

Teacher Learning as Changing Meaning, Practice, Community, Identity and Confidence: the Story of Ivan

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This article arises from a broader study that investigates mathematics teacher learning in relation to teachers' participation in a two-year In-Service Education and Training (INSET) programme, structured to enhance participation in a community of practice, in the context of current South African curriculum change. The broader study focused on explaining the learning mechanisms by which teachers become professional, competent mathematics teachers (able to tackle curriculum change) through participation in an INSET community of practice that overlaps with a wide range of other professionally associated communities (such as the school communities and professional associations).

By means of rich and textured vignettes and quotations, the study illustrated that in-service teacher learning involves the complex intersection of various components of learning identified by Wenger (1998), namely: meaning, practice, identity and community. However, the study revealed a fifth important component of learning, one not considered by Wenger, namely that of confidence.

In this article, I provide a vignette of Ivan (one of the fourteen teachers who participated in the two-year in-service programme). In it, I have used Wenger's four categories of learning (meaning, practice, identity and community) to structure and to organise the data I gathered in relation to Ivan's learning to become a professional, confident mathematics educator. Through the vignette of Ivan we see the importance of confidence as a possible fifth component of learning.

Wenger's (1998) model of learning

Wenger's (1998) book *Communities of Practice: Learning, Meaning, and Identity* provides a theory of learning in which the primary unit of analysis is neither the individual nor social institutions but 'communities of practice'. The account systematically explores the intersection of four learning components – community, practice, meaning and identity – which provide a conceptual framework for analysing learning as social participation.

This work continues from his earlier work with Lave (see Lave and Wenger, 1991). In the introduction to this book, Wenger acknowledges the achievements of his earlier work with Lave, but notes that the central concepts of identity and community of practice, while central to their work, "were not given the spotlight and were left largely unanalysed" (p. 12). here he tells us he has "used them as the main entry points into a social theory of learning" (p.12).

Wenger goes on to explain that communities of practice are everywhere and because they are so informal and pervasive they are rarely focused upon. Focusing on them

allows us to deepen, expand and rethink our intuitions. He relates communities of practice to the four learning components as follows.

On the one hand, a community of practice is a living context that can give newcomers access to competence and also invite a personal experience of engagement by which to incorporate that competence into an identity of participation. [...] On the other hand, a well-functioning community of practice is a good context to explore radically new insights without becoming fools or stuck in some dead end. A history of mutual engagement around a joint enterprise is an ideal context for this kind of leading-edge learning, which requires a strong bond of communal competence along with a deep respect for the particularity of experience. When these conditions are in place, communities of practice are a privileged locus for the *creation* of knowledge. (p. 214)

Furthermore, Wenger emphasises that learning is inevitable, since failing to learn something involves learning something else. However, he adds that reflection on learning, despite its inevitability, is important because:

We wish to cause learning, to take charge of it, direct it, accelerate it. [...] Therefore our perspectives on learning matter (p. 9)

Wenger's work on learning resonated with many of my commonsense assumptions of learning and I too was compelled to reflect more systematically on these assumptions, since I was directly involved in 'taking charge of' the learning of teachers.

In his book, Wenger defines his four learning components as follows:

- *meaning* is a way of talking about our ability to experience the world as meaningful;
- *practice* is a way of talking about shared historical and social resources, frameworks and perspectives that sustain mutual engagement in action;
- *community* is a way of talking about the social configurations in which our enterprise is defined and our participation is recognisable as competence;
- *identity* is a way of talking about how learning changes who we are.

He summarises this framework in the following diagram:



Figure 1: Components of a social theory of learning – an initial inventory (Wenger, 1998, p. 5)

Wenger then notes that the elements are:

deeply interconnected and mutually defining [... one could] switch any of the four peripheral components with learning, place it in the centre as the primary focus, and the figure would still make sense. (p. 5)

It was the simplicity of this four-component ‘model’, its ability to capture the complexity of learning through the interconnectedness of the components, and its provision of a structuring framework for a social theory of learning that I was most attracted to as a structuring device for analysing teacher learning.

The context of the study

South Africa is currently embarking on radical educational reforms. Educational change has been stimulated by the major political changes, which occurred in the country during the 1990s. A new curriculum, premised on a learner-centred, outcomes-based approach to education, was launched in 1997. Key principles include integration, relevance, learner-orientation, flexibility and critical creative thinking (NDE, 1997a).

The empirical field for the study was an in-service mathematics teacher education project called the Programme for Leader Educators in Senior-Phase Mathematics Education (PLESME). PLESME was developed in order to create leader teachers in mathematics with the capacity to interpret, critique and implement current curriculum innovations in mathematics education in South Africa. Other major aims included enabling and fostering collegial and co-operative ways of working with other mathematics teachers and district advisors and furthering mathematical skills and knowledge necessary for implementing curriculum developments.

Assessment was portfolio-based. Portfolios included, for example, conference presentations, materials designed by teachers, input on developing curriculum documents and classroom videos. PLESME worked with fourteen teachers from schools in Soweto and Eldorado Park (both urban townships outside Johannesburg) over a two-year period.

The study drew on a range of qualitative methods with their roots in case-study research, grounded research and ethnography. In the research, I adopted the dual role of both researcher and co-ordinator of the INSET programme and

thus was both ‘observer as participant’ and ‘participant observer’ (Merriam, 1998). The vignette of Ivan is constructed from three sets of interviews, questionnaires and classroom observations conducted at different points over the two-year period.

Narrative vignettes could have been constructed for each of the participating teachers and these would demonstrate similar changes. In other words, all teachers provided evidence of *increased*: ownership of ‘new’ ways of talking about teaching and the new curriculum; use of learner-centred methodologies and engagement with mathematical meaning; participation in a wide range of education activities; status and personal identity as a competent professional; and confidence (Graven, 2002). Of course, this is not to say that all the stories would be the same and, indeed, the data reveal many differences in the speed and nature of change between teachers in these areas. Ivan’s vignette exemplifies the nature and complexity of PLESME teachers’ learning.

A narrative vignette of Ivan

Ivan teaches mathematics and science at a primary school in Soweto (an urban township outside Johannesburg). In ‘township’ schools (such as Ivan’s), repeating after teachers (chanting) and rote learning was common practice. It was also common for learners and teachers to treat resources such as textbooks and writing books as precious commodities only to be used under strict supervision and only for ‘neat’ work. Such work often involved copying definitions or examples from the board. In general, there was both a lack of resources and an under-use of available resources (Vinjevold, 1999).

Ivan had no formal teacher training and had not studied mathematics since school (he studied commercial mathematics at school). He had instead studied for a Diploma in Information Technology. Like most South African teachers of mathematics, Ivan became a mathematics teacher not through choice but as a result of the serious shortage of mathematics teachers. Currently in South Africa 50 percent of the teachers of mathematics have less than a Grade 12 mathematics qualification (Kahn, 2001). Thus, while Ivan was a *teacher of mathematics*, he had not studied nor intended to become a *mathematics teacher*. At the start of 1999, Ivan had been teaching mathematics for nine years and was intending to leave teaching shortly to work in computers.

Meaning: learning as (changing) experience

In this part of the vignette, I provide an illustration of Ivan’s learning as changing experience and changing understanding of the new curriculum as meaningful. At the start of 1999, Ivan explained that he was insecure about the new curriculum but was still open to learning about it.

MG:[1] What are your views on the new curriculum?

Ivan: The new curriculum basically I am not just yet conversant with it because they have started with the smaller grades so I am not as yet sure about it, but all I have heard is that it basically is that the teacher facilitates the learning right, but it

doesn't mean the children are blank, but you should take their background into cognisance [...] Like I said, I don't know much about it, I am still waiting to be trained. I am still open-minded about it, but if the policy states that no child fails or something like that then I don't know.

The final sentence of the above quotation shows that while Ivan is open to the curriculum change, he is concerned about how it will impact on the assessment of learners. Some curriculum support documents issued by the National Department of Education indicated that 'there will be no passing or failing' (NDE, 1997b, p. 19). With pressure on schools to ensure good results in the external grade 12 examinations, and with a focus by district advisors on common external assessments, Ivan's concern is understandable.

While Ivan identified with the political aims of the new curriculum, he was unable to make mathematical sense of what some of them meant.

MG: So specific outcome three says that learners must be able to demonstrate understanding of the historical development of mathematics in various social and cultural contexts and the fourth one says that learners must be able to critically analyse how maths relationships are used in social, political and economic relations and the eighth one says that learners should be able to analyse natural forms, cultural products and processes as representations of shape, space and time. [...] When you read that what do you think or feel about them?

Ivan: I think it is basically an attempt to link mathematics to what children can relate to, in their past, their present and what they could expect, something like that. I think in a way it is attempting to make the mathematics real to children in having to analyse relationships using social and economics I would say, political I am not sure if they could relate to that yet. Historical development and cultural context I think they are objects which culturally they can link up with their shape, geometric sense or mathematical sense. I think it is good in that sense.

The views expressed by Ivan reflect the broader context of political change and the difficulties of implementing the new curriculum. Ivan's support for the political motives behind Outcomes 3, 4 and 8 are clear, but it is equally clear that he has had little support in making sense of them and is stifled by the "complex and voluminous terminology" (Jansen, 1999, p. 9).

Six months later, in a second interview, Ivan no longer made statements of insecurity in relation to talking about or making sense of the new curriculum. In talking about the new outcomes, Ivan provided some examples of what they meant for mathematics teaching. For example, in relation to Specific Outcome 8, Ivan responded as follows.

Ivan: If it's a cultural product I'm thinking of the art

form you know. The art form in terms of calabashes, I think the shapes. The Ndebeles how they paint them I think there is a pattern that they follow there (*inaudible*) like the Zulu, like the necklace, like the numbers when a man meets a woman, a woman returns her love by putting something on a man. Those colours they speak they follow a certain pattern. Aah, shape, space and time, I learnt the sun, the older people they look at the sun and they can tell you approximately what time of the day it is and stuff like that. And then shape, some other cultural products you can tell from which nation they are from by looking at their art you know the art expresses an integral part of the culture. [...] The pattern of flowers, that kind of thing. Also in listening to music there is a pattern, you find out that maybe after so long the beat comes again, after so long the beat comes again, I think it is cultural as well. Even poems, music, and so on, has a kind of pattern. Geographically, the sun, the moon, the sun taking so many days revolving, the moon, it's a pattern, it's time. Scientifically, I also learnt that, I learnt that in Standard 8 in a Science book they used an echo - if it bounces back they can tell how deep is the ocean. I am trying to remember that. It bounces back and they can tell how deep is the ocean, and so forth. (Ivan interview, June 1999)

Ivan provided a range of examples in the above explanation. These examples are drawn from Ivan's experiences (for example, his experience of learning Science at school) and a range of resources that became available to Ivan through his participation in the PLESME community of practice. Ivan continued to provide concrete examples in his explanations of the outcomes and the curriculum in later interviews. His changing way of talking about the outcomes is indicative of his changing experience of the outcomes as meaningful.

Practice: learning as (changing) doing

In this part of the vignette, I provide an illustration of Ivan's learning as changing practice - I especially focus on his changing classroom practices. Ivan explained his changing classroom practice as follows.

I think I've now managed to hold their [learners] interest sometimes they are not even aware when times up, you will hear the next teacher knocking on door. Yaah, it means that the lesson was interesting. Many ideas now come to mind how one can approach a lesson. If one approach fails, you think of the next. (Ivan interview, June, 1999)

In the same interview, Ivan explained how his access to intellectual resources such as knowledge of theories of learning, critical reflection of his teaching practices and an increased repertoire of approaches to lessons and learner-centred practices made his teaching experience "to be quite challenging". By November 1999, Ivan's increase in

confidence in relation to the new curriculum and teaching was evident. He now described his teaching as an “exciting experience” and explained that some approaches that he had not used before were now an “integral part” of his lessons.

The teaching has become more exciting for both my pupils and myself. [...] There are various forms of approaches that I have overlooked and some which I didn't know of, but which now form an integral part of my lesson approach: for instance, the use of newspapers in Mathematics; involving pupils in different activities in order to achieve different outcomes. (Ivan questionnaire, November 1999)

These quotations point to links between Ivan's changing understanding and ability to make *meaning* of new curriculum ideas and his changing teaching *practice*. Similarly, in the questionnaire of July 2000, Ivan explained that his participation in the PLESME community “makes teaching to be an exciting experience, it offers different perspectives and new approaches to mathematics”. He explained this difference in his classroom practice by talking about his increased confidence and his changed identity/image in relation to his learners and parents.

I have more confidence in presenting the subject and in asking questions that are exciting to pupils. The children love my subject because it is not monotonous, they always look forward to my next period. When children tell you that they enjoy your subject and their results are improving and you also get positive feedback from the parents, it is very encouraging. (Ivan questionnaire, July 2000)

These *stated* changes in classroom practice, in terms of a broader repertoire of approaches to teaching, more learner-centred practices and Ivan's increased confidence, are supported by classroom observations conducted at three different points throughout the INSET. Video recordings, observation schedules and detailed notes were taken of each of the lessons. All three observations were of Grade 7 classes.

It is beyond the scope of this article to provide transcripts from lessons. However, I will provide a brief summary of the primary observed changes in Ivan's teaching practice from the first observed lesson to the final observed lesson, eighteen months later. In the discussion, I use Cuban's (1993) notion of 'learner-centred' versus 'teacher-centred' practices as a tool for describing some of the changes in relation to style and methods of classroom practice. According to Cuban, the following features are indicators of the two practices.

Indicators of teacher-centred practices	Indicators of learner-centred practices
teacher talk exceeds learner talk instruction is frequently whole class use of class time is largely determined by the teacher the teacher relies heavily on the textbook. the class arrangement is typically rows of desks facing the board	learner talk exceeds or equals teacher talk most instruction is individual or small group learners help choose the content to be learnt learners determine partially or wholly the rules of behavior there is a use of varied instructional materials the classroom arrangement permits learners to work together

Mathematically, the first lesson dealt superficially with naming various four-sided shapes and some of their properties. There was no mathematical challenge in the lesson, but rather a recall of what learners knew. The style of the lesson was highly teacher-centred. Ivan controlled all interaction. There was no opportunity for learners to work independently or to engage in discussion with one another. Learner activity involved repeating after the teacher, responding to teacher questions (which usually required brief answers involving factual recall), yes or no answers or pointing to what learners saw. There was no written learner activity in the lesson nor in the form of homework.

Engagement with learner answers occurred only when answers were 'correct'. Ivan occasionally asked learners why they gave the answer they did and simplistic explanations would suffice (for example, Ivan: “Why do you say it's a rectangle?” Learner's answer: “Because the two opposite sides are equal”). There was a notable absence of questions requiring learners to explain their understanding, an absence of challenging questions and an absence of dealing with learners' 'incorrect' answers.

When learner answers were seen by Ivan to be incorrect, Ivan communicated this to learners and asked other learners to provide 'correct' answers. Thus, learner meanings, in cases where they were different from Ivan's, were not dealt with. All learner activity involved responding to Ivan in whole-class interactions.

In contrast, by the second and third observed lessons (seven and thirteen months later), movement towards more learner-centred practices and more engagement with mathematical concepts and learner meanings was evident. This changing practice reflected Ivan's changing understanding (meaning) of new curriculum ideas; his changing roles and identity as a teacher (he became more of a learning mediator), his changing relations with learners in his classroom community and his growing confidence in each of the above.

Ivan's second observed lesson involved using fractions, percentages and decimals to solve various problems related to buying clothing, budgeting and comparing test performances. Ivan began the lesson by getting learners to say what they know about percentages. He put a jersey on the board with a price tag of R200 and wrote “75% off”. He calculated (with learners following the calculations on the board and sometimes coming up to the board and to do the calculations) the percentage discounts and final selling price of this and other items. Ivan asked learners to estimate what they could buy with R100 given the discounts on a range of clothing items.

After working out some simple percentage discounts (such as 75% of R200), Ivan got learners to calculate 25% of R33. The calculations of this question forced learners to interpret, in context, the meaning of a remainder: that is, when a learner did the calculation at the board he got 25% of R33 = 8 remainder 1. The learners did not know what the 1 meant. Ivan pushed learners through a series of questions to figure out what this '1' meant. Once learners knew it was '1 quarter of a Rand', Ivan explained that while a quarter of a Rand is correct, it does not make sense in the context of money. He pushed learners to then convert one-quarter of R1

to a decimal. One learner suggested that $1/4 = 0.4$. Ivan dealt with this misconception by getting the learner to do the division of 1 by 4 to see that this is not the case. Ivan explored some of the links between fractions, percentages and decimals: that is, that 25% of R33 = R8 $1/4 = R8.25$.

Ivan went on to put a table of a fictitious family's monthly budget on the board. He asked learners a range of straightforward questions to be answered from the table. For example, he asked learners if R2000 was sufficient to cover the budget. From this, he continued with the main focus of his lesson, working with percentages. He got learners to derive the fraction that each item on the budget represented and to convert these fractions to percentages. Ivan did not show the learners how to do this, but rather had a learner to come up to the board to do it. He guided the learner with questions and tips at the board, and encouraged the learner to explain to the class what he was doing. At the end of the lesson, Ivan discussed other everyday contexts in which learners could apply the skills they learnt in the lesson.

The lesson involved converting among fractions, decimals and percentages and Ivan made an effort to integrate these with familiar real-life contexts. He engaged with these three concepts in a way that connected them to each other and to problem solving and maintained his mathematical focus and the mathematical goals of the lesson were much clearer than for the first observed lesson.

While one would not necessarily describe Ivan's second lesson as typically 'learner-centred', there was a clear move from Ivan's first observed lesson towards *more* learner-centred practices. In this lesson, Ivan allowed learners to do mathematical calculations for themselves rather than have them merely watching, following and responding to Ivan's demonstration. He encouraged learners to do the problems themselves and not just watch those at the board doing them. Many learners were actively involved in doing calculations themselves (either at the board or, for a few learners, at their desks), although many learners were still passively watching.

Ivan took more of a guiding role with learners rather than showing and telling all. He tended to get learners to explain their meanings and made an effort to engage with these meanings. Ivan regularly asked learners why they gave the answer they did and encouraged learners to show their methods (at the board) and to explain their thinking. Eliciting learner explanations now seemed to be part of everyday classroom practice since learners at the board were quite comfortable in explaining what they were doing. Other changed practices in the lesson, indicating *movement* toward more learner-centred teaching, included more learner talk and some individual interaction between Ivan and learners.

Despite these shifts, for many learners activity was restricted to responding to questions in whole-class interactions and to watching other learners solve problems at the board. In other words, only some learners followed Ivan's encouragement to work on the problems themselves at their desks. The absence of learner activity in terms of *doing* written mathematics in their books seemed to be typical of other lessons, evidenced by the fact that little written mathematics was found in learner books and by learners not taking out their books at the start of the lesson. Furthermore, at this point learners did not have textbooks, which meant

that giving homework was problematic.

Ivan's third observed lesson showed continued movement towards more learner-centred practices (i.e. less teacher talk, more working with learner meanings and more working with learners individually), but the main shift from the second observation was the substantial increase in individual learner activity. This was evidenced by the fact that a large portion of Ivan's third lesson involved *all* learners doing written mathematics in their books. The lesson began with all learners taking out both their mathematics workbooks and their textbooks. It seemed clear this was now standard practice for lessons.

The mathematical focus was the division of fractions and reconciling learnt methods with visual (from the chart) methods. The lesson progressed from division of simple, well-known fractions that were easily solved and verified with reference to the more complicated fractions that involved mixed numbers which could not be easily done using the chart. To verify such answers, Ivan resorted to another method (checking by addition). In this way, he drew learners' attention to the connection between division of fractions and addition of fractions. For example, he challenged learners to prove (using addition) that $2\frac{1}{4} + 1\frac{1}{8} = 2$.

The primary change in the style of this lesson was the inclusion of class-work and homework and the increase in the time Ivan spent working individually with learners (about 40% of the lesson). Class-work and working from textbooks was clearly part of a typical lesson, as evidenced by learners taking out both class-work books and textbooks at the start of the lesson. In both previous observed lessons, many learners had nothing on their desks and where learners had books on their desks they were often closed. Ivan's style of working with learners individually involved asking learners questions to help them find their errors and to give Ivan insight into their misconception. The desks were arranged in groups so as to facilitate group work and learners working together (whereas in the previous lessons individual desks were paired in rows of two).

It is important that Ivan's movement towards more learner-centred practices be interpreted contextually against the background of dominant teaching practices within 'township' schools such as the ones Ivan taught in. Ivan's trajectory in terms of changing practices was clearly shaped and framed by the changing context within which he was working: that is, at the start of 1999, textbooks relating to the new curriculum were not available at Ivan's school, and textbooks relating to the previous curriculum were scarce.

In this respect, Ivan's use of textbooks was likely a central factor in Ivan's increased confidence, clarity of direction in the lesson, mathematical focus and individual learner activity. Thus, while for Cuban (1993) heavy reliance on a textbook is usually interpreted as an indicator of teacher-centred practices, Ivan's use of textbooks (to plan the lesson and to provide individual learner work) resulted in more learner activity. The textbooks supported learners in doing mathematics themselves (allowing more time for Ivan to evaluate and mediate learning individually). The absence of textbooks in the first two observed lessons seemed to result in less logically structured lessons, evidence of a range of misconceptions in relation to the mathematical content of

lessons, an over-reliance on teacher talk and limited written work on the part of learners.

These observed changes in classroom practice concur with Ivan's own explanation of his changing practices and his growing confidence in mathematics teaching. In Wenger's terms, Ivan's learning as changing practice is evidenced by more learner-centred teaching practices in the mathematics classroom. These changing practices can be seen as both a result of Ivan's learning and a part of the process of his continued learning.

Identity: learning as (changing) becoming

In a reflection session on Ivan's second observed lesson, Ivan explained that his participation in and with the PLESME community had changed the way he was perceived in his community and provided him with a level of 'expert' status. He explained how this contributed to his being offered the Head of Department position at his current school and that a group of publishers approached him to become involved in working on a primary school mathematics text book.

Furthermore, Ivan explained that the previous year he was thinking of leaving teaching but that he was now 're-motivated'. In the final interview, Ivan noted that he might be interested in studying further: "you yourself appreciate the subject and dig deeper or do further studies". (Ivan interview, November, 2000). The emergence of a stronger identification with mathematics teaching as a long-term career (as evidenced by Ivan's choice to stay in the profession and possibly study further in mathematics education) indicates the development of a stronger identity as a mathematics teacher.

In the questionnaire at the end of the first year of participation in PLESME (November, 1999), Ivan explained that he had become involved in a wide range of new activities. For example, he had been to a teacher centre (that he first visited during a PLESME field trip) to find appropriate textbooks and learner materials for his school. He had shown these books to his colleagues and had recommended that they also attend the teacher centre in search of ideas and resources.

Ivan's participation (and status/identity) with others in his community had continued to increase. In July 2000, he explained how his relationship to other mathematics teachers had changed:

The colleagues have more confidence in me because I share with them the new information they refer other children... Teachers from other schools invite me to ask for solutions. (Ivan questionnaire, July, 2000)

Ivan continued in the questionnaire to say that he held regular meetings at his school and that he shared information with other teachers. He added that he was helping his school to launch a computer centre and had approached a teacher centre to provide software.

Ivan's increasing status in his school community and his developing identification with mathematics teaching as a long-term profession illustrates his learning in relation to the component of identity. The examples above reveal Ivan's

learning as 'becoming' a more active and noticed member of the community of mathematics teachers. The examples also illustrate close links between Ivan's changing practices, his increasing alignment and engagement with the PLESME community and his school community, his changing identity (by others and his identification of himself as someone who wants to remain a mathematics teacher) and his increasing confidence.

Community: learning as (changing) belonging

Ivan's changing practices (discussed above) illustrate a changing alignment by Ivan with respect to various communities related to his being a mathematics teacher. We have already seen evidence of Ivan's changing relations with his learners (i.e. his classroom community), his changing status with his principal (who offered him the 'Head of Department' job) and with fellow teachers both in his school and neighbouring schools (his school community).

In addition, there was an increase in Ivan's alignment and engagement with the PLESME community. Over time, Ivan's perception of the role of presenters and other teachers in the PLESME community changed. In June 1999, he explained their role as 'inspiring'.

Ivan: I think they're [presenters] inspiring, their love for the subject I think it rubs off, in terms of how they present the subject, their confidence, one wants to emulate that, and the new ideas that they bring and also from different experiences that you have drawn from other teachers, your colleagues like us, so it's sort of an eye-opener to realise that oh some people approach this thing this way how do I relate to that, how would I have approached it, or maybe it's a similar experience to mine only to find that I had approached it differently, but if I had done it that way I would have coped better. Like that example you gave of that child, huh? They were given money to divide it

MG: Yes. Oh, Karabo. [2]

Ivan: Ya, ya, Karabo, ya, ya. It was eye-opening, Karabo's experience. In that particular instance going from other's experiences, it was quite inspiring. (Ivan interview, June, 1999)

In June 1999, Ivan explained the role of other PLESME teachers in assisting his learning as 'nice'. "So bringing in teachers from different schools, *it's nice*." (Ivan interview, June 1999) However, by November 1999 (one year into PLESME), Ivan noted sharing ideas with teachers from other schools as the first benefit of participating in PLESME: that is, he saw this as an important part of the PLESME practice and no longer simply a 'nice' aspect. Ivan wrote in response to a question about the benefits of participating in PLESME:

The PLESME programme is very eye-opening, in the sense that teachers of various schools and backgrounds are involved; this helps because we share different

ideas. The programme co-ordinators are very dedicated and they are also drawn from different fields of approach. (Ivan questionnaire, November, 1999)

Furthermore, Ivan described his working with teachers from Eldorado Park as an “exciting experience” and that sharing common problems had brought the teachers closer together. (Ivan interview, August, 2000) He explained how he was confident enough to ask a PLESME colleague to give a lesson to his learners on fun creative mathematics ideas, thus indicating his willingness to draw on the PLESME community for support. (Ivan interview, November, 2000)

Ivan’s alignment to various communities also included the professional mathematics teachers association: the Association for Mathematics Educators of South Africa (AMESA). He described his experience of his participation in the AMESA conference where he presented a paper as:

a very educational experience, learning different methods and exciting ideas from different educators from different places even from overseas. Meeting people who were so willing to share their ideas and exchanging telephones it was so fulfilling. (Ivan questionnaire, July, 2000)

In this way, Ivan extended his professional community from learners and colleagues at his school to including teachers from schools in other districts (most notably Eldorado Park teachers involved in PLESME), teacher educators from a range of organisations, educators in local district offices and teacher centres, and members of AMESA. It is important to note the importance of this extension in a post-apartheid era. Under apartheid, teachers in the then-African DET were cut off from teachers in other departments and were not permitted into national mathematics associations such as the Mathematics Association of South Africa, as this was reserved for ‘white’ teachers only.

The evidence above illustrates Ivan’s learning as a process and a result of changing ways of belonging and changing alignment to various education related communities.

Confidence: learning as (changing) mastery

In each of the four learning components discussed above, confidence emerged as either a result and/or an explanation of Ivan’s learning. In the final interview (November, 2000), Ivan himself explained the way in which his increased confidence related to his changing understanding, practices, identity and participation in communities. In this interview, teachers were asked to explain what they had meant by ‘confidence’ when they used it in response to questions in earlier interviews and questionnaires. Ivan responded as follows (various sentences numbered for subsequent reference):

Ivan: 1. By confidence, I mean the command of subject. Okay, the strategies in presenting the subject, the approach.

MG: 2. And what does it mean to be more confident at these?

Ivan: 3. I’m in a better position to can bring a child to appreciation of the subject, mastering the

subject, understanding the learning programs. Okay? And broadening the child’s understanding of the subject. [...]

4. You know personally when you are confident about the subject it is easier to impart it than when you are not sure. [...]

5. Even the children can pick it up.

6. You yourself appreciate the subject and dig deeper or do further studies.

7. Like I have given you the example that teachers are afraid because they have never done it [the new curriculum]. So it means you rise to the occasion.

8. Others have more confidence in me, they [teachers in his school and other schools] are asking me to set papers and evaluate theirs, so it means they have confidence in me.

9. Also interacting with other teachers, how Mr. Modise [his principal] came to support me and wanted me for his school, its how it comes about and interacting with other teachers, like knowing guys like Cedric, Karl [PLESME teachers].

10. Like, for instance, I was confident enough to invite Barry [a teacher in PLESME] to do this part of a lesson and the kids will enjoy it. I have confidence in myself for inviting him.

11. We are usually afraid to do this because it means admitting weakness. Confidence allows me not to have to know everything. (Ivan interview, November, 2000)

Comments 1 and 3 in the extract above illustrate a link between confidence and practice. In this respect, practice involves access to knowledge (and meaning) and an ability to use this knowledge to help learners understand mathematics. In other words, confidence enables Ivan to teach successfully.

Comments 4, 5, 6 and 7 illustrate a close link between confidence and Ivan’s identity. This is his identity as a mathematics teacher, one who: can teach with ease (4), is not afraid to take on new challenges and believes in his ability to rise to those challenges (7), has an interest in mathematics (6) and has learners who identify him as being more able (5).

Comments 8, 9 and 10 illustrate the connection between confidence and community. Community provides the support that encourages confidence (8-9) and community stimulates a change in practice in that Ivan has to take up new roles and practices in relation to that community (e.g. evaluating their papers). And this relates to a changing identity in that community as someone who has ‘expertise’ in these roles and practices. Similarly, comment 10 illustrates the relationship among confidence, community (support) and practice. Here, Ivan draws on a fellow teacher to do a

lesson for his class, a practice he has never used before.

Comment 11 captures Ivan's summary thoughts on confidence. Confidence allows him not to have to know everything. It indicates development in his identity towards someone who views himself as a life-long learner with the ability to gain access to resources for learning in changing situations. This resultant confidence, in a self-fulfilling cycle, results in further confidence. Ivan has developed confidence and therefore he knows he does not have to know everything *and* Ivan knows that he does not have to know everything in order to be competent. He therefore develops more confidence. Thus, confidence is both a product of Ivan's learning and a process of this learning.

What does Ivan's vignette and the broader study from which it comes offer Wenger's model?

A key challenge I faced in applying Wenger's four-component model of learning as a frame for the analysis of teacher learning in the broader research study related to the specificity of the profession of 'teaching'. Their focus on communities of practice led Lave and Wenger (1991) to challenge traditional forms of teaching.

Rather than a teacher/learner dyad, this points to a richly diverse field of essential actors and, with it, other forms of relationships of participation. (p. 56)

Indeed, their work does not deal with the notion of teaching at all. Wenger (1998) continues to undermine the value of teaching to the point that he asks: "How can we minimise teaching so as to maximise learning?" (p. 267). But as a teacher or teacher educator, one then has to ask: what does it mean to be a *teacher* when it is argued that the practice of *teaching* should be minimised?

Just as Wenger (1998) avoids the notion of a teacher or master (as was used in his 1991 work with Lave), he fails to engage with the notion of 'mastery'. As Ivan's story illustrates, 'mastery' of the profession of mathematics teaching is broader than mastering the practice of teaching learners mathematics, or in Wenger's terms, successfully organising a community of practice in which mathematics learning takes place. Mastery, in relation to becoming a professional mathematics teacher, involves becoming *confident* in relation to: one's professional knowledge and experiences, one's participation in professional activities, one's membership in a range of professionally related communities and one's identity as a professional mathematics teacher.

As in the story of Ivan, the use of the term 'confidence' had arisen sporadically throughout the data of the fourteen PLESME teachers. The frequency of the use of this term by teachers both to describe and explain their learning increased as time went by. This prompted further exploration and data gathering on the meaning of 'confidence'. [3]

Since Wenger (1998) appeared to have overlooked 'confidence' in his emergent perspective on learning, it begged further *grounded* exploration in relation to this study. Thus, in November 2000, three months after PLESME had ended, I interviewed all fourteen participating teachers on what they had meant by confidence in their earlier communications about their learning. The responses of the teachers

were categorised into seven different categories. It is beyond the scope of this article to discuss all of these categories in detail (see Graven, 2002); suffice it to say that the emergent categories were similar to those that surfaced in earlier interviews and questionnaires and that were illustrated in Ivan's story. The categories of confidence included: classroom practice, access to knowledge resources, access to community resources, confidence of others in teachers, increased participation, affective factors and understanding one's own limitations.

In this article, I want to focus on the latter category of confidence as 'understanding one's own limitations'. This category was captured in Ivan's explanation of his developing confidence as that which 'allows me not to have to know everything'. I focus on this category of confidence as it led me to argue that confidence cannot be simply subsumed within Wenger's four other components of learning but needs consideration in its own right. Other utterances by teachers that fell into this category included for example:

I can expose myself to what I know, I mean to other people and I am willing to say Okay fine, show me wrong, prove me wrong. What is your idea then? What I say is I am open let's learn. That is what that self-confidence is. (Karl)

And also knowing that if it doesn't work for this lesson I can change my method and try something else, it's not a matter of do it or die kind of thing. (Delia)

This category related confidence to understanding one's own limitations and viewing one's learning as a life-long process within the profession of mathematics teaching. This category of confidence is especially interesting in that it provides insight into the notion of confidence, in relation to learning, in its own right: that is, it relates confidence to learning to become a *confident* 'masterful' professional mathematics teacher.

The quotations in this category revealed a shift in teachers' understanding of their own learning and the nature of learning in general. This shift resonates with a Socratic philosophy of learning – that it is better to know that you do not know, than to think you do know – and that there is power in understanding one's own limitations. Ivan reveals in comment 10 that confidence enables him to accept that he does not have to know everything in order to be a competent professional mathematics teacher. In a dialectical cycle, this belief in turn produces confidence. Similarly, many PLESME teachers changed their understanding of what it meant to be a competent professional mathematics teacher and began to see learning as an integral part of being a professional, irrespective of one's level of formal education.

This can be especially difficult for teachers since they are usually constituted as 'all knowing'. Teachers as learners in an INSET context differ from other learners in other contexts such as schools or apprenticeships. The evidence in this category of confidence suggests that teachers challenged the 'all-knowing' construction of 'a professional teacher'. This new construction supported those teachers with limited mathematical backgrounds in developing identities as mathematics teachers despite the limitations of their pre-service

studies. Teachers expressed confidence in the acceptance that indeed one cannot know everything, but one can become a life-long learner within the profession of mathematics teaching. This new approach to learning was both a result of confidence and provided teachers with increased confidence.

Thus, I argue that mastery of the profession of mathematics teaching involved: confidence in what teachers had learnt and the meanings they constructed in relation to changing developments in their profession; confidence in their ability to participate in the various practices (and communities) of the profession of mathematics teaching; confidence in their ability to access resources to supplement their learning; confidence in their identities as professional competent mathematics educators; confident acceptance that there was still much more to learn and a willingness and confidence to become a life-long learner in the profession of being (and becoming) a mathematics teacher.

In this respect, like Wenger's (1998) other four components of learning, confidence is both a product and a process inherent in teachers' learning to become professional mathematics teachers. Thus, in the same way as *identity* involves '*learning as becoming*', as well as the experience of *being* a person with a particular identity at a particular point in time, confidence involves *learning as mastery*, as well as the production of an experience of the achievement of a particular level of mastery at a particular point in time. In this way, confidence and mastery are both produced by and are productive of learning.

Due to the absence of the notion of confidence in Wenger's work, I argue that his framework of learning does not deal comprehensively with all primary aspects of learning (in all contexts). In the broader study from which this article is derived, I used confidence as an overarching fifth component requiring discussion and analysis in its own right. As is shown in the vignette of Ivan, confidence, like meaning, practice, identity and community, was closely intertwined with all other learning components. However confidence, in my view, as it emerged from the data in this study, has its own specific features that could not be subsumed within the other components. Thus, confidence in relation to learning as mastery [4] involves the insight to know when you do not know, the confidence to admit to this and the ability to access the necessary information (or experience) and support from the broader professional community of mathematics education (or other overlapping communities).

In summary

Ivan's learning involved 'becoming' someone different in relation to his changing meaning, practice, identity, com-

munity and confidence. This becoming was shaped by Ivan's participation in practices valued by South African society at a macro level (adoption of new curriculum practices) and, at the micro level, participation in particular professional communities.

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Notes

[1] MG refers to myself, Mellony Graven, as the interviewer.

[2] In a video shown to PLESME teachers, a child called Karabo used an unusual method to share money. All teachers noted that Karabo did not understand the problem and his written work should be marked wrong. The video then continued to show Karabo explaining his method. After listening to the explanation, it was clear that Karabo's method of solving the problem was quite sophisticated. Throughout, PLESME teachers referred to 'like Karabo' to signify the importance of working with learner meanings.

[3] It is important to note that my focus on 'confidence' occurred during the post-PLESME phase of the broader study. This highlights the fact that 'confidence' was not part of my research agenda, it was not a term I used in interviews and it was not a term employed in the discourse of PLESME workshops. Instead, 'confidence' was a term introduced by teachers (independently of each other) as a means to describing and explaining their learning.

[4] In this sense, 'confidence: learning as mastery' can be added to Figure 1 along with the other four components such as 'practice: learning as doing' and 'community: learning as becoming'.

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