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Learning by teaching: a cultural historical perspective on a teacher's development

Abstract

How can teacher development be characterised? In this paper we offer a conceptualisation of teacher development as the enhancement of knowledge and capabilities to function in the activity of a teacher and illustrate with a case study. Our analytic focus is on the development of a science teacher, David, as he engaged in an innovative, collaborative project on learning photonics at a metropolitan secondary school in Australia. Three dimensions of development emerged: technical confidence and competence, pedagogical development and personal agency. We explore the transformative effects of intrapersonal tensions within the teacher's constitution of his role in the emerging community of enquiry — positioning him in turn as learner, instructor and facilitator. We view the context for David's actions as a complex and dynamic system and interpret David's development as arising from his responses to the differences in his emerging roles in the project.

Teacher development

How can we understand the development of a practising teacher? What are the conditions for and object of this development? How can we make transparent the contextual and organisational factors that shape and are shaped by the teaching activity? How is the development of a teacher mediated by cultural tools? In this paper we explore these questions through a

case study of a teacher's participation in an innovative science-learning project. Our analysis is filtered through a theoretical lens, Cultural Historical Activity Theory.

A cultural historical approach provides a particular perspective on the object of and the conditions for teacher development practices. For Vygotsky (1978), the development of higher mental functions is the result of the unification of mental and manual tools through joint practical action. Learning precedes development and is a tool-mediated act that takes place through social participation in situated practice. The acquisition of cultural tools is the key aspect of learning, changing how humans interpret, interact with and transform their external world (Hedegaard, 2001). Through social participation in practice we appropriate knowledge and capabilities for functioning in our world. Learning enables us collectively and individually to meet challenges and create futures for ourselves and our societies.

The literature on teacher development has focussed primarily on the teacher as the object of formal education, such as research evaluating the learning of pre-service and in-service teachers during courses in teacher education institutions or in the field (Edmond, 2003; Goodfellow & Sumsion, 2000;

Sullivan 2002). These studies have highlighted the constraints and resources for ‘apprentice’ teachers in diverse environments. Flores (2001) has examined the contextual, work-place, effects on the socialisation and practice of new teachers. However, the development of the experienced teacher mediated by his or her actions in teaching has been relegated to the background in the literature. Indeed, Evans (2002) notes that the concept of teacher development is unclear and the characterisation of teacher development almost entirely absent from the literature.

Teacher development can be conceptualised by the notion of activity. Activity is a dynamic system of human functioning and involves the goals, the means for and the outcomes of human action in transforming the energising object of activity (Leont’ev, 1978; Davydov, 1999). The object of teacher development is enhanced teacher activity — the enhancement of the knowledge and capabilities to function as a teacher. In teaching activity the teacher’s actions are directed at transforming the student as the object of activity, developing societally and culturally accepted knowledge and capabilities (Engeström, Hakkarainen and Hedegaard, 1984). Development of teaching capabilities includes broadening the teacher’s responses to and the resources for the demands of this activity. Renshaw (2003, p. 358) expands on the function of a teacher as going beyond merely ensuring that students learn; teaching requires critical reflection on what students learn, in what context and with what goals “and to reflect on *who* has the opportunity to learn *what*” (italics in original). That is, teacher development encompasses an increased capacity to take responsibility for meaningful learning, and to understand and take into account the significant political, ethical and social dimensions of student learning.

Any instantiation of meaning or performance of a role, such as the role of a practising teach-

er, is the unique manifestation of cultural and historical influences at many levels and from many sources. A specific social identity emerges through being introduced to and acting within the knowledge traditions, procedures and material tools of a specific activity. Identity is formed, located and revealed through social participation in specific societally organised activities. “Social identity” (Hedegaard, 2003) conceptualises the contextual nature of identity. A person becomes a teacher by doing what a teacher does.

Development is dialectical as new forms emerge from old: sometimes co-existing and enriching or decaying. The present social identity of a teacher is mediated by past and emerging forms. The plane of development comprises of overlapping and intersecting social identities formed through participation in different activities: professional and personal domains and from different points in time. Intellectual resources developed from participation in these activities can be drawn upon, enriching the current activity. This developmental dimension incorporates the notion of relational agency, “an ability to seek out and use others as resources for action and equally to be able to respond to the needs for support from others” (Edwards and D’Arcy, 2004).

The context of the study

The setting for this investigation is a collaborative, science-learning project that was developed at a secondary school in a major metropolitan centre, the national capital of Australia. The study is an aspect of the PhD project of Fittler investigating the science learning community. The project was part of a larger, on-line, outreach project designed to raise awareness and enable the wider community to participate in an expanding new field of activity: photonics (Crawford & Fittler, 2004). The project involved middle secondary school students, in years 8 to 10, creat-

ing an online and interactive experience in photonics. Fittler's role in the project was two-fold: as a learning facilitator in the online community and project researcher.

Photonics is a field of science that explores and harnesses the properties of light and other forms of radiant energy and is one of the research areas that underpins new information and communication technologies. There are many applications of photonics in medicine, engineering, science and commerce including energy generation, detection, imaging, commercial scanning, laser technology, communication and optical systems and fibre optics. Photonics was introduced to the teacher and students in the project as "new" and "cutting edge" science. The teacher later referred to photonics as "just one little area of physics".

Development can be stimulated by changes in the system surrounding an individual or from developmental changes occurring within an individual. Changes can create imbalance and dissonance requiring action from the individual and resulting in transformation. Our analyses have indicated that there are many stimuli in the system surrounding and shaping David's teaching activity. We observe the co-existence of various forms of teacher activity that emerge and are revealed through his teaching practice. In this paper we highlight how tensions between different teaching roles serve as catalysts for transformation.

Method

We address the following research questions:

- How is the development of the teacher, David, characterised in the context of the science-learning project?
- What were the tensions in David's constitution of his role in the emerging community of enquiry and how were these instrumental in transforming his activity as teacher?

The data sources for the study were email correspondence and interview transcripts with David, field notes and a learning journal collected by Fittler as she participated in the project. The first meeting with David was the initial planning meeting for the project in June 2002. The project commenced in the school in early August 2002 and ran until mid November 2002.

Regular contact over a period of six months by email and direct face-to-face interaction occurred. Two formal interviews with David took place in 2002: one in late September during the project and another in late November at the end of the project. Follow up questions were sent to David via email in December 2002. Responses were received via email from David in February, 2003. Discussions between Fittler and the teacher continued during the planning and implementation of a second, similar project at the school in August 2003. A third interview was conducted in March 2004.

Qualitative data analysis was an iterative process involving repeated readings and annotations of the data sources. Tensions were identified by drawing on Engeström's (1999) "expansive visibilisation" methodology. Attention was given to hesitations, contradictions and collocations in the subject's accounts of his experiences. Innovations in David's actions were traced to analyse the circumstances surrounding their emergence. Our analysis is a foregrounding or highlighting of particular aspects of activity that contributed to transforming the teacher's identity; a collective interpretation of selected data that illustrate teacher development in context.

As part of the ongoing process of checking the validity of the analysis, David was asked to comment on and add to the interpretations of email and face-to-face communications as the analysis progressed. That is, each stage of the analysis led to new strategies for improving the data collection and analysis in recurring cycles (Miles & Huberman, 1994). We position data

as co-constructions emerging in the interactions of researchers and research participant. As with any education research, ethical as well as methodological issues were important to consider and address — there are tensions between accurate and detailed reports and the need to ensure confidentiality about sensitive issues.

Findings

Background of Teacher

David described himself as “coming from a maths background” and had taught mathematics and junior science for the past few years. His previous experience in other schools included teaching senior physics. When the project commenced David was “a new boy on the block”, having recently arrived at the school from teaching in another state of Australia. His teaching experience was diverse; he had taught in three states of Australia and in the USA.

David had found his own school career as a student challenging. He described various learning difficulties and other “hassles” including dropping out of school half way through year 11. He reported “grabbing” his maths textbook and science textbook over the Christmas holidays before returning to school in year 12 although, as he said, “I was not a brilliant student”. David drew on his experiences, his personal history, to develop an intense interest in teaching and creating “doors for drawing students into activity” in diverse, not necessarily traditional, ways. David commented that he had a Masters degree and had “done OK ... but what I am saying is that I learned to teach myself”.

David has a student centred philosophy to his teaching, observing that: “it’s what happens with the student, not what I do, that is important”. This approach is manifest in his experience with developing programs at

previous schools for “at risk students” and recently establishing an interventionist reading program at this school. His interest and enjoyment of the project was linked to the students’ processes of learning and progress — their journeys of discovery — and his satisfaction at seeing the potential of the students realised.

The Organisational Environment

David’s teaching, his actions and intentions are related to the culture of the school and the wider social and political environment surrounding and shaping these actions.

David perceived that the school culture was oriented to the creative arts — music, drama, dance — and that the many extracurricular activities of the students in this area led to students often being out of the classroom during lessons. The focus on success in drama and dance was at the expense of academic achievement. Moreover David had the impression that students at the school tended not to be strong in mathematics and science areas, particularly physics.

David felt that the school did a lot for disadvantaged students but that the academic work of the better students was not sufficiently recognised. He discussed with the researcher the “tendency for the tail to wag the dog” perceiving that “the bottom end of the school dominates the ethos of the school, the character of the school”.

The location of the school in the national capital of Australia (Australian Capital Territory or ACT) presented both resources and constraints. There were many educationally enriching events in the ACT for students to engage in: field trips for the “kids” that students in other parts of Australia had to travel long distances to participate in. Yet the lobbyist perspectives of the parents meant, paradoxically, that the school was under-resourced. According to David parents insisted on their rights not to pay fees “because it’s free education” so

the school did not have the resources it could have.

In the ACT expectations of the school and teaching staff are high and David noted that teaching staff are constantly expected to “create new systems and new things”, one of the reasons “why we are also burnt out”. Teachers were very busy and overloaded, David describing this as: “last term it was absolutely a zoo here”. David reported that teaching staff also have extra responsibilities to do with curriculum requirements such as registering computer competencies. This was an added incentive for the school to take on the photonics project which incorporated technological skills and capabilities. He commented that the program (the photonics project) “really meets just about everything” from a “marketing” point of view and covered a “huge” area of ICT competencies for students.

Development of the Teacher

Three different but connected dimensions of teacher development emerged from the analysis. These are

- technical confidence and competence
- pedagogical development
- personal agency or self-efficacy.

In this section we summarise and explain these dimensions. We will expand on the dynamics of development and interrelationships among the developmental dimensions in the sections on tensions following the heading: How Did Development Occur?

The first dimension is concerned with the technical resources available to David and his own journey from unfamiliarity with IT (information technology), multimedia and web design, to a level of confidence and competence where he felt able to include web based activity in his teaching. David commented that as his wife worked in the management of information services he had some informal exposure to the scope and challenges of IT but that up

to now he had lacked the time to address his own lack of skills in this area or avoided doing so and noted that this was a weak area for him. He expressed curiosity and interest in how the photonics project would play out and how students would perceive it.

Yes, I was wanting to see what it (the project) was; how it works. ... And even the application, the fact that they are using the computers and the internet and how students feel about those sorts of things. ... I must admit I am not as strong as I would like to be ... in the old IT area so that's one of the things (September, 2002).

The photonics project provided the opportunity to use IT to teach and provided potential resources both human and technological. David believed that “the potential is fantastic” for the students to access expert assistance and teaching saying: “if you can put the whole multimedia in you'd have the students interview a scientist, somebody who's in their area of photonics”.

The second dimension, David's pedagogical development, included his creation of new learning goals, changed understandings of teaching and learning, reconceptualisation of his role as teacher, communication and interactivity. As will be elaborated later in the paper. David introduced novel activities into his teaching for the project including team work in a sustained project, rather than for short projects only, and journal writing.

The usual activity of a teacher is characterised by David as, “chalk and talk”; the teacher has the active role in the learning process. He characterised this as: “you're up the front” providing explanations and giving expression to your own creative talents rather than the students”. David acknowledged that this was the predominant approach to teaching science.

Reconceptualising his role meant to David that students and teacher worked together as members of a learning community, rather than the teacher as centre of knowledge.

It's interesting to see the dynamics in terms of how they interact and that sort of thing and the fact that I did it (that way) rather than me teach it.. is because of what I saw in (the project) with photonics.. it was something new... so, yes it made a major impact in terms of whole new, for me, a new way of teaching science (September, 2002).

As the project proceeded David reflected on his satisfaction with the students taking responsibility for their own learning and that of their colleagues: "the fact that they were actually discovering the stuff" and "they weren't blocked by the others". He articulated his belief that the project was increasing students' motivation to learn physics and, for some, was instrumental in developing their perspectives on it.

Participating in the photonics project mediated David's vision for enhancing students' communication skills and for making science more accessible to students. This was particularly significant in the case of students for whom the usual 'door' to science, strong mathematical skills, was problematic.

One of my aims is that students learn to communicate technology. ... The big thing that I think was — and I'd like to push — is the ability to have people who are technically competent but also very good at communicating because I think that's the real need and that way you can pull in students who are not necessarily mathematically orientated. ... Sure you need to be good at maths, you need to be competent at maths but you don't have to be Einstein. ... You know it blocks ... mathematics blocks a lot of students from doing science and if we have another door ... because I've worked in community groups, I mentioned this before ... if you've got doors into an activity and different ways by which people can become a part of that activity, the more doors, the more people you have in that activity, right?

... So if this program that you've got, right, the work we've done with photonics, would get students into science, not just photonics, but science ... Rather than saying: 'well I'm good at maths,

you know, I can therefore do science' (they could say) 'hey, I'm good at media, I'm good at communicating, I can do science, you know, I can do research'. It shows them another door and I think that's probably the biggest thing about this program (November, 2002).

The third area of development that emerged from our analysis was David's growing sense of self efficacy or agency. According to Bandura (1994) perceived self-efficacy is concerned with people's beliefs in their capabilities to exercise control over their own functioning and over events that affect their lives and belief in self efficacy is essential for people to overcome obstacles and persist with difficult tasks. Looking back on the photonics project David reflected on his increased self efficacy expressed as a renewed sense of vigour and an interest in developing new ways of teaching.

It has given me an opportunity to look at other ways of learning in terms of.. academic sort of.. way in which we communicate to the students rather than chalk and talk and all these sorts of things. So that's a big factor.. which has really kept my interest in teaching (March, 2004).

For David personal agency was in part the result of his participation in Fittler's research accompanying the science-learning project and interacting with her (expanded in Fittler, 2004). Through interacting with the project researcher David rekindled his interest in research and developed awareness and understandings about activity theory as well as confidence in his own abilities to learn and develop. These interactions included sharing mutual interests in research, education and social justice. Publications on activity theory and other educational literature were sources of mutual reflection and discussion. David described his participation in Fittler's research process as:

Helpful to me in analysis and reflection in regard to future programs. Your research topic and

methodology has also been in and of itself an education for me (February, 2003).

Hence David's reflections on his engagement in the research support the relational dimension of agency proposed by Edwards and D'Arcy (2004) as David both drew on the resources of the researcher, Fittler, to enable his own educational actions and also supported and assisted Fittler in her research endeavour.

How Did Development Occur?

We discuss two categories of tensions corresponding to different teaching roles. The first category of tension concerns the teacher as a novice versus an expert and the second is between the teacher as instructor versus facilitator. We outline how these tensions were manifest in David's activity, his ways of being and doing — and how David responded to the tensions. We suggest that David's technical and pedagogical developments and increased sense of self efficacy, outlined in the previous section, emerged in part as resolutions of these tensions.

Tension Between “Teacher As Novice And Learner” And “Competent Teacher”

The first area of tension concerns how David constituted his role with respect to the technological aspects of the photonics project. In the area of web design David articulated a need to be technically competent to maximise his ability to facilitate the students' learning. He expressed this in a number of ways indicating that this area was a “big weakness” and he needed to be “a lot more competent” and “I'm *really going* to have to learn how to do web design”. Personal difficulties were exacerbated by ongoing technical problems in the project, including not being able to upload files and difficulties logging on. In addition he reported that there was inadequate technical support for the project. David's need to increase his technical capabilities was purpose driven to enable him to give more as-

sistance in the learning process. He noted at the end of the project:

What happens when you're competent in any area, right, you not only know the stuff, the content, but you also know where to find something for the student (November, 2002).

In addition he felt he would be failing if he couldn't refer ‘kids’ to appropriate resources saying: “if you don't know then you don't know where to refer them”.

However, David articulated concerns about constituting his role as being technically competent and experienced — the expert. One concern was that the physics, the photonics, as the object of learning would be subsumed by the technology, which he saw as a tool.

But at the same time there's a danger and that is that you turn it into an IT lesson and you teach IT and they do it and I don't think that's the objective of the thing. (November, 2002).

Further, from the beginning of the project, he wanted to ensure that the learning would be student centred rather than teacher centred; an advantage of him being a novice was that the students would solve problems for themselves.

Yes, because quite often some of the kids would be even better than me in finding other resources. ... And, not all, there is a big range, but those who are competent can resource things and I think that one of the reasons why they don't ask is because they're used to nutting it out for yourself. They don't go and ask somebody when they buy a computer game, they just nut it out. ... And so ... some of them actually found it (the information) even quicker than I would (September, 2002).

It appears that David was able to navigate this tension and steer his actions towards learning and development noting that: “it was a steep learning curve for me”. Problems that David encountered in his novice role, and delays in response to his requests for technical support stimulated David to draw on his own resources

and develop technical competence and confidence. We see, too, the beginnings of a new identity emerging with the dialectical processes of resolving the tension — that of being a competent user of technology alongside students rather than being the final authority.

Some outcomes of this tension were:

- Interest in multimedia; purchasing a video camera for class use;
- Innovation of an online student group (yahoo) as a response to the difficulties associated with uploading files;
- Development of insights: interviewing a scientist for the next photonics project to act as a resource and to promote development of the students' communication skills;
- Longer term outcome: David volunteered to teach a "computer application" class, a semester elective, at the school in 2003.

Tension Between "Teacher As Instructor" And "Teacher As Facilitator"

Through participation in the photonics project a new form of teaching activity for David emerged: "facilitator". This activity is characterised by David as having an emphasis: "on the students actually learning rather than (me doing) the teaching" and on students not being "teacher dependent", with student actions involving "discovering" and even "going off on a tangent". He envisaged that students would access resources which were not dependent on his expertise saying: "the expertise is coming from outside; the connections are from outside." For David the perceived benefits of such an approach were enhanced learning processes, communication skills and students "learning how to learn".

David commented that his emerging new activity was "radically different from the normal teaching situation". He grappled with competing professional roles and responsibilities

observing that on the one hand: "I'm their teacher but I'm not the subject expert" but on the other hand asserting: "I'm sorry, I'm still their science teacher and still subject matter oriented — you know that there is a content, there is still some stuff they've got to know".

Implementing the role of facilitator led David to engage in innovative teaching actions. Two of these were to organise students to work in teams on the project as a sustained task and to introduce journal writing by the students.

The aim of students working in teams to research a topic was that "they would teach it to the rest of the class". This would present opportunities for the other students to ask questions and critique the presentation, and, later in the semester, all the students would be formally examined on the content of the presentations. Students working in teams as a long-term activity (inside a classroom) was a "whole new way of teaching science" for David. Looking back on his teaching he said:

My students in the past especially in science labs definitely worked in teams. However, these were always short term. (February, 2003).

David attributed this new action to participating in the photonics project as team work had been implemented and modelled by the project consultants. He noted that his actions developed from "the fact that they did it rather than me teach it; it is because of what I saw in photonics; (it was) something new". This modelling of innovative teaching actions by the project consultants influenced David's perceived sense of self efficacy, supporting Bandura's (1994) assertion that sources of influence for perceived self efficacy include mastery experiences and witnessing the success of others in managing task demands.

Tensions were evident between this emerging new role for David and his usual school based activity of "teacher" as instructor. David feared

that students might communicate incorrect understandings to the class as a result of their underdeveloped competencies. He said: “you run a big risk because ... what happens if this student comes out and doesn’t explain it well?” This could have ramifications for the formal assessment of the students. Also David noted that the students “were a bit off task”, noting that there was a tendency for students to go off and do their own narrow things.

Hence there was a dissonance between sharing responsibilities with the students, inherent in an emerging role as facilitator, and what he saw as responsibilities of the “teacher”—to coordinate and monitor, and to be accountable for the progress of students and students’ learning outcomes. This tension could also be understood as arising from sharing responsibilities with the students, a function inherent in the student centred activities of group work, versus their under-developed capabilities to handle the demands of the task.

David’s response to this tension resulted in the emergence of a new pedagogical tool, a learning journal.

We had a little book; a journal and they had to write down what they had done and that is itself an education for them because they’ve always tended to do the minimum. ... So the whole idea of journaling is an education for them. And teaching them and getting them to understand the significance of that. That’s what I am using as a part of their assessment ... they have the date, they have what they actually did and then what they do is write down the names of the others in their groups and just one or two words as to what others in their group are doing. Because I am trying to get them to understand what the rest of their [group is doing] (September, 2002).

The purposes of the new tool were not only to assist the students to manage their time and organise and delegate their tasks while embarking on group work but also to provide quantifiable and recordable data for assessment procedures. He reflected later:

Another aspect of the journal-keeping related directly to assessment. The powers that be want quantitative data on students. Yet, in this classroom, there was always so much occurring at the same time, it was difficult, if not impossible, to formally assess the students. The journals gave some way of keeping track (February, 2003).

Thus the journal writing as a task was an attempt to alleviate the dual pressures associated with the problems of sharing responsibilities with students, inherent in David’s role as facilitator, and his professional accountability and responsibility as teacher.

In both instances of the new teaching actions described we see the adoption or “borrowing” of a component (a tool, model) from a different activity to re-mediate his existing activity and resolve inner tensions. In the first instance, the notion of group work was a model borrowed from his experiences in another component of the project. Similarly, David had encountered and engaged with journals in his experiences with postgraduate study and in Christian formation classes: “I had known about journaling because they talk about journaling in all sorts of other things but not in this context”. Hence David’s development was facilitated by shared positions in his history and current activity.

Discussion

In this study, we have presented a way of conceptualising teacher development as a complex and dialectic process realised in teaching activity. Our data underpins a focus on tensions as stimulants for development and illustrates the agency of the teacher in responding to these differences and inner conflicts. We have discussed three dimensions of development that were found to emerge from David’s actions: technical confidence and competence, pedagogical development and personal agency. The pedagogical and technical dimensions widen the potential resources that David can draw upon to medi-

ate his present or future teaching actions and thus enhance his range of responses to the challenges inherent in his teaching environment. Perhaps the most significant outcome relates to the increased personal agency or self efficacy of the teacher. This dimension enables the practitioner to explore and engage in activities previously perceived as daunting. Thus increased self efficacy not only provides the practitioner with more opportunities but also with new opportunities in which learning and development can occur. David's increased sense of self efficacy led to deep interest and willingness to experiment with new teaching actions and to tackle problems. He sustained his efforts even after failures or setbacks such as difficulties with loading files on the web and other technological problems. He appeared to develop assurance that he could recover from setbacks and exert control, which accords with Bandura's (1994) proposal about the effects of perceived self efficacy. David's agency was demonstrated by his initiative in implementing a similar project at the school the following year.

Teaching activity is the condition for teacher development and enhanced knowledge and capabilities to function in teaching activity is the object of teacher development. David's teaching activity was a complex and dynamic phenomenon. Various forms of teaching activity were found to emerge and co-exist — positioning David as learner, instructor and facilitator. Through his teaching activity tensions between these different forms of activity arose and became manifest. Rather than as barriers to potential development, differences provided opportunities for David's learning and development. It was apparent that David was able to navigate and negotiate these differences enabling development to proceed. His increased capabilities included improved attitudes to and competence with technology and these were linked to an increased capacity to support active and responsible learning of

students — enabling them to draw on resources other than the teacher.

The development of a teacher is mediated by cultural tools. Our case study illustrates how new tools, such as educational literature, stimulated David's learning and development. Cultural tools were also introduced to alleviate the pressures associated with the intra personal tensions. David responded to the challenges posed by the tensions by modifying and adapting his actions and by re-mediating his activity with physical tools and learning models borrowed from his past experiences, personal knowledge or current professional experiences. Group work, journal writing and an online student group were different forms of cultural tools that emerged from David's responses to the differences and inner conflicts he encountered in the project.

The implications of this study are both theoretical and practical. Conceptualising activity as the unit of analysis facilitates our understanding of the complex phenomenon. With a broad and comprehensive focus, it is possible for the researcher to identify and make transparent the contextual features that penetrate into and organise the activity. In this study we observed how features of the wider social and political setting and culture of the school shape and are shaped by the teaching activity. Likewise, we see how David's experiences in his personal and professional domains mediate his current teaching activity. David's experiences provide a rich resource for his future actions. Our study suggests a fruitful avenue for exploring the professional development of a practising teacher. Our lens on David's activity in an innovative learning project highlights the pedagogical opportunities provided by the teacher's actions. David advanced his professional skills to create learning environments to foster students' communication skills, encourage students' independent learning and collaboration and broaden students' perspectives on sci-

ence. David's intentions and actions to create alternative entries and ways for students to engage with science, rather than only via a strong mathematics background, resonates with Renshaw's (2003, p. 358) characterisation of a teacher's function to reflect on and take responsibility for inclusiveness — creating opportunities for diverse students to engage in “worthwhile” learning. Participating in the research associated with the project promoted reflection and a sense of progress in David's ongoing interest and commitment to self-education and life-long learning.

Conclusion

Our theoretical approach provided a methodological lens for analysing developmental processes as being formed, embedded in and defined by everyday social practice. As characterised by Jonassen and Rohrer-Murphy (1999, p. 68) an activity theory framework shifts the methodological focus from “knowledge states” to a focus on “the activities, in which people are engaged, the nature of the tools they use in those activities, the social and contextual relationships among the collaborators in those activities, the goals and intentions of those activities, and the objects or outcomes of those activities”.

The data have provided insights into the systemic constitution of a teacher's role as he participated in an innovative learning project. We interpret the context for David's actions as a system of overlapping activities and acknowledge, like Wardekker (2000), that a system extends beyond what is locally experienced by the subject and readily viewed by the researchers.

A cultural historical framework alerts us to view a teacher's practice as a process — a narrative in the making — and to search for positive, transformative elements in this process where, at first, barriers to learning and development are perceived. In ongoing research we continue

the journey of understanding and interpreting the activity of a teacher in a community of enquiry.

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