context of human experiences and identity. Specifically we use "authenticity" as described by Guba and Lincoln (1994, pp. 106–107), which they conceive of as having four components: fairness (ontological authenticity), educative authenticity, catalytic authenticity, and tactical authenticity. The first two are related to understanding (respectively, of self and others). The second two are related to action (respectively, stimulating and empowering). Our methodology in this chapter makes explicit use of the understanding-

related aspects of this sense of authenticity. Aspects of the action-related component of meaning may be implicitly present as well.

### ***13.2.2 Actualising the Methodology***

In this section, we briefly describe context, design, and implementation of our narrative study as relevant to the focus of this chapter. For a more detailed description with respect to the whole project, see Butler et al. (2019).

In relation to researching collective identity formation, the context of this narrative research has been as important as its design. The context, as explained above, is a large multi-institutional project focused around mathematics and science teacher education. Within this project, the teams at each institution spanned different disciplines and brought extensive and varied experience across tertiary education and research. The focus of the project at our institution was Mathematics and Statistics (where the broader project also included Science). The scheme that the grant was awarded within had a focus on teaching praxis that was unusual for the mathematics and statistics disciplines involved. Nevertheless, it was highly regarded, both for its funding scale and the nature of the collaborations possible within it.

If we see work spanning the mathematical sciences and the formal study of education as being interdisciplinary, then at the start of the project, there was already significant interdisciplinarity within individuals within the project team. Specifically, many of us had qualifications that meant we would be plausible candidates for jobs in either environment, with education faculty having held postdoctoral positions in mathematics and mathematics faculty with graduate qualifications in education (one Master's and one Graduate Certificate).

Throughout the life of the project, the project team met weekly to discuss ideas and plans, with occasional extra meetings to progress specific subprojects. The idea of a narrative research project arose at one of those weekly meetings and was further developed in the same context.

In the initial design phase, team members agreed that there would be interviews of all the original academic team members, conducted by the project officer. These interviews were to be recorded and transcribed and interviewees given the chance to make any corrections to the transcripts before they were shared amongst the team. Within project meetings, the team collectively drafted an initial list of interview questions, which were later refined by the project officer based on an extensive review of literature.

A first round of interviews was conducted in October 2014. Team members subsequently met and decided to write reflections on these interviews, which happened between November 2014 and January 2015. The second round of interviews was conducted in December 2015, and a second round of reflections was completed in February of 2016.

For the purpose of analysing data for this chapter, the narrative and reflective transcripts were concatenated into a single file and repetitively read and searched.

The length of the resulting concatenated file exceeded 55,000 words. This large size meant that we chose to implement some automated searching in addition to free reading. In particular, searches for keywords community, practice, collective, identity, interest, experience, and solidarity, and synonyms thereof, were employed.

In reporting quotes from interview transcripts and reflective text, the following conventions were employed. Project team members employed within the School of Education, together with the project officer, were assigned letters A, B, C, and D. Project team members employed as either mathematicians or statisticians were assigned letters W, X, Y, and Z. The labels 2014, 2014R, 2015, and 2015R were assigned to refer, respectively, to first-round interviews, first-round reflections, second-round interviews, and second-round reflections. Thus a quote labelled (W, 2014R) indicates its origin in a mathematician's or statistician's reflection on the first-round interviews. The purpose of this labelling is to illustrate features of interest, given the chapter's focus on commonality in the presence of interdisciplinarity, whilst appropriately preserving anonymity.

### 13.3 Analysis and Discussion

This chapter explores the narratives of the individual members of the team. In particular we examine the interviews and reflections looking for evidence of the formation of a collective identity (or identities) during the period within which this narrative study took place.

Our analysis delves into three related conjectures. The first one relates to the entwined nature of collective identity as a gestalt in our context, comprising more than the sum of its parts. The second involves a layering of collective identity on two levels: "as the project team" and "as mathematics teacher educators". A third concerns the relationship between disciplinary boundaries and collective identity. We conjecture that working across boundaries does not necessarily prevent collective identity, even when the different perspectives involved align with different and potentially conflicting values.

What follows, as well as being a story of our colleagues within our local project team, is also our own story that we now tell as authors of this chapter. Stories are all told from a certain viewpoint; we acknowledge that other tellings and meanings are possible and likely. In writing about collective identity, we further develop our own construction of collective identity. Thus, the act of reporting our findings influences our findings. As auto-ethnography, the telling of our story is part of its continuation.

Our results in a study of this nature are necessarily personal and subjective, but this does not make them arbitrary. Different lenses give different views of the same data. A measure of the effectiveness of a lens is the extent to which the view it provides affords an improved understanding of self and others. This improved understanding is part of *authenticity* as viewed within a constructivist paradigm. Specifically, according to Guba and Lincoln's (1994, p. 114) four categories of

authenticity discussed previously, two are especially relevant here: *ontological authenticity* “enlarges personal constructions”, and *educative authenticity* “leads to improved understanding of constructions of others”.

It turns out that the lens of collective identity, with its three facets of interests, experiences, and solidarity (Whooley, 2007), is productive in terms of authenticity, in the sense of giving us an improved understanding of ourselves and each other. For instance, although “solidarity” is not a term that we initially used to describe our relationship (as indicated by its absence from transcripts and our own recollections), post-analysis, it is clear to us as authors that we did have considerable solidarity that helped to implement changes to programs (such as the inclusion of a new compulsory subject) that would not have happened otherwise. Thus one result of this analysis is the conclusion that collective identity is a highly effective lens in interpreting our narrative data and hence potentially other narrative explorations in similar contexts.

Collective identity does not mean collective identification. Individually and as disciplinary subgroups, we are not the same as each other. In seeing our narratives through the lens of collective identity, we gain insight into the ways and extents to which our self-understandings and our practices are similar and different, consonant and complementary, and aligned and potentially mis-aligned. The identity/identification distinction is illuminated in Whooley (2007) when in discussing “collective identity” he writes, “many movements face a conflicting set of identities among their members and must attempt to build solidarity *across* these multiple identities” (p. 587).

In the context under discussion in this chapter, we, the project team, are not collectively *identified* because, even though we share an identity as MTEs, we have diverse other identities which are also important to us and which, furthermore, differently colour our individual experiences of being MTEs. For instance, some but not all of us, in addition to being MTEs, include/included educational researcher as part of our identities, and some but not all of us include/included educator of future mathematicians and engineers as part of our identities.

In reporting our analysis below, we have chosen a number of quotes that exemplify and explain our findings. We have only included a relatively small number of such quotes and endeavoured to include representative quotes from members of the team across disciplinary boundaries.

### ***13.3.1 Collective Identity: The Ingredients***

To answer the question “Do we, the project team, indeed have a collective identity?”, we, the chapter authors, have used Whooley’s (2007) characterisation described in the Introduction section. We confirm that indeed the three elements that constitute a collective identity according to Whooley, interests, experiences, and solidarity, are prevalent within the transcripts. We found many quotes elaborating on each of these elements, confirming our hypothesis regarding the formation of a



common identity during the project. The first category was identifiable through frequent use of phrases such as “common interests” and familiar synonyms thereof. The second category was recognised by frequent occurrence of common synonyms for “experience” and related keywords like “doing” combined with “together”. The third category required deeper consideration, since the word “solidarity” did not occur in the transcripts. However, related words such as “allies” were present, as well as phrases that in context implied common values, such as “common beliefs”. All three authors checked for the integrity of the categories. One author coded membership thereof, and the other two authors checked this and concurred in all cases. A selection of these quotes follows:

### 13.3.1.1 Common Interests

I guess the thing that keeps us all working together, at least one of the things, all 3 disciplines share a common interest which is to improve the landscape of Maths education and the way that it's taught and to get wider and broader interest in Maths and Maths Education and Stats education. (Z, 2015)

That whole vision about maths & science teaching as a creative activity; and communicating the wonder of maths & science. That aligns with my values and I can also see that would have the potential to make these teaching jobs/ careers as a more interesting exciting thing than just saying here is the syllabus here are your lesson plans: go! (W, 2014)

I think we are all just interested in improving Maths education. That's the bottom line. (D, 2014)

### 13.3.1.2 Common Experiences

By coming to the meetings – even a simple thing like last week looking at my colleague from Maths out of genuine interest was sitting there working something out on the back of something and that shows a genuine passion for maths and you don't always see that – so just seeing how mathematicians think and work and that has influenced me by highlighting the importance about being passionate about what you are doing – I am passionate about learning and teaching and so I am in the right space (A, 2015)

I have been in schools and it is very, very similar ... in terms of how much you are trying to do and chasing your tail and time limits and pressures and the diversity of the expectations and the high, high standards (B, 2014)

The tasks we had been assigned had always been similar here in my discipline. And while I'm doing my courses they tell me about what is going on in their discipline area and I presume when they are in their discipline circles they tell them about what is going on here in this discipline. So we knew about each other's work and so forth. (Y, 2014)

### 13.3.1.3 Solidarity

I think it has been a bit of a God-send ... to have been able to find a group you are just happy to meet with ... you can talk to them, you can email them, they seem to take things in the right way they all have a common belief or want to improve education and seemingly not about themselves individually for self gain ... just a nice bunch (Z, 2014)

I think they are a lot more open than I initially thought to pedagogies and to the idea that pedagogical content knowledge is as important as content knowledge. I think that has surprised me. I have been surprised how they include us, the education department, into all their daily workings. I did not expect it to be so good. (C, 2014)

### 13.3.2 *Collective Identity as a Gestalt*

Our first finding when exploring the narratives in search of identity formation cues is the inextricable interwoven-ness of aspects of common interests, experiences, and solidarity, in much of our talk about these matters. Although collective identity can logically be examined in terms of the three components separately as above, for our project team, those meanings were often entwined in twos and threes in ways that could not be separated without loss of meaning and thus formed a gestalt:

One I have known for a long time; we have been allies from afar. Another is relatively new, but when they came along we started to see synergies if you like, when this came on. We had a natural affiliation because we are all interested in teaching. (Y, 2014)

I think it is that we do have that common goal to improve mathematics teaching ... but I think it is also an attitudinal sort of thing. We all seem to like just discussing these ideas and I think it's also all of our sense of humour; nobody takes themselves too seriously and that creates a good bond and I think that we generally enjoy all the meetings we have – it is something I look forward to in the week. (D, 2014)

The nature of the intertwining of concepts in the above quotes gives clues to possible causes. Terms aligned with the idea of solidarity, like *allies*, *affiliation*, *bond*, *common philosophy of what we want*, and *common ideological approach*, are all presented as caused by common interests and/or experiences at the individual and personal level. Also, interests are presented with a connotation of values. For instance, in the phrase “we all have interest in improving Maths education”, the phrase *have interest in* could grammatically be replaced by any of *engage in*, *enjoy*, or *value*, and we posit that this is so because shades of all these meanings are present in the speaker’s use of the word *interest*.

Thus, we, the authors, conjecture that collective identity may be functioning as a gestalt in our context because mathematics education is simultaneously deeply personal (Palmer, 2017), value-laden (Bishop, 2001), and socially contested (Davis, 2015; Hersh, 1997; Tampio, 2017; Valero, 2017). For instance, the deeply personal aspect relates to two different senses of “interest”: one relating to enjoyment and the other to valuing. The first pertains simply to “common interests”, whereas the second has aspects of both “common interests” and “solidarity”. The socially contested nature of mathematics education has echoes of the sociological origins of the notion of collective identity. Reminiscent of a gestalt, Melucci (1995) writes of people forming a “we” by continually adjusting actions and their personal meanings, means and a sense of associated possibilities and limits, and relationships with the field of action; and he refers to the need for individuals to create for themselves “a certain integration ... between ... contrasting requirements” (pp. 43–44).

### ***13.3.3 Collective Identity as Partially Enabled by the Project***

In this section, we claim that the participation in the project was instrumental in the formation of project team members' identities and collective identity.

In substantiating this claim, an associated question we ask is, "How might this claim be false?" One possibility, pointed to by frequent references in the transcripts, is that all the team members might have already had identities as MTEs before the project even began. In investigating this possibility, we begin to see indications of a layering of different kinds of collective identity. The following quotes are drawn from a combination of team members' original reflections within the narrative process and current reflections of the author team, post-project. Such a combination is needed to understand the ongoing effect of the project subsequent to its formal conclusion.

It all started when I did my PhD – I realised I prefer the teaching side than the research side ... I have an affinity with teaching teachers (Z, 2014)

So my objective would be to produce all of these things in my teachers. I want them to be autonomous beings inside a community of practice, I want them to have a go at creativity, I want them to understand the nature and utility of maths, I want them to know how maths has contributed to society and so forth because they are all the things they need to know as custodians of the discipline. (D, 2014)

The relationship between us was going to shape what teacher education for mathematics teachers was going to be about. (C, 2014)

In the above, we see that some members of the project were identified as MTEs long before the project began, yet there are also hints that the relationship to come within the team was to be personally significant in a way that relates to our roles as MTEs. Similar findings were observed in the study conducted by Barton et al. (2015). A window has opened: we now see a potential layering of collective identity for project participants, firstly as members of the project team and secondly as members of a more diffuse group, namely, mathematics teacher educators. A similar principle might apply to other collaborations. Thus the significance of this layering is both to the general theory of collective identity and to its particular implications in the work and challenges of mathematics education.

### ***13.3.4 Collective Identity as Multi-layered***

Collective identity as the project team is different from that as mathematics teacher educators. We see and analyse these as two different layers of collective identity. In the first layer, our personal identities are, potentially, drawn in the light of our relationship to a very specific set of individuals. In the second, the group involved is larger, more diverse and dispersed, and less well-defined. The second is more abstract, the first more concrete.

A very concrete sense of rapport and appreciation for the team as specifically constituted of particular individuals was evidenced both in quotes we have already seen above and many more, such as the following:

Everyone is willing to listen, share, and to try to understand and accommodate the other team members. (D, 2014R)

Common purpose I think. I mean we each have different views about what is ideal, but I think we are actually impressively open to each other's views. (W, 2014)

... amazingness of each of my colleagues, and specifically the ways in which their talents and spirits contribute [...] enabling what we can now say in retrospect is really Professor Chubb's vision for maths (and science) to be taught more like it is practiced.

(X, 2014R)

I think we are all on the same page as far as we want the project to work and be successful and to move that along, but I think it's the combination of our backgrounds that is going to actually make the project better than it would be if any of us tried to do it independently.

(D, 2014)

I really like them all for who they are and they are different, hey?

(C, 2014)

The more abstract sense of identity as a mathematics teacher educator is something that we have already seen in quotes in the previous subsection. However, abstraction in this sense is a double-edged sword: more generically applicable but less indicative of collective action.

In analysing MTE collective identity, we expect to see all of Whooley's (2007) three components of interests, experiences, and solidarity, but in slightly different and more diffuse forms than in the context of project team identity. For instance, all MTEs would be expected to have a common interest in mathematics education, but not necessarily in the success of a particular grant or initiative. The experience of solidarity is also necessarily different. As an MTE, collective allegiance is likely to be around the value of mathematics education generally, whereas on the scale of our project, there was a sense that all team members were making a conscious and deliberate effort to make sure that every individual was supported in all of their endeavours within the project:

... everyone wanted to play ball together and because there had been relationships established between multiple member groups, groups within this group, it made it a lot easier at the beginning, but there were still those initial stages of trying not to say the wrong thing accidentally (Z, 2015)

I think it is a common approach to trying to improve things for the greater good. (D, 2015)

I think we are all idealists, and I think that's nice, we are talking a common language, and then we have our pragmatism side of things which is different for each of us, whether it's the team-members in stats, in maths or in education, but we are helping each other see what their constraints are, the logistics are and that sort of stuff ... the thing that is holding it together is the shared vision. (W, 2015)

### 13.3.5 *Effects of Disciplinary Boundaries*

Team members from both sides of potential disciplinary boundaries were interested in the theory of boundaries in the context of communities of practice (Wenger, 1998). One of our common interests was the boundary or boundaries between us.

I don't think we have any shirkers in the group and I think there is a lot of mutual respect. But I also know there is a lot of disrespect in general terms between different faculties ... you know, the only real science is physics everything else is stamp collecting – you know that famous quote – I mean, that's within the sciences, the Snow's two cultures and all the rest. (W, 2015)

... this is getting at the idea of boundary encounters ... I think it's great because it's adding to my knowledge about our teaching students and how they learn mathematics – by talking to the people that are teaching them mathematics. Otherwise it's very easy to stay in your silo ... They are learning content and pedagogy and they have got to put it together and so I think if we can help put that together across the boundary. (D, 2014)

This is not to say that disciplinary boundaries had no effect. Even though amongst the initial team members for whom all of our PhDs were mathematical, disciplinary boundaries associated with our belongingness to education or mathematics or statistics did have practical impact.

There was evidence that the team members were trying to express respect for each other's areas of expertise, and not occupy what might be felt to be undeserved territory:

I think the ability of the teacher to apply their knowledge flexibly ... that knowledge can be the pedagogical stuff (which I don't have a formal handle on) and the mathematical knowledge. (W, 2015)

I guess I don't want to speak on behalf of the other ... because I don't see them as others, although I see them as experts in their space. (A, 2015)

Sometimes disciplinary boundaries were expressed in terms of different values. These kinds of different values have been problematic in other times and places (Tampio, 2017); however, the view is put forward without antagonism here:

I think if there is a fundamental difference between us ... I mean I think we are all interested in improving mathematics teachers and the quality of teachers we produce and the quality of maths teaching in schools but I think fundamentally the reason underlying that is a bit different. For the maths academics they are really interested in the health of the discipline of mathematics [...] whereas for the teachers I produce, I guess I am much more focused on the reality they face in schools, where they will be teaching not just those top students, but the large population ...

(D, 2014)

Reflecting on colleague's claim ... for me I don't think it is about the "best" students. Also when I'm thinking about the health of my discipline, it is about how the whole society sees it, and that includes the folks whose main passions are in entirely other areas of life. (X, 2014R)

We conjecture that although members of the project team were aware of disciplinary boundaries as being present and potentially problematic, this fact did not influence either the individual team members' personal identities as MTEs or their view of their colleagues as MTEs.

We make our conjecture on two bases. The first is that there is no evidence to the contrary that we have recognised in our very extensive narrative project transcripts. The second is the following expression of collective identity made precisely in the context of fond recognition of disciplinary boundaries.

Actually it is really symbolic – crossing the campus – or crossing the discipline boundary – actually we should get a photo of ourselves on the bridge down there! (D, 2014)

We further wonder, is an identity as multidisciplinary protective against harmful disciplinary divisions? That is, might our own putative interdisciplinary identities have enabled us to form a collective identity as MTEs even within the context of potentially problematic differences in values?

### ***13.3.6 Transitions Between Layers of Collective Identity***

In our experience, identity and relationships formed within the project mediated the activities of team members. Something similar is described in the study of Barton et al. (2015). These activities influence the long-term impact of the project beyond what was institutionalised during the period when it was funded. Hence we are interested in the relationship between the collective identity as a project team that was formed within the project and collective identity as MTEs that may continue into the future.

The design of our narrative study does not facilitate definitive conclusions on the transition between layers, nor do we wish to imply that such a transition between layers will or should always happen; nonetheless insights can be gained by considering what team members expressed about project legacy.

A first observation is that there was a clear desire for project legacy. Two quotes illustrate that common desire:

... a legacy or something you can put hand on your heart and say look at that, now the people that come through our teaching programs are now doing this whereas previously they weren't; and there is now this earlier collaboration between disciplines, they are now going out much more well equipped to handle what is going on in the classroom, plus they have also got a skill set which is not just defined by the classroom, but they are more worldly ...

(A, 2015)

Perhaps we shouldn't be expecting anything more than what any other small group is achieving, but I would hope that from such a large and long collaboration that we would be able to be recognised for something that has made a significant impact to the landscape of maths education, to the point where there are greater numbers of people interested and participating in maths and maths related disciplines. (Z, 2015)

Secondly, within an extensive catalogue of desired legacies at the national and local level, one stood out as more commonly expressed than any other across the span of the narratives in time and people: it was the desire for a community of practice starting at undergraduate level. This desire was expressed within the first round of interviews.

So, for teacher education, it is to have teachers that are confident in their maths skill, confident in their ability and that know how to collaborate with other teachers, know how to teach other teachers – not just their students and feel part of the community of practice with other teachers, with university people. Perhaps that is the strongest thing I have about this project and this vision: the community of practice; and a grass roots one for that matter, that is very important to me. (C, 2014)

Changes that I would like to see the project and allied initiatives bring include: more stewardship and promotion of professional communities which (for individuals) start at University during their training, but extend far beyond ... (X, 2014)

The same desire was expressed again in the second round of interviews.

I would like a community of practice to be set up ... I would like my students in 4th year to feel already part of the community. That's what I would like to achieve. (C, 2015)

I would love to do something to leave a legacy. So that we can point to something and say that is because of the project that that happened. In particular to that end I would love to get the sense of community going ... I mean the ... undergraduate community (Y, 2015)

I think the other thing which has come out, which is something which has been nicely informed by what has been happening in the other project nodes, is how community building works and how that supports teachers in their early years of teaching. I am hoping that we will make a difference there. (W, 2015)

The prominence and persistence of a desire to establish a community of practice has a pleasing twofold significance in our analysis. Firstly, it is simply a common value that we happen to know is still driving the activities of at least some team members beyond the project and is thus evidence of an enduring component of collective MTE identity. Secondly, that conclusion is further supported by the fact that the value is a valuing of community, with its entangled connotations of collective identity.

There was a clear desire expressed by some team members, in both rounds of interviews during the project, that the team's work together should continue beyond the end of the grant:

I hope we keep on working together and I hope we take it to the full extent it can be taken and I hope that when this project finishes that we can continue the work that we have started into many other different projects – you know – sidekick projects and all that. (C, 2014)

... we need to build a track record that will enable future funding to be obtained to support future hopefully common interests and collaboration of the group ... My hope is this doesn't end when the grant ends. I think we should be continuing to have meetings beyond this otherwise things will just fall over and we go our own ways and we should be forward planning for that now to see how that is achievable. (Z, 2015)

At this stage, we can report that some of the “sidekick” projects and some of the legacy of impact that team members hoped for have come to pass. Whether that impact grows or diminishes with time, and what roles we may each play in the future, remains to be seen.

## 13.4 Conclusions

In this chapter, we have traced the learning journey of a team of mathematics teacher educators, of which we have been a part, and thus elucidated three main aspects of interest: a need within mathematics education for different kinds of practitioners to work together to address what may otherwise be a fraught pedagogy-content dichotomy, personal experiences of practitioners working at such an interface, and broader implications about the nature of collective identities. In particular, within our project, we formed productive collective identities in layers and in overlapping ways.

Further, in terms of theorising collective identity, in writing this chapter, we have formed some conjectures as to the ways in which collective identities can be shaped. Some of these conjectures may form the basis for further research. For instance, we hypothesised that the gestalt-like nature of MTE collective identity may arise from the personal, value-laden, and socially contested nature of mathematics education within society. We proposed that collective identity of a team within a particular project could promote long-term changes in broader collective identity beyond the project. We also conjectured that working across disciplinary boundaries, even those that are traditionally fraught, does not necessarily harm the formation of collective identity, in good circumstances. Further to this, we wonder if the prior or simultaneous formation of an identity as *interdisciplinary* or *multidisciplinary* might be an enabler in forming collective identity even in a contested space.

We conclude this chapter with reflections on the project and its influence in our own identity formation from the three authors of this chapter.

Even though I do not see myself as a mathematics teacher educator, I do see myself as having been a mathematics teacher educator enabler in this work. The mathematics aspect of this identity was birthed and grew throughout the project. In addition to the administrative aspect of my role, I was in an educator role within the project, and that happened when I was given an open door to be creative, collaborative and contribute. I was able to select from my pedagogical smorgasbord to enable learning. (Project Officer, 2018)

The project certainly shaped my identity as an MTE. Before, I saw myself as a mathematics educator (amongst other aspects of my mathematical identity), but not with that particular focus on educating mathematics teachers specifically. Now I see myself as having some expertise and some identity-stake in that area. This sense of myself is due both to the huge learning that I have done in that area, and is positively influenced by the recognition that the grant and members of our team's leadership in our School's practices within that area have had within the School. (Mathematics, 2018)

For me participating in this project completely shaped my identity as a maths teacher educator. The project began the year after I started convening the mathematics teaching degree, so it has been a significant feature of most of my time in this role. The conversations that I have had with team members, one in particular from mathematics, have been such a huge and positive influence on my thinking. I think our maths teaching degree is much better because of this project. (School of Education, 2018)

**Acknowledgements** With deep gratitude, we acknowledge our fellow project team members, who have given us so much. We also acknowledge the Office for Teaching and Learning which funded our project. We are also grateful to other colleagues from the broader project who supported from afar and to supportive colleagues across disciplines from our own Institution and beyond.



## References

- Adler, J., Ball, D., Krainer, K., Lin, F.-L., & Novotna, J. (2005). Reflections on an emerging field: Researching mathematics teacher education. *Educational Studies in Mathematics*, 60(3), 359–381.
- Barton, B., Oates, G., Paterson, J., & Thomas, M. (2015). A marriage of continuance: Professional development for mathematics lecturers. *Mathematics Education Research Journal*, 27(2), 147–164.
- Bass, H. (2005). Mathematics, mathematicians, and mathematics education. *Bulletin of the American Mathematical Society*, 42(4), 417–430.
- Beauchamp, C., & Thomas, L. (2009). Understanding teacher identity: An overview of issues in the literature and implications for teacher education. *Cambridge Journal of Education*, 39(2), 175–189.
- Bishop, A. J. (2001). Educating student teachers about values in mathematics education. In F.-L. Lin & T. Cooney (Eds.), *Making sense of mathematics teacher education* (pp. 233–246). Dordrecht, The Netherlands: Kluwer.
- Borwein, N. S., & Osborn, J. H. (2020). On the educational legacies of Jonathan M. Borwein. In D. Bailey, N. Borwein, R. Brent, R. Burachik, J. Osborn, B. Sims, & Q. J. Zhu (Eds.), *From analysis to visualization: A celebration of the life and legacy of Jonathan M. Borwein* (pp. 103–132). Cham, Switzerland: Springer.
- Butler, E., Prieto, E., Osborn, J., Howley, P., Lloyd, A., Kepert, A., & Roberts, M. (2019). Learning across discipline boundaries through narrative inquiry: A study of collaboration to improve mathematics teacher education. *Mathematics Teacher Education and Development*, 21(2), 87–105.
- Carrillo, C., & Flores, M. A. (2018). Veteran teachers' identity: What does the research literature tell us? *Cambridge Journal of Education*, 48(5), 639–656.
- Daiute, C. (2013). *Narrative inquiry: A dynamic approach*. Thousand Oaks, CA: Sage Publications.
- Darling-Hammond, L. (1999). *Teacher quality and student achievement: A review of state policy evidence*. Seattle, WA: Center for the Study of Teaching and Policy, University of Washington.
- Davis, B. (2015). Where mathematics curriculum comes from. In M. Bockarova, M. Danesi, D. Martinovic, & R. Núñez (Eds.), *Mind in mathematics* (pp. 3–18). Munich: Lincom Europa.
- Dawson, S. (1999). The enactive perspective on teacher development: A path laid while walking. In B. Jaworski, T. Wood, & S. Dawson (Eds.), *Mathematics teacher education: Critical international perspectives* (pp. 148–162). London: Falmer Press.
- Day, C., Elliot, B., & Kington, A. (2005). Reform, standards and teacher identity: Challenges of sustaining commitment. *Teaching and Teacher Education*, 21(5), 563–577.
- Day, C., Kington, A., Stobart, G., & Sammons, P. (2006). The personal and professional selves of teachers: Stable and unstable identities. *British Educational Research Journal*, 32(4), 601–616.
- Eacott, S., & Holmes, K. (2010). Leading reform in mathematics education: Solving a complex equation. *Mathematics Teacher Education and Development*, 12(2), 84–97.
- Goos, M. (2014). Creating opportunities to learn in mathematics education: A sociocultural perspective. *Mathematics Education Research Journal*, 26(3), 439–457.
- Goos, M. (2015). Learning at the boundaries. In M. Marshman, V. Geiger, & A. Bennison (Eds.), *Mathematics education in the margins* (Proceedings of the 38th annual conference of the Mathematics Education Research Group of Australasia (pp. 269–276). Adelaide, SA: MERGA.
- Goos, M., & Bennison, A. (2002). *Building learning communities to support beginning teachers' use of technology*. Paper presented at the annual conference of the Australian Association for Research in Education, Brisbane 1–5 December. Retrieved 15 March 2019 from <https://www.aare.edu.au/data/publications/2002/goo02058.pdf>
- Guba, E. G., & Lincoln, Y. S. (1994). Competing paradigms in qualitative research. In N. Denzin & Y. Lincoln (Eds.), *Handbook of qualitative research* (pp. 105–117). Thousand Oaks, CA: Sage.
- Hattie, J. (2008). *Visible learning: A synthesis of over 800 meta-analyses relating to achievement*. London: Routledge.

- Herman, D., Manfred, J., & Marie-Laure, R. (2010). *Routledge encyclopedia of narrative theory*. New York: Routledge, Taylor and Francis Group.
- Hersh, R. (1997). *What is mathematics, really?* New York: Oxford University Press.
- Hill, H. C., Blunk, M. L., Charalambous, C. Y., Lewis, J. M., Phelps, G. C., Sleep, L., & Ball, D. L. (2008). Mathematical knowledge for teaching and the mathematical quality of instruction: An exploratory study. *Cognition and Instruction*, 26(4), 430–511.
- Hökkä, P., Vähäsantanen, K., & Mahlakaarto, S. (2017). Teacher educators' collective professional agency and identity—transforming marginality to strength. *Teaching and Teacher Education*, 63, 36–46.
- Jaworski, B., & Wood, T. (2008). *International handbook of mathematics teacher education* (Vol. 4: The mathematics teacher educator as a developing professional). Rotterdam, The Netherlands: Sense Publishers.
- King, D., & Cattlin, J. (2017). Building a network and finding a community of practice for undergraduate mathematics lecturers. In J. McDonald & A. Cater-Steel (Eds.), *Implementing communities of practice in higher education* (pp. 29–51). Singapore, Singapore: Springer.
- Krainer, K., & Wood, T. (2008). *International handbook of mathematics teacher education* (Vol. 3: Participants in mathematics teacher education). Rotterdam, The Netherlands: Sense Publishers.
- Llinares, S., & Krainer, K. (2006). Mathematics (student) teachers and teacher educators as learners. In A. Gutiérrez & P. Boero (Eds.), *Handbook of research on the psychology of mathematics education: Past, present and future* (pp. 429–459). Rotterdam, The Netherlands: Sense Publishers.
- Losano, L., Fiorentini, D., & Villarreal, M. (2018). The development of a mathematics teacher's professional identity during her first year teaching. *Journal of Mathematics Teacher Education*, 21(3), 287–315.
- Melucci, A. (1995). The process of collective identity. In H. Johnston & B. Klandermans (Eds.), *Social movements and culture* (pp. 41–63). London and New York: Routledge.
- Meretoja, H. (2013). Philosophical underpinnings of the narrative turn in theory and fiction. In M. Hatavara, L.-C. Hydén, & M. Hyvärinen (Eds.), *The travelling concepts of narrative* (pp. 93–108). Amsterdam: John Benjamins Publishing Company.
- Palmer, P. J. (2017). *The courage to teach: Exploring the inner landscape of a teacher's life*. San Francisco, CA: John Wiley & Sons.
- Petersen, E. B. (2014). Re-signifying subjectivity? A narrative exploration of 'non-traditional' doctoral students' lived experience of subject formation through two Australian cases. *Studies in Higher Education*, 39(5), 823–834.
- Riessman, C. K. (2008). *Narrative methods for the human sciences*. London: Sage.
- Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, 15(2), 4–14.
- Tampio, N. (2017). Who won the math wars? *Perspectives on Politics*, 15(4), 1087–1091.
- Valero, P. (2017). Mathematics for all, economic growth, and the making of the citizen-worker. In T. Popkewitz, J. Diaz, & C. Kirchgasser (Eds.), *A political sociology of educational knowledge: Studies of exclusions and difference* (pp. 117–132). London: Routledge.
- van Lankveld, T., Schoonenboom, J., Volman, M., Croiset, G., & Beishuizen, J. (2017). Developing a teacher identity in the university context: A systematic review of the literature. *Higher Education Research & Development*, 36(2), 325–342.
- Wenger, E. (1998). *Communities of practice: Learning, meaning, and identity*. Cambridge: Cambridge University Press.
- Whooley, O. (2007). Collective identity. In G. Ritzer (Ed.), *Blackwell encyclopedia of sociology*. Malden, MA: Blackwell.