

Exploring the perspectives of participants of two mathematics professional development courses in South Africa: personal, professional and community outcomes

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Abstract

This paper reports on the professional development of four mathematics teachers in South Africa. The four teachers all participated in a Mathematical Thinking (MT) course before taking an Advanced Certificate in Education (ACE) in mathematics. The research, which aimed to understand these teachers' ongoing professional development, took place two years after they had completed the ACE course, at a time when they were helping to run a subsequent MT course, taking the role of teaching assistants (TAs). The teachers provided written 'stories' of their experiences during and after the two courses and were interviewed twice after the two courses; the first interview drew on the stories and the second drew on the first interview. The qualitative data gathered were analysed using a three-part framework of outcomes: personal, professional and cultural/social. In terms of personal outcomes, they reported renewed confidence and passion for teaching mathematics, changed beliefs and values, and acknowledged new learning experiences; they did not, however, report on learning about mathematics, the curriculum or planning. In terms of professional outcomes, they reported changes in both their own classroom teaching practice and their approaches to leadership. Finally, there was little evidence of cultural/social outcomes, but participants reported on opportunities that had been offered to them and on new collaborations in their communities. We have called these 'community outcomes' and suggest that cultural/social outcomes might be renamed community outcomes so that it is extended to include these sorts of opportunities.

Key words: professional development; mathematics; teacher learning; community outcomes

Introduction and background

The research reported in this paper looks beyond the three common outcomes of professional development for teachers: improved teacher knowledge, better teacher classroom practice and learner improvement. It considers the wider professional development of individuals taking part in particular professional development courses in South Africa.

Teaching in South African mathematics classrooms is often regarded as of poor quality (Maserow, 2015; Mji & Makgato, 2006); the tendency appears to be a teacher-led approach, characterised by a teacher at the front of the class with passive learners (Mji & Makgato, 2006), which is at odds with the increasingly popular social-constructivist view that children learn through active engagement and social interactions (John-Steiner & Mahn, 1996; Swan, 2008).

To address the problem of poor quality teaching and lack of teacher subject knowledge in South Africa, in-service teacher education programmes have been established (Adler & Davis, 2006; Mji & Makgato, 2006). One example of professional development opportunity for teachers is the Advanced Certificate in Education (ACE) (a certificate that enables teachers to upgrade their three-year teaching diploma to a four year diploma). From 2015 the ACE was replaced by an Advanced Certificate in Teaching (ACT).

A pre-requisite to the ACE course in this paper was a Mathematical Thinking (MT) course aimed at improving mathematical and pedagogic content knowledge. The MT course is a three-month blended learning course consisting of a ten-day residential component followed by a distance learning component. The modules of the ACE were taught at a residential course for five days at a time over two years and, simultaneously, supported by distance learning. The progress and learning of the teachers engaged in both courses were assessed through written assignments. Funding for the programme did not cover classroom visits. This study explores the personal and professional development of four teaching assistants (TAs), all alumni of the MT and ACE courses, with regards to their experiences of participating in the two courses.

Literature review

Research on change generally accepts that change is a process, not an event, and that it takes time; change can be difficult for individuals and organisations; individuals begin to make changes which are later adopted by organisations (for example, see Saunders, 2012). While theories of change clearly highlight the importance of sustained change, much of the research on professional development suggests that evaluations take place very soon after the initiative has finished (Goodall, Day, Lindsay, Muijs, & Harris, 2005) and seldom attend to longer term or indirect benefits.

Further, the experiences of the individual teacher gained from the initiative, set against their overall professional experience, is used less often to make an assessment of the effectiveness of the initiative. However, we believe, as do Bolam (2007) and Davies and Preston (2002) (amongst many others), in the importance of the experience of the individual. We consider that a teacher's teaching context, prior learning and experience must be taken into account when exploring the influence of a professional development initiative on a teacher. Most important, perhaps, is the need to take into account the ongoing professional experience of the teacher when we look back at a professional development initiative and attempt to understand how it may have influenced a teacher's development. In our study we have explored frameworks which emphasise the professional development of the individual teacher.

The British Council (2015) has developed a framework for continuous professional development (CPD) which focuses on stages of development of individual teachers: awareness, understanding, engagement and integration. In this framework, awareness and understanding concern the development of a teacher's knowledge about aspects of teaching (e.g. understanding learners); engagement relates to trying out new practices; and integration means embedding the practices in everyday classroom use.

Clarke and Hollingsworth (2002) describe variations of teacher change as change with respect to training, adaptation, personal development, local reform, systemic restructuring and as growth or learning. In the South African context, Long, Graven, Sayed and Lampen (2017) suggest that any outcomes of professional development should consider evidence of teacher agency by looking at the strengths and identifying further support while taking into account the constraining factors and enabling factors for teacher agency. King (2014), who claimed that there is a lack of skills and tools to evaluate professional development, developed a framework focusing on teachers' professional learning about the teaching of literacy; her framework included ways of exploring both the short- and long-term impacts of a professional development initiative. To address long-term impacts, she included, and emphasised, 'staff outcome' with three subcategories: personal, which relates to the British Council's awareness and understanding phases, professional, which could include the British Council's engagement and integration phases, and cultural which 'reflect[s] the way things are done in a school' (King, 2014, p. 106). By this she means, for example, working collaboratively between teachers in a school and the development of professional learning communities in schools.

King's categories are closely related to those of Bell and Gilbert (2005) who argue that teacher development programmes must address development in three areas: personal, professional and social. Their premise is that social development, as part of teacher development, involves renegotiation and reconstruction of what it means to be a teacher; and ways of working with others that allows the kinds of interactions which are necessary for this renegotiation and reconstruction. They explain that teachers tend to feel isolated in their classrooms and they value collaboration with other teachers to discuss, share and reflect on, new ideas and practices.

King and Bell and Gilbert provide useful ways for us to begin to understand the longer term impacts of the MT and ACE courses in mathematics in our study.

Research methods

The research aimed to explore the effects of the experiences of the MT and ACE courses, from the perspectives of alumni taking on roles as TAs, seeking to understand their professional lives during and after the course. Notably, the teachers' perceptions of change may not reflect actual change and we emphasise here that, in this particular study, our interest was in their perceptions and perspectives and not, for now, in actual change. Our interest suggested the need for a qualitative approach, described by Cresswell (2014) as a naturalistic approach to exploring phenomena, starting from the participants' own experience.

Organisation of the course

The participants of the 3-month MT course taught mathematics at upper primary and secondary schools. The 2-year ACE course targeted MT alumni who aspired to become mathematics subject leaders. During the ACE course the participants completed ten modules, of which six focused on the content of mathematics in their respective phase groups, general education theory, perspectives in mathematics education, and teaching and pedagogy (called the Teaching and Learning Environments (TLE)).

The modules (in both courses) modelled 'active learning' approaches to teaching, involving the use of readily available practical resources such as egg-boxes, used at the intermediate level, to support an understanding of division and fractions (e.g. four boxes of six fit into a tray of 24). The intention was that teachers would experience learning mathematics in learner-centred ways which would, in turn, encourage them to teach mathematical thinking using these approaches in their classrooms.

In both the first and second years of the ACE, the TLEs required participants to follow detailed guidance, to: form a cluster of teachers and run a workshop, with or for the teachers in the cluster, on a given mathematical topic and with a given pedagogical focus (e.g. guided re-invention); teach a lesson on the same topic; and report on the experience. The focus on initiating and leading workshops was intended to introduce the participants to working with other teachers of mathematics; this was intended to develop their confidence as professionals and leaders by requiring them to plan and lead the workshop and model the way that teachers might introduce and teach mathematics using learner-centred approaches. Reporting on the workshop and the implementation of the related classroom lesson was intended to provide evidence that they had fulfilled the requirements of the course and to encourage them to reflect on their experiences and learn from their reflections. In addition, in the second year they were required to design their own action research project; they were asked to identify an area of their teaching they wanted to improve, and then design, try out, and reflect on an intervention to address this and report on it. It was hoped that the TLE module would achieve outcomes that would normally be assessed by face-to-face classroom visits.

Data collection and analysis

Four alumni of the course, all teaching at the senior phase (Grades 7, 8 and 9) or working with senior phase teachers, were selected to take part in the research, which took place in July 2016, two years after they completed the ACE. At the time they were helping to run a MT course as TAs. The research was explained to them; they agreed to take part and signed the usual ethical clearance forms. Brief details about the four participants follows (names have been changed). All participants are from the Eastern Cape in South Africa and are isiXhosa speaking. Interviews were conducted in English.

1. Gift, male, (classroom practitioner) has been teaching mathematics for 14 years. He obtained good results during his pre-service teacher training at diploma level which gave him the belief that he was a good mathematics teacher. He was concerned that his learners were not attaining good results.
2. Fezeka, female, has been teaching mathematics for 19 years. During her second year of the ACE she was promoted to head of the mathematics department at her school.
3. Wilfred, male, (Principal) was already a principal when he started the ACE. He has been teaching mathematics for 26 years.
4. Zintle, female, (MSTE Coordinator) has been teaching mathematics for 17 years. She described herself as an all-round top student of mathematics. When she started the ACE, she was already overseeing mathematics, science and technology across thirty primary and secondary schools in her district.

Gathering most of the data took place over five days. Our data collection aimed to maximise the benefit of co-location without placing a burden on the participants. The four participants were asked to write an account of their experiences during the MT course and the ACE course. This account (Story 1), was designed to provide the researchers with a starting point from which to develop semi-structured interview questions. The participants were then interviewed (video recorded), with questions drawn from the account (Interview 1). The two researchers analysed the video interviews, and based on this analysis, devised further questions for the second interview, which took place a week later (Interview 2). Two of the participants (Wilfred and Fezeka) provided a second account of their experiences during the MT and ACE courses (Story 2), but this time they were asked to focus specifically on their professional selves before and after completing the ACE course.

We used the main aspects of staff outcomes from the work of King and Bell and Gilbert, namely personal, professional and cultural/social, to frame our analysis. We take 'personal' to mean changes to the individual in terms of learning about, and attitudes to, mathematics and teaching. 'Professional' we see as changes in practice and leadership and these refer to actual, self-reported changes in what the participants do in their professional lives. 'Cultural' and 'social' refer to collaborative working with colleagues in schools or the same professional development initiative.

Findings and discussion

The findings presented in this section are grouped within the three main themes. The comments by the TAs reported in the findings section refer variously to one or more of the components of their experiences with the professional development organisation.

Personal

All the participants reported some learning, mostly making more general comments such as "my knowledge, both content and strategy is widening" (Wilfred, Story 1). More specifically,

Gift, Zintle and Fezeka reported that they had learned teaching strategies to engage the learners with practical activities and making mathematics more enjoyable for their learners. Gift, for example, explained that he had long believed that learners could “learn through play”, and explained that the teaching strategies suggested at the courses provided some approaches he could use in his own classroom. Zintle also mentioned the teaching strategies demonstrated at the courses, saying “I realised that we are being capacitated with strategies making learning fun” (Interview 1). She gave a specific example of learning about “kinesthetic learning” as an alternative to using a “drilling” method and “giving them rules”. Fezeka also gave examples of her learning, saying that she could “allow the learners to ask questions by involving them in the lesson” (Interview 2). She went on to say that the mathematics could be made fun by using visuals and concrete objects. There was no evidence, however, of an analysis of how these approaches might provide ‘better’ learning experiences for their pupils; while they appeared to be convinced that these approaches would be more engaging for them, there were no attempts to explain why better engagement would or could lead to improved cognitive development of the learners.

Whereas we might have expected some reference to learning, in the context of teaching mathematics, about preparation, planning, or formative assessment practices, particularly as planning and formative assessment were explicitly addressed in the course, there were none. Their comments also did not relate to policy documents such as the Curriculum and Policy Statement (CAPS) which was referred to throughout the course. It is difficult to know whether this was because they did not think these aspects of their work were important or they did not consider they had learned in these areas; this might be interesting to follow up.

They did not report that they had learned mathematics although the courses were set up with the explicit aim of improving mathematical content knowledge and included tests of mathematical content at the end of the course. It could be that the participants in our research did not feel they had learned any new mathematics since they had come to the course confident in their mathematics knowledge, or it could be that they did not think this was worth mentioning. It appears that confidence in mathematics content knowledge is common amongst many South African teachers, although this confidence is often misplaced as found by Bansilal and Rosenberg (2011). We were surprised, though, particularly as it seems that improved teachers’ mathematical knowledge does have a small but significant effect on learner attainment as found by Pournara, Hodgen, Adler and Pillay (2015).

Many course participants found the requirement of running workshops for the TLE modules extremely challenging. Each of the four participants suggested some learning related to this activity. Gift, for example, said that he had learnt how to plan a workshop using a PowerPoint presentation and how to ask other teachers questions during the workshop. As he said: “The way we have been taught to prompt, to ask questions, until somebody comes up with the answer. That helped me very much.” (Interview 1). Wilfred said that planning the workshops taught him to want to know more which has continued in his professional life. “I knew every time I would do a workshop, I have to be sure of what to say and had to search for more. I am glad that attitude has not stopped.” (Story 2). He also said, in reference to the action research aspect of the TLE modules, that he had learnt that he had to write correct English, how to analyse data and how to add references to his work. Gift’s and Wilfred’s comments about planning workshops are interesting; they suggest that these teachers were not previously aware that running workshops requires careful planning. In some ways the participants were demonstrating a stage of development beyond awareness and understanding rather it leans towards engaging with the workshop materials, engaging with research literature and engaging with report writing. It is well known that action research has the potential to encourage teacher learning (Bansilal & Rosenberg, 2011; Roulston, Legette, Deloach, & Pitman, 2005; Zeichner,

2006); and *a priori* we might have expected reports of learning associated with the action research. However, whereas much of the literature refers to action research within classroom contexts (e.g. Bansilal & Rosenberg, 2011), here the research took place in the context of working with teachers and aimed to develop the participants as leaders of professional development. It appears that to some extent the aims were achieved; the participants appeared to have learned about some aspects of leading workshops for teachers.

Zintle described the feedback from the lecturers to the TLE workshop assignments as “looking at yourself in the mirror”. She suggested that she had realised that her strengths required refinement, explaining that the feedback from the lecturers had developed her, drawing attention to the integration of what she had learned to her practice. Gift stated that through the process of reflecting in the assignments, he began to understand that the learners were different to each other and that this helped him to think about his teaching style. He reported asking himself the question, “How could I do this better?” Through his reflections, Gift also appeared to be integrating his awareness and understanding of new approaches into his pedagogical practice. As Zeichner (2006) points out, reflective practice is necessary for professional development and it is encouraging that Zintle and Gift reported their learning in this way; a question arises about why the other two did not.

All the participants reported that they had gained confidence; in their own teaching, in in-school relationships with other teachers and in their interactions with colleagues from different schools. For example, Gift explained how he had developed the confidence to share some of the approaches he had learned on the MT course with colleagues and Wilfred said that he felt confident because other teachers believed in him. He also said that his involvement with the organisation had “helped me gain self-confidence. Now I am able to stand up and make presentations in front of a big audience” (Story 1). It is perhaps not surprising that the participants had become more confident, because they had travelled and had experiences probably beyond the possible boundaries of their colleagues’ experiences. Although developing confidence was not an explicit goal of the programme(s), it could be argued that confidence is the foundation for change beyond or before changing practice. Bell and Gilbert (2005) and King (2014), in their emphases on the social and cultural aspects of professional development, recognise the importance of developing confidence; in both cases through some kinds of collaborations with other teachers. The teachers in our research did not explain how their confidence had grown and we can only speculate whether it was through collaborations with other teachers as envisioned perhaps by Bell and Gilbert and King.

Wilfred, Gift and Zintle all mentioned that their love for mathematics had been in some way rekindled. Gift mentioned this on two occasions, saying first that his attitude towards mathematics teaching had been improved and second that mathematics teaching was ‘reborn’. Wilfred said that he had “regained the love of mathematics” (Story 1) and Zintle said that her “passion” for mathematics had been raised. This is interesting; although these participants did not report learning in mathematics, it seems that they enjoyed doing mathematics.

A general theme that ran through the responses of the participants related to a shift in their beliefs about mathematics, how children (and teachers) learnt mathematics and how mathematics should be taught. One aspect of this shift could be described as moving from a teacher-centred approach to a learner-centred approach, with Fezeka, for example, stating that “you can’t just tell the learners, you must involve them” (Interview 1). Gift indicated a similar shift, saying that “we think we are teaching but it is evident that we are cheating most of the time because we are the people that are talking, talking, talking, talking” (Interview 2). Both these comments indicate a belief that teaching requires more than ‘talking, talking, talking,

talking' and perhaps embracing a socio-cultural perspective on teaching and learning (Vygotsky, 1986).

Zintle and Gift emphasised the manner in which their approach towards professional learning had changed. Zintle, referring to professional development contexts, explained that previously she may not have taken into account teachers' prior knowledge and experience. She stated that "usually you take teachers as empty vessels" and realised later that this may not have been the most appropriate approach. She said "you are learning from each other because they are coming with their own strategies and you are coming with your own strategies" (Interview 1). Gift, also, seemed to have experienced a similar shift, saying that "I discovered that I was not the fountain of all knowledge and the teachers could learn from each other" (Interview 1). In a sense, this increased awareness echoes the reported shift in beliefs about teaching mathematics to children; in both cases there is some understanding of the need to view the learners (whether they are teachers or children) as responsible for their own learning.

Overall, within the 'personal' aspect of the analytical framing, three main themes emerged: learning, confidence and passion, beliefs and values.

Professional

The second category of outcomes is the professional; changes in practice, which involve engagement and, later, integration.

The participants all reported an increased focus on the learners within their classroom practice. Gift, for example, described his teaching as having "more emphasis on the learners". He said that his preferred teaching style now was to "design activities that will engage children" (Interview 2), saying that the learners enjoyed the lessons when he used pair and group work. Fezeka said that she had begun to allow her learners to work independently giving her learners time to discuss the mathematics, introduced mathematical games and encouraged her learners to make their own resources.

Zintle gave concrete examples of changes in her own teaching practice. One example she gave was the use of a 100 grid to teach prime numbers, saying "I used the 100 grid I learnt using the multiples" (Interview 2). Another example related to teaching about 2D shapes, saying that "before, I was using the telling method that was taught to me. It was when I came to [the courses] that I began to let the learners discover you make them draw the shape and see the properties of the 2D shape" (Interview 2).

These examples demonstrate a shift from teacher-led lessons to transferring ownership of learning to the learners and can be seen as meeting the British Council's levels of engagement and integration. However, there is no way of knowing the extent to which their teaching reflects our visions of learner-centred teaching (cf. Cohen, 1990) but some of the examples they gave convinced us that they knew something of what learner-centred teaching looked like; it is likely that they learnt this through the modelling approach adopted on our course. It might be interesting in a follow-up study to observe these teachers in their classrooms to help us understand to what extent their practice fits with the course's expectations.

While general and more specific changes in the participants' practice were reported, little mention was made of formative assessment, reference to curriculum documents or to lesson planning. These omissions reflect the omissions reported in the 'personal' subsection and are, in that sense, unsurprising but still disappointing given the explicit attention they were given within the professional development courses.

Cultural/social

Cultural and/or social outcomes are the sorts of changes that involve working collaboratively with other teachers in schools; for example sharing practice.

The comments from the participants with regard to sharing approaches to teaching and learning mathematics with other colleagues in the schools were mixed. Fezeka and Wilfred were positive and it seems that they were able to introduce some of their new teaching strategies into their schools. Fezeka said that the teachers in her school ‘loved the strategies’ she used in her teaching. Wilfred stated that he shared the new ideas with the teachers at his school. He explained that many of the teachers asked him how to approach a topic in mathematics that they found challenging in the classroom, saying that he drew from his experience at the course. Gift was more cautious. He stated that ‘ideas are spreading in the school but there is tough resistance amongst teachers’ (Interview 2). Notwithstanding Gift’s caution, we believe that the fact that colleagues in school appear to recognise that the research participants’ practice had changed adds some weight to our claim that there had been a change in their practice and thus that they were reaching at least the level of engagement, if not integration, in the British Council’s levels of change. In other words, they appeared to be trying out the approaches they had learned about, and were perhaps moving towards embedding them in their teaching. However, from the accounts of the participants, it appears that the interactions involving school colleagues were more about the participants suggesting ideas to their colleagues than collaboration; there is little evidence of the sorts of changes suggested by King and Bell and Gilbert, in terms of social or cultural interactions. Nevertheless, we believe the interactions described are valuable and important.

Neither King nor Bell and Gilbert mention promotion or taking leadership roles as an outcome of professional development. However, we consider that this could be an important outcome of participation in a professional development course or programme. Our data provides some examples.

Fezeka was promoted to head of department after her first year of the ACE course. She suggested that this promotion was because of her involvement with the course and her work towards the ACE qualification. She said that her leadership and management skills at school, in her role as a head of department, had improved which she appeared to attribute to the planning and delivery of the workshops.

Wilfred and Zintle had already been in leadership positions when they started the ACE course. Both reported that their leadership styles had changed. Wilfred stated that as a principal he now encouraged his staff to “try new things, new strategies, new styles” (Interview 1) and he led by example in his own teaching. Wilfred stated that he learnt to respect others more; he had adopted a “new leadership style” because he saw the value in learning from others. Zintle explained that she began to take on the role of a mentor after she realised that her role was to facilitate the sharing of teaching strategies amongst the teachers.

The participants’ reports referring to leadership-related outcomes suggest that for three of the four, there had been some changes: Fezeka’s promotion and improvements in both her own and the other two’s leadership style. It seems that some learning outcomes related to leadership can be attributed to the requirement of the TLE to run workshops. There was nothing further in the course to explicitly address leadership skills. However, it is likely that teachers who voluntarily attend courses such as ours will want to lead, and want to lead well; it could be that Wilfred and Zintle learnt about leadership from the example of our tutors. Further, as the literature suggests (Geldenhuys & Oosthuizen, 2015), some teachers choose to take part in professional

development to develop their leadership skills and because they think it may lead to a promotion: this seemed to be the case for our research participants.

In a final two examples, Fezeke explained that the teachers who participated in the TLE workshops recommended her as an expert to the subject advisor who then asked her to lead content gap sessions on her behalf. She said that she now regularly worked alongside her subject advisor to lead on the professional development of teachers in the district. Wilfred reported that the district officials chose him, as a consequence of attending the courses, to set a common paper for the learners because they ‘believed he had the expertise’ (Interview 2). These opportunities could be seen as a long term outcome from their participation in the professional development courses, which is not, in our view, captured by the categories ‘social’ and ‘cultural’. These examples, and the ones above concerning suggesting ideas and developing leadership, might be better captured by the term ‘community’ outcome.

All the participants appeared to be keen for more teachers to engage with the courses, with Gift stating, for example, ‘if teachers want to improve teaching then they should take the course’ (Interview 1). Wilfred said that he wanted to share what he had learnt with the teachers in the district. He explained that he first practised the strategies at his school, with his colleagues, before he tried sharing ideas with other teachers in the district. Likewise, Fezeke reported that she saw the TLE workshops as an opportunity to share the skills with teachers from neighbouring schools. Zintle became ‘a class monitor and peer-mentor to others’ during the second year of the ACE course followed by a piloting mentoring programme she initiated in two circuits (each with 30 schools). She explained that a main focus of the mentoring programme was to instil the teaching strategies she had learnt during the MT and ACE courses. She said she was ‘looking forward to recruit more teachers and maths specialists to join the programme so to improve the maths performance’ (Interview 2). We think this is important because it suggests clearly that these teachers perceived significant benefit in taking part in the courses.

Conclusions

This paper aimed to reveal and understand the longer-term benefits to teachers who experienced the MT course and the ACE course. We used a framework with three main categories to organise the data: personal, professional and cultural/social. Further sub-categories emerged from the data, summarised in Figure 1 below. We believe that these categories and sub-categories provide a useful way of framing an understanding of longer term outcomes from professional development, which pay attention not only to the participant’s learning and changes in classroom practice, but also to their wider development as professionals.

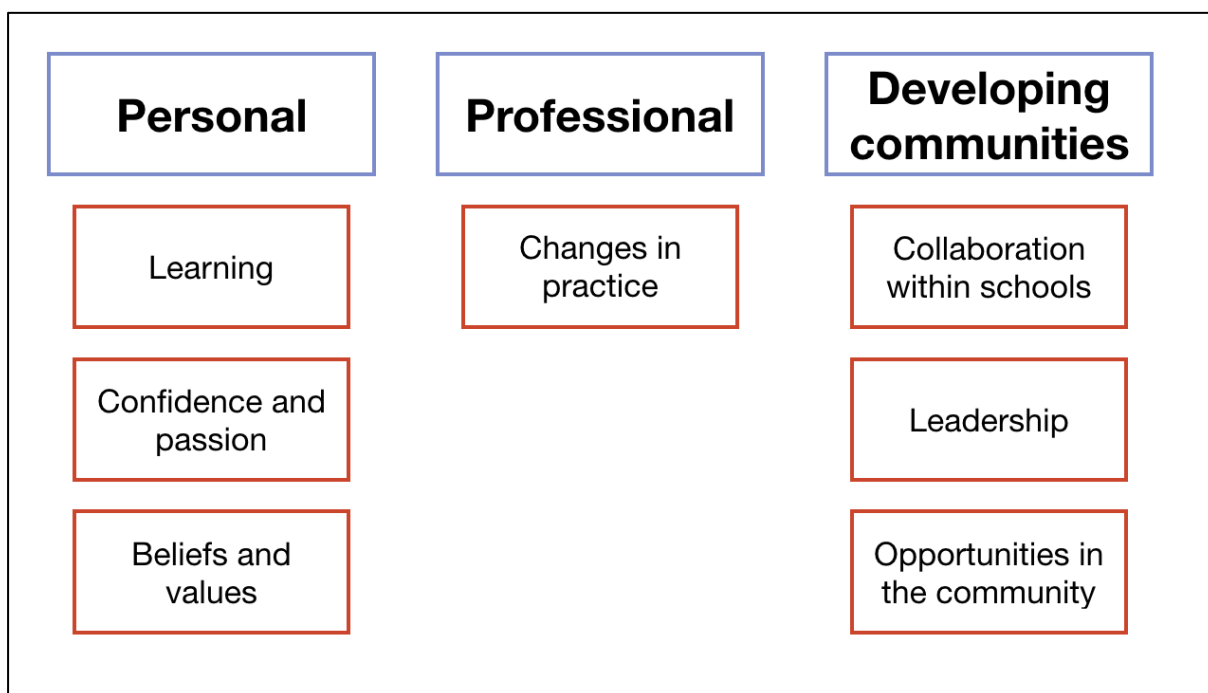


Figure 1: Summary of findings

All the participants provided evidence of changes in their knowledge, attitudes and practice, sometimes with concrete examples. We are confident in claiming that they gained and sustained benefits. To some extent, this claim is further supported by the strong recommendation from the participants that other teachers also take the course is perhaps the most important finding as it suggests the extent and quality of the perceived benefits gained by these four experienced professionals.

There is some indication in what they said that they were continuing to learn, as they observed what happened in the classrooms in which they were assisting. It is also likely that they would find it difficult to work out which learning came from which aspect of the two courses they had completed, or if their learning was enhanced by their attendance as TAs. On the whole they did not attempt to unpick how their learning had happened, even when asked. While understanding this is important for us in further developing professional development courses, it is not the topic of this paper and in a sense it does not matter for now. What matters is that for these four teachers, there seems to have been significant professional and personal growth to some extent at least as a result of participating in the mathematics professional courses. It might be interesting to observe these teachers working in their classrooms or with other teachers to help us understand what their current practice looks like.

In addition to not unpicking how learning had happened, the analysis of our data has revealed several other potential aspects of learning about which the participants did not make comments, such as the learning of mathematics, the curriculum and planning. We would argue that unpicking how learning has happened is difficult and requires deep reflective thought; but reporting on the learning of mathematics, the curriculum and planning should not be difficult and a question remains about why they did not mention these.

Finally, we return to our comment that we believe in the importance of taking into account each teacher's response to professional development on both personal and professional levels; and

in particular their ongoing professional experience. In our research, we attempted to understand the overall ongoing professional experience of four teachers who took part first in the MT course and then in the ACE course. We believe that we have been able to demonstrate that these four individuals experienced sustained and important personal and professional growth and while there is little evidence of growth in the cultural or social aspect of professional development, there are community outcomes. Future work in professional development with similar research questions to ours might test this extension of the frameworks of King and Bell and Gilbert.

References

- Adler, J., & Davis, Z. (2006). Opening Another Black Box: Researching Mathematics for Teaching in Teacher Education Mathematics knowledge. *Journal for Research in Mathematics Education*, 37(4), 270–296.
- Bansilal, S., & Rosenberg, T. (2011). South African rural teachers' reflections on their problems of practice: Taking modest steps in professional development. *Mathematics Education Research Journal*, 23(2), 107–127.
- Bell, B., & Gilbert, J. (2005). *Teacher development: A model from science education*. London: Routledge.
- Bolam, R. (2007). Emerging Policy Trends : some implications for continuing professional development. *Journal of In-Service Education*, 26(2), 267–280.
- British Council. (2015). *Continuing Professional Development (CPD) Framework for Teachers*. London. Retrieved from <https://www.teachingenglish.org.uk/teacher-development/continuing-professional-development>
- Clarke, D., & Hollingsworth, H. (2002). Elaborating a model of teacher professional growth'. *Teaching and Teacher Education*, 18(8), 947–967.
- Cohen, D. K. (1990). A revolution in one classroom: The case of Mrs. Oublier. *Educational Evaluation and Policy Analysis*, 3(12), 311–329.
- Cresswell, J. W. (2014). *Research Design - Qualitative, Quantitative, and Mixed Methods Approaches* (4th ed.). London: SAGE.
- Davies, R., & Preston, M. (2002). An evaluation of the impact of continuing professional development on personal and professional lives. *Journal of In-Service Education*, 28(2), 231–254.
- Geldenhuis, J. L., & Oosthuizen, L. C. (2015). Challenges influencing teachers' involvement in continuous professional development: A South African perspective. *Teaching and Teacher Education*, 51, 203–212.
- Goodall, J., Day, C., Lindsay, G., Muijs, D., & Harris, A. (2005). *Evaluating the Impact of Continuing Professional Development (CPD)*. London: Department for Education and Skills.
- John-Steiner, V., & Mahn, H. (1996). Sociocultural approaches to learning and development: A Vygotskian framework. *Educational Psychologist*, 31(3/4), 191–206.
- King, F. (2014). Evaluating the impact of teacher professional development: an evidence-based framework. *Professional Development in Education*, 40(1), 89–111.
- Long, C., Graven, M., Sayed, Y., & Lampen, E. (2017). Enabling and Constraining Conditions of Professional Teacher Agency: The South African Context. *Contemporary Education Dialogue*, 14(1), 5–21.
- Maserow, J. (Ed.) (2015). *Taking Equal Education into the Classroom*. Khayelitsha, South Africa: Equal Education.
- Mji, A., & Makgato, M. (2006). Factors associated with high school learners' poor performance : a spotlight on mathematics and physical science. *South African Journal of Education*, 26(2), 253–266.
- Pournara, C., Hodgen, J., Adler, J., & Pillay, V. (2015). Can improving teachers' knowledge of mathematics lead to gains in learners' attainment in Mathematics? *South African Journal*

- of Education*, 35(3).
- Roulston, K., Legette, R., Deloach, M., & Pitman, C. B. (2005). What is 'research' for teacher-researchers? *Educational Action Research*, 13(2), 169–190.
- Saunders, R. (2012). Assessment of Professional Development for Teachers in the Vocational Education and Training Sector: An Examination of the Concerns Based Adoption Model. *Australian Journal of Education*, 56(2), 182–204.
- Swan, M. (2008). A Designer Speaks : Malcolm Swan Designing a Multiple Representation Learning Experience in Secondary Algebra. *Journal of the International Society for Design and Development in Education*, 1, 1–17.
- Vygotsky, L. S. (1986). *Thought and language* (rev. ed.). Cambridge, MA: MIT Press.
- Zeichner, K. M. (2006). Teacher research as professional development P – 12 educators in the USA. *Educational Action Research*, 11(2), 37–41.