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This paper is an expression of how the authors are collectively becoming mathematics teacher educators, as they write and speak into one another's lives through the process of co/autoethnography. Extracts are presented from extended conversations between the authors, illustrating their process of formulating through reflecting on, and consciously appreciating, their unformulated actions as mathematics teacher educators. In their expression of the process of becoming, the authors begin to formulate the notion of conviction. From their enactivist perspective, they see their convictions emerging through the process of becoming mathematics teacher educators and their process of becoming mathematics teacher educators as the emergence of their convictions.

Keywords: Becoming, mathematics teacher educators, co/autoethnography, conviction.

The development of the mathematics teacher educator

There is a separation articulated in literature within the domain of mathematics teacher education, between what is termed as a 'mathematics teacher educator' and what is termed a 'didactician'. Even (2014) characterises didacticians as a subset of mathematics teacher educators, specifically, didacticians are mathematics teacher educators who "work in the field of teaching development with practicing [sic] teachers, including university faculty as well as practice-based mathematics educators" (p. 329). The particular feature here of the didactician is the focus on the development of *practising* teachers. Didacticians are not necessarily based at a university and include, for example, professional development providers and teacher-leaders. For us, we use mathematics teacher educator (MTE) in reference to ourselves. This is not to say that we do not work with practising teachers, but it is important to note that we are both based in a university where we work primarily with prospective teachers of mathematics on a one-year course, where prospective teachers work towards a Postgraduate Certificate in Education (PGCE), that includes qualified teacher status. We each have over ten years of experience teaching mathematics in secondary classrooms having both completed our PGCEs at the same university in which we now work, on the same course that we now teach. Tracy completed her PGCE in 2003 and has worked as an MTE for two and a half years. Julian completed his PGCE in 2006 and has worked as an MTE for one year.

As a community of teacher educators who value teaching practices that incorporate teachers researching their own teaching, there is a discernible argument that, as teacher educators, we too should participate in such inquiry into our own teaching and development. The development of mathematics teacher educators (MTEs) is a growing area of research within mathematics education. One useful distinction that has been made within this research domain is between what is termed "the *education* of mathematics teacher educators" and "the mathematics teacher educator *as learner*" (Krainer, Chapman, & Zaslavsky, 2014, p. 431). Research on the education of MTEs reports on studies of the preparation and professional development of MTEs through formal courses

and programs designed specifically to prepare educators to educate teachers. Research on the MTE as learner, however, places its emphasis on the "teacher educators' autonomous efforts to learn, in particular, through reflection and research on their practice" (p. 432). MTEs are in a powerful position to research their own lived experience as insiders, rather than outsiders looking in, both as practitioners and researchers, researching their own practice. However, it is still being acknowledged (see e.g., Lin & Rowland, 2014) that only a few *full* studies exist where the prime focus is on the learning of the MTE (see e.g., Nicol, 1997; Tzur, 2001), rather than the learning of the MTE being reported on as a derivative of the research conducted by those MTEs.

One such full study on the learning of the MTE from Tzur (2001) is one in which he tells the story of his own development as a mathematics teacher educator through self-reflective analysis. This work from Tzur demonstrates how powerful self-reflection can be and how it can form the basis of rich data about what it might mean to learn as an MTE. Another significant piece of research is found in Nicol's (1997) thesis; *Learning to teach prospective teachers to teach mathematics*, which is a study that investigates the problems, tensions, and dilemmas that she experienced as a beginner teacher educator learning to teach prospective elementary teachers. Her study reports her efforts in designing and investigating a pedagogy of mathematics teacher education, which makes attempts to place inquiry at the focus of teaching and learning.

What and *how* mathematics teacher educators learn

In 2008, a series of International handbooks of mathematics teacher education were published, in four volumes (with new editions currently underway). Volume 4: *The mathematics teacher educator as a developing professional* (Jaworski & Wood, (Eds.), 2008), described as focusing on the knowledge and roles of teacher educators working with teachers in teacher education processes and practices, is divided into three sections: Challenges to and theory in mathematics teacher education; Reflection on developing as a mathematics teacher educator; and Working with prospective and practising teachers; what we learn; what we come to know. A distinction being made here, which is also made by Lin and Rowland (2014) in their critical overview of research on teacher knowledge and professional development from a decade of PME (Psychology of Mathematics Education) conference proceedings, is between *what* and *how* mathematics teacher educators learn. For Lin and Rowland, studies on *what* MTEs learn are "classified as aiming to reveal or characterise mathematics educator's learning outcomes", whereas studies of *how* MTEs learn aim to "explore or comment on mathematics educators' learning processes" (p. 509). According to Lin and Rowland, MTE learning had not been frequently reported on and studies that investigate how-oriented-questions were the least frequent of all (they identified three research reports over the decade of proceedings). This paper is one response to the gap in the *how* of MTE learning, but in reporting our research, we also accept the inevitability of the *what*; in reporting any research, including research into process, there is an immediate objectification.

Becoming mathematics teacher educators

In his 1962 essay, Rogers offers a vision of an individual who is in the process of becoming a fully functioning person. The individual that Rogers describes is becoming "all of one piece", where the "distinctions between 'role self' and 'real self', between defensive façade and real feelings, between

conscious and unconscious, are all growing less" (p. 29). Here, we begin to comprehend the process of becoming as a unification of ourselves at the surface level with ourselves at the level of depth.

If we consider becoming from the perspective of learning, Hager and Hodkinson (2009) adopt a metaphor of learning *as* becoming in that "people become through learning and learn through becoming whether they wish to do so or not, and whether they are aware of the process or not" (p. 633). This view of learning as an inevitable process, rather than as a fixed state of having become (as with, for example, an acquisition model of learning (see Sfard, 1998)), signifies a change in the learner themselves as well as a change in the activity the learner is engaging with.

From an enactivist perspective, we see knowing as doing through being in and bringing forth a world in which we participate. The process of coming to know is thus a process of *becoming* through which both knower and known are transformed. Within enactivism, knowing is embodied, yet extends from the body of the individual in that the individual is not seen as distinct from the world but embedded in "a series of increasingly complex systems" (Sumara & Davis, 1997, p. 416) such as classrooms or universities. Unlike constructivism, where the focus is on cognitive knowing, enactivism considers alternative ways of knowing, including non-cognitive ways. In terms of epistemology, a useful categorisation of types of human action is made by Davis (1996, p. 193) that is, the "formulated" (cognitive) and the "unformulated" (non-cognitive) and with enactivism, the emphasis is on the unformulated. Davis goes on to propose that "formulations continually emerge from our unformulated actions" (pp. 193–194) and it is through this constant emergence that we develop our habits as MTEs, our "know-how" (Varela, 1999, p. 19). In contrast to know-how, we "know-what" through a process involving "reflection and conscious appreciation" (Varela, 1999, p. 19) and therefore becoming MTEs can be viewed as a process of continual emergence of our formulations (know-what) through jointly reflecting on, and consciously appreciating, our unformulated actions (know-how), and so it goes on.

Becoming mathematics teacher educators *through* co/autoethnography

Julian: I think when we spoke before, you made use of that [word] when you talked about what happened in a maths class, in your classroom.

Tracy: But I used that without really thinking about what it meant. I mean, I don't think I've ever thought about what it meant quite like I am now.

Our conversations are not bounded by a working day and move beyond strict boundaries of a workplace agenda to touch on concerns of our wider lives. We seek to make explicit use of extended conversations with one another to support our becoming through continual emergence of our formulations. Having captured two such extended conversations, we draw on co/autoethnographic (Coia & Taylor, 2005) methods, moving us beyond our accounts of our unformulated actions, as we write and speak into one another's lives. As enactivists, we reject the strict separation of self/other that appears in existing co/autoethnographic literature (e.g. Coia & Taylor, 2005) and instead look to the co-emergence of shared meaning through being connected (Begg, 2001) in becoming MTEs together. For us, the process of co/autoethnography does not *enable* our becoming, rather our combining in the process is itself the becoming. In what follows, we present three extracts from two of our extended conversations, illustrating our process of

formulating through reflecting on and consciously appreciating our unformulated actions as MTEs. We see these extracts as expressions of our becoming.

Extract 1: Modelling being in a classroom

Tracy: I just didn't feel like I could do it. I didn't feel like I could just go and tell this 25-year-old man to stop rocking on his chair, whereas if he was a 16-year-old boy, I wouldn't have any issue doing it.

Julian: So, you saw this as an issue with teaching adults?

Tracy: I didn't know what else it could be, I mean, they're adults and they're children, that's the difference right, but it's not that, it just didn't make sense at the time.

Julian: And now?

Tracy: And now I'd quite happily tell someone not to rock on their chair in the PGCE group, and I think the difference is how I see myself, in that role, not as authoritarian or something, but that I'm modelling being in a classroom, and suddenly then it's okay. So, I'm doing it for a different reason. I'm not trying to teach him not to hurt himself. I mean he might do, he might well hurt himself, but, it's then not about me and my issue that they're adults. That's not the issue anymore. The issue is that I want that room to feel like I want their classrooms to feel; safe and respectful.

Julian: Modelling being in a classroom feels like another one of those tenets.

Tracy: Yes, it is! and suddenly, I've got this conviction and now I *can* go and tell people to stop rocking back on their chairs.

Extract 2: Your relationship is with the mentor

Julian: I've felt really positive about the opportunities that have come up to work on mathematics with the school-based mentors when I've gone into schools for joint lesson observations.

Tracy: During the lessons?

Julian: Yes, but also afterwards. There have been one or two cases that I guess have stayed with me, of the three of us talking after the lesson and carrying on working on the mathematics, like moving from area of compound shapes to think about conversion between units of measurement in area, and then in volume. The sharing of different images to illustrate those felt really powerful between the three of us.

Tracy: Say more…

Julian: So, part of it was me exploring the wisdom of the course that in the debrief conversations we as university tutors are really working with the mentors. I suppose at this point, it has been partly me trying to inhabit the convictions that were spoken in the context of the course. But now I can see that it also really

connects with something that emerged for me strongly when I moved from the PGCE course to start in my first school, which was about working on mathematics together as teachers.

Tracy: So, you were carrying this on from your role as a teacher, with other teachers?

Julian: Well, yes. But really, that move to my first teaching job was a sense of loss, of no longer having those spaces to work together on the mathematics. And it's something I've tried to grow again ever since. So, working with the mentor feels like modelling as well as working on the mathematics, creating a space together to unpack what's going on. It has developed another layer of significance for me. I feel a conviction about the value of creating those spaces with the mentor, who might then expand the spaces throughout their work with our prospective teacher.

Extract 3: Working at the meta level

Tracy: We talked before about an algebra session where I used a visualisation. I hadn't spent long enough working through what I was going to say in setting up the visualisation, so it wasn't a surprise that there were a few different versions of what people were seeing.

Julian: What people were seeing as the image?

Tracy: Yes, their mental images. Having said that, if I had somehow set it up so perfectly that everybody saw the same thing, then we wouldn't have spent that period of time testing out one another's images, I had to work quite hard to make sure that happened and that was a good discipline for them to experience I think.

Julian: I think you said that you'd commented along those lines during the session, something about it being important to spend time making sure everybody was seeing the same thing.

Tracy: Yes, that's working at the meta level right? I think I might have said something similar doing this in a mathematics classroom though so that's not something new.

Julian: So, what is new, what is different now?

Tracy: Someone from the group asked a question while I was setting up the visualisation and I refused to answer it, I think maybe I gestured something to communicate that when it happened, and then much later on, I returned to it and addressed my not answering someone's question explicitly. Then I think I said something like, "something you need in the classroom, if you're going to do visualisation, is to establish the rules, and I don't think I established the rules clearly". I don't think I would have said that in my classroom at school. Again, that is about being meta, being explicit about my decision making.

Julian: For me there is also something there about when to step in and step out of the mathematics.

Tracy: Yes, a splitting of my attention in that moment, I knew it had to be dealt with, but not at that time, it got logged as something that had to be returned to. It's not that they must do visualisation, but that if they choose to, there are some rules, rules that I had conviction about as a teacher. I guess my conviction now, as a mathematics teacher educator, comes from these experiences in the classroom.

Our emerging formulations: formulating the formulating

The extracts above serve to express snapshots of our process of becoming MTEs, each one offering a sense of us formulating our unformulated actions as MTEs. This next section serves to express our emerging formulations from having brought these extracts together, formulations that have arisen for us through a process of reflecting on and consciously appreciating within and across these three snapshots. The title of this section is our attempt at emphasising the continual emergence of new formulations, through formulating (expressed in this section) the formulating (expressed in our extracts). One way of us consciously appreciating the formulating expressed within these three extracts is by looking for patterns both within each extract and across all three extracts.

Each extract is richly veined with marks of the formulations articulated about the university course with which we work. The tenets we hear in these extracts, "I'm modelling being in a classroom"; "as university tutors we are really working with the mentors"; "that's working at the meta level right?", were previously heard in conversations with Laurinda Brown, who was PGCE tutor to each of us, and Alf Coles, who has worked on the course with Laurinda and whom we joined as PGCE tutors. We have articulated to one another the "trying on" of these tenets at the level of unformulated actions. Through the process of becoming MTEs we have begun to make sense of these tenets in ways that we find meaningful. Acting on these tenets and developing a sense of owning them can also be seen as formulating our formulating.

There is a sameness which has become apparent to us as we search for patterns across the extracts, that reflects something of the structure of each one in relation to how we view the process of becoming as the continual co-emergence of our formulations from our unformulated actions. In extract 1, an unformulated action for Tracy was *not* moving to stop one of the PGCE students rocking on his chair. In extract 2, an unformulated action for Julian was his carrying on working on the mathematics. In extract 3, an unformulated action for Tracy was refusing to answer a question. From these unformulated actions, we try out different formulations on one another as they co-emerge. From the extracts we see these formulations are then followed by a sequence of further re-formulations, marked by, for example, "but it's not that"; "yes, but also"; "well, yes. But really"; "having said that".

An element of what guided our choice of extracts to present is the emerging theme of conviction. So strong has this theme become for us in our conversations, we are no longer able to separate what appears from these extracts to be changing or emerging convictions from how we are becoming MTEs. What follows is a further formulating, the focus this time on becoming MTEs *as* the emergence of convictions.

Becoming mathematics teacher educators *as* the emergence of convictions

In the extracts above, we draw repeatedly on language of conviction as we work on our formulations. In formulating conviction, we look first to Descartes (1991), who adopted conviction to describe a state of belief "when there remains some reason which might lead us to doubt" (p. 147), and knowledge as "conviction based on a reason so strong that it can never be shaken by any stronger reason" (p. 147). If conviction is to be characterised as belief, strongly held, then it carries with it some particular quality that sets it apart from other states of believing.

For us, however, the sense-making process that informs statements, which might be labelled as beliefs, is inherently a product of the emergent interactions of the (changing and changed) individual with the (changing and changed) world, for which we adopt the enactivist term "structural coupling" (Reid et al. 2000; Maturana, 2002, p. 15). We are interested in how our own sense of conviction emerges and becomes something that can be articulated as we are becoming MTEs. We see changes in conviction as a manifestation of changes in our structural coupling, strengthened (or weakened) through the process of formulating our unformulated actions. Gallagher and Zahavi (2008) identify conviction as fundamentally intertwined with changes in ourselves,

> I remain the same as long as I adhere to my convictions; when they change, *I* change. Ideals and convictions are identity-defining; acting against one's ideals or convictions can mean the disintegration (in the sense of a dis-integrity) of one's wholeness as a person. (p. 206)

Thus, as our convictions change (or emerge) then we change, through a process of becoming. It is our convictions that define us as MTEs (our "identity") and to act against our convictions, for example, if Tracy were to *not* model a classroom with the PGCE group or if Julian were to *not* model being a mentor, would "mean the disintegration (in the sense of dis-integrity)" of ourselves as MTEs.

We recognise in ourselves the sense of integrity that comes from being able to identify the alignment of our actions and our convictions. Within the Cartesian epistemology mentioned above, conviction might be seen as a deficient form of knowing, a position held when there is still doubt. The identity-defining property of conviction, however, makes conviction, for us, more than a label. From our enactivist perspective, we see the emergence of our convictions as coming to know. We view our convictions emerging through the process of becoming MTEs, and our process of becoming MTEs as the emergence of our convictions.

It was our intent to present in this paper the process of our becoming, the process of our formulating. We acknowledge that in the creation of this paper there exists a paradox. The value for us continues to be in the formulating (the *how*) but we accept that what gets presented here is inevitably a formulation (the *what*) at a point in time.

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