IDENTITY AS AN EMBEDDER-OF-NUMERACY: NUMERACY AND TEACHING SCIENCE OUT OF FIELD

Anne Bennison
The University of Queensland, Brisbane

Abstract

Teaching subjects they are not formally qualified to teach presents those teaching out of field with many challenges. Being expected to promote numeracy learning in contexts where numeracy is seen as an across the curriculum responsibility places additional expectations on out-of-field teachers. This paper draws on some findings from a study that investigated how to support teachers to promote numeracy learning across the curriculum. The study developed and evaluated a conceptual framework for identity as an embedder-of-numeracy and employed an adaptation of Valsiner's zone theory to understand how such an identity is formed. The purpose of this paper is to highlight some of the issues faced by out-of-field teachers when they are also expected to promote numeracy learning. The case study of a secondary school teacher who was teaching science out of field is presented. Limited opportunities to develop the subject knowledge needed to teach science and how she viewed the representational tools she employed were identified as contributing to the way in which she addressed numeracy learning opportunities in science. Further research is needed to investigate ways to assist out-of-field teachers to promote numeracy learning in ways that assist them to address the other challenges they face.

Background

Teachers are generally considered to be teaching out of field if they do not have the discipline and education qualifications for the subject or level of schooling they are required to teach (McConney and Price, 2009). For secondary school teachers this means not having completed tertiary qualifications that include either a major or a minor in a discipline and the appropriate teaching methods courses. The phenomenon of teaching out of field is not new and often used to overcome issues of recruitment and retention (Ingersoll, 1998). Teaching subjects they are not formally qualified to teach presents those teaching out of field with many challenges. Being expected to promote numeracy learning in contexts where numeracy is seen as an across the curriculum responsibility places additional expectations on out-of-field teachers.

Numeracy is the capacity to cope with the mathematical demands of life in personal, work, and citizenship contexts. Different terms are used (e.g., mathematical literacy) and the interpretation of this construct varies between countries; however, numeracy can be usefully conceptualised in the five dimensions seen in the numeracy model developed by Goos, Geiger, & Dole (2014): *mathematical knowledge*, *context*, *tools*, *dispositions*, embedded in a *critical orientation*. In Australia, numeracy is seen as the responsibility of all teachers and is included in the Australian Curriculum (ACARA, n.d) as a general capability to be developed in all school subjects. Support for this curriculum mandate is seen in the Australian Professional Standards for Teachers (AITSL, 2014) which set out what teachers need to know and be able to do to support students' numeracy learning. However, teachers are unlikely to fully embrace such an approach unless they can see benefits to student learning in the subjects they teach, something that may not be readily apparent to out-of-field teachers.

This paper reports on some findings from a study that investigated how to support teachers to promote numeracy learning across the curriculum. The study drew on an extensive review of literature to develop a preliminary framework for identity as embedder of numeracy (Bennison, 2015) so that the complexity of this identity could be captured, and employed an adaptation of Valsiner's (1997) zone theory to reveal the trajectories of identity formation over time (Wenger, 1998). An empirical phase in the study allowed this sociocultural approach to be evaluated and the proposed framework and adaptation of Valsiner's zone theory to be revised (Bennison, 2016).

One of the findings to emerge from the empirical phase of the study that is pertinent to out-of-field teachers was that motivation for teachers to embed numeracy into the subjects they teach seems to

Anne Bennison
a.bennison@uq.edu.au

come from being able to see how attending to numeracy learning opportunities can enhance subject learning. Consequently, promoting numeracy learning is likely to be challenging for out-of-field teachers because they have not had formal training to help them to develop the content, pedagogical, and curriculum knowledge to support subject learning and may, therefore, focus on "covering content" at the expense of providing richer learning activities. A further finding of relevance is how teachers' use of artefacts that could be considered as boundary objects (Star & Greisemer, 1989) influences numeracy learning. These artefacts exist in mathematics and the subject being taught and have both mathematical and contextual meanings, respectively. Effective use of boundary objects to promote numeracy learning may present difficulties for out-of-field teachers because it requires "facility and flexibility with viewing situations from mathematical and contextual vantage points" (Venkat & Winter, 2015, p. 576). Even if out-of-field teachers have an understanding of the mathematical vantage point they may not see or understand the contextual vantage point.

The case study of a secondary school teacher who was teaching science out of field is presented to illustrate some of the issues encountered by out-of-field teachers when they are expected to attend to numeracy within the subjects they teach. Specifically, the paper addresses the following research question: In what ways might the identity as an embedder-of-numeracy of an out-of-field science teacher influence the way in which she promotes numeracy learning?

Theoretical Framework

Wenger (1998) saw identity as an important part of learning, and many researchers have seen teacher identity as a way of providing useful insights into the learning and practices of teachers (e.g., Enyedy, Goldberg, & Welsh, 2005; Goodnough, 2011). While a range of theoretical perspectives have been used to investigate teacher identity (e.g., poststructuralist by Walshaw, 2010; narrative inquiry by Bjuland, Cestari, & Borgersen, 2012), Lerman (2001) advocated for the use of sociocultural approaches understand teacher learning in terms of the ongoing development of teacher identities. One such approach is Valsiner's (1997) zone theory. The theoretical framework developed and employed in the present study has two elements: a framework for identity as an embedder-of-numeracy and an adaptation of Valsiner's zone theory (Bennison, 2016).

The framework for identity as an embedder-of-numeracy (Bennison, 2016) is organised by five *Domains of Influence*: Life History, Knowledge, Affective, Social, and Context. Within each of these domains are factors that seemed most likely to influence how teachers promote numeracy learning in subjects across the curriculum. For example, mathematical content knowledge, pedagogical content knowledge, curriculum knowledge, and subject knowledge were defined and included within the Knowledge Domain. The framework is summarised in Table 1 (see Bennison, 2016 for how each of the factors were defined).

While the framework for identity as an embedder-of-numeracy provides a means of capturing the complexity of a teacher's identity in the context of promoting numeracy learning across the curriculum, a limitation of the framework is that it does not reveal how the included factors interact nor how this identity might change over time. This limitation is overcome by employing an adaptation of Valsiner's (1997) zone theory.

Valsiner (1997) saw development as involving interactions between an individual and their environment, and conceptualised this developmental process as the interaction between three zones: zone of proximal development (ZPD), zone of free movement (ZFM), and zone of promoted action (ZPA). He defined the ZPD as the set of possible ways that an individual could develop, the ZFM as the internal and external constraints on an individual, and the ZPA as the set of activities that are promoted. Key features of this theory are that the zones have indeterminate boundaries, overlap, and are constantly changing. Furthermore, individuals are able to exercise agency by accepting or rejecting actions that are promoted. Valsiner argued that the ZFM and ZPA work together as a ZFM/ZPA complex and that development takes place under the influence of successive ZFM/ZPA complexes; thus enabling the dynamic nature of identity to be captured.

Anne Bennison
a.bennison@uq.edu.au

Table 1
Framework for Identity as an Embedder-of-numeracy (adapted from Bennison, 2016, p. 174)

Domains of Influence	Factors
Life History	Past experiences of mathematics
	Pre-service education
	Initial teaching experiences
Knowledge	Mathematical content knowledge
	Pedagogical content knowledge
	Curriculum knowledge
	Subject knowledge
Affective	Personal conception of numeracy
	Attitudes towards mathematics
	Beliefs about pedagogical approaches that are possible
	Motivation to embed numeracy into subjects
	Perceived preparation to embed numeracy into subjects
Social	School communities
	Professional communities
Context	School policy environment
	Resources for teaching

The ZPD, ZFM, and ZPA were re-interpreted for the present study and factors that were included in the framework for identity as an embedder-of-numeracy were mapped onto the zones. The mapping process was not one-to-one as some factors could be mapped onto more than one zone. The ZPD was interpreted as the set of possible ways that a teacher's identity as an embedder-of-numeracy might develop. This zone was contingent on the knowledge and affective attributes specifically related to numeracy that exist in their current state because of past experiences. For this reason, factors from the Life History Domain, Knowledge Domain, and Affective Domain were mapped onto this zone. The ZFM/ZPA complex was considered to include environmental elements that permit certain teaching actions for numeracy and the teaching approaches for numeracy that are promoted. Factors mapped onto the ZFM/ZPA complex came from the Affective Domain, Social Domain, and Context Domain. One way of representing the manner in which the framework for identity as an embedder of numeracy was mapped onto Valsiner's (1997) zones is shown in Figure 1.

Research Design and Methodology

The empirical phase of the study was conducted over a two-year period (2013-2014) and employed case study methodology (Stake, 2003). The participants were eight teachers from two secondary schools in Queensland who had previously agreed to participate in a larger project (hereafter referred to as the *Numeracy Project*). The teachers had varying levels of experience and curriculum specialisations. One of the teachers, Barbara, was observed teaching mathematics and science. She was a qualified mathematics teacher but teaching science out of field; thus, her case is the focus of this paper.
Barbara and three colleagues from her school participated in the Numeracy Project. This project was conducted over three years (2012-2014) is six schools, three in Queensland and three in Victoria. Participants were generalist primary teachers and specialist secondary teachers from a range of disciplines. The project investigated the potential a professional development intervention that utilised the numeracy model developed by Goos et al. (2014) to assist teachers in planning for numeracy in the subjects they taught. The teachers took part in a series of professional development workshops that were followed by school visits where researchers (including the author of this paper) observed the implementation of numeracy focused tasks, conducted post-lesson interviews, and provided ongoing support for teachers. Although Barbara had opportunities to share her experiences of the Numeracy Project with her three colleagues, none of these colleagues taught science.

Anne Bennison
a.bennison@uq.edu.au

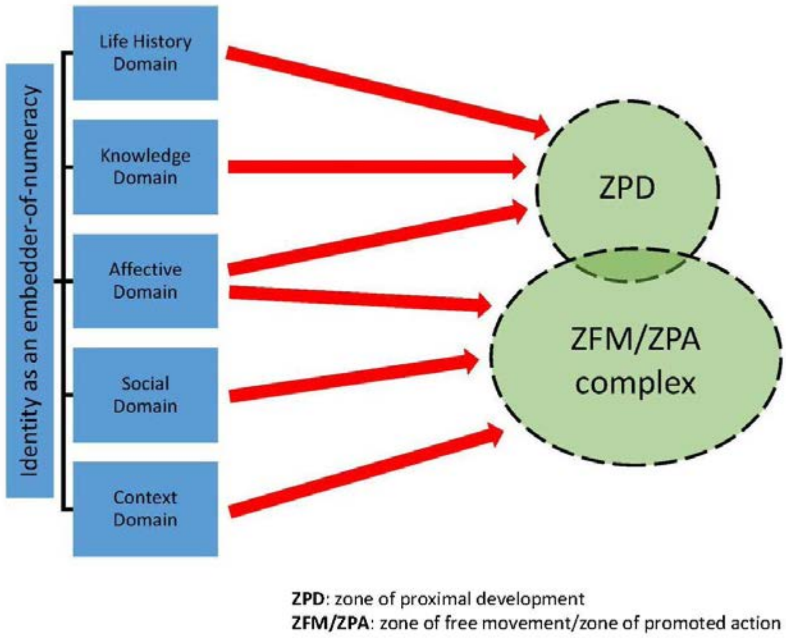

Figure 1. Mapping of the framework for identity as an embedder-of-numeracy onto Valsiner's (1997) zones (Bennison, 2016, p. 188)

Barbara was visited five times in her school during the study. Data collection methods comprised lesson observations and interviews, which were semi-structured, audio-recorded, and transcribed. Barbara participated in a *scoping interview* during the first year of the study. The purpose of this interview was to obtain information about her background, beliefs about numeracy, school context, and previous opportunities to learn about promoting numeracy learning. On each school visit Barbara was observed teaching one or more lessons and interviewed about her practices in observed lessons. *Lesson observations* focused on the tasks that were used and how these addressed both numeracy and subject learning. Field notes were taken during lesson observations and combined with resources used by the teacher (e.g., handouts, PowerPoint presentations) to provide as near as possible complete record of the lesson. The focus of *post-lesson interviews* was the planning and implementation of tasks, teacher and student learning, and teacher reflections.

Content analysis of the interview transcripts was used to identify aspects of Barbara's zone of proximal development (ZPD), zone of free movement (ZFM), and zone of promoted action (ZPA). Coding decisions were made based on how these zones were interpreted. For example, the possible ways in which a teacher's identity as an embedder-of-numeracy might develop (ZPD) was seen to depend on knowledge and affective attributes drawn from the Life History Domain, Knowledge Domain, and Affective Domain. For this reason, excerpts of text from interview transcripts about school and university experiences of mathematics were coded as belonging to the ZPD. Coding decisions of several interview transcripts were discussed with a more experienced colleague and discrepancies reviewed and resolved. As interviews were conducted over a two-year period the month and year of each interview excerpt included in this paper is indicated in brackets following the quote.

Goos et al.'s (2014) numeracy model provided a framework for analysing Barbara's personal conception of numeracy and the tasks she utilised in observed lessons. Using the approach employed previously by Goos et al, Barbara's description of her interpretation of numeracy and classroom activities were coded in terms of the five dimensions evident in the numeracy model: mathematical knowledge, context, tools, dispositions, and a critical orientation.

Anne Bennison
a.bennison@uq.edu.au

The case study of Barbara was developed by drawing on data analysis to construct a narrative that includes an example of practice to illustrate how being an out-of-field science teacher may influence how she addresses numeracy demands and opportunities in science.

Barbara: An out-of-field science teacher

Barbara was an experienced mathematics teacher who had been teaching for over twenty-five years. The school in which she was teaching was located in a provincial city where mining was the main industry. There were approximately 1,000 students who came from both metropolitan and rural areas. The school was located in an average socioeconomic area. School results for numeracy on the National Assessment Plan – Literacy and Numeracy (NAPLAN) were close to those for schools with students from similar backgrounds and the national average (ACARA, 2014).

Professional Context

Barbara was located in a staffroom with Mathematics, Manual Arts, and learning support teachers, but not science teachers. For this reason, her opportunities to work collaboratively with others teaching science were limited to regularly scheduled staff meetings. For example, she attended weekly meetings with other teachers when she was teaching Grade 8 Science in the first year of the study: “In science we have a weekly meeting where all the [Grade] 8 science teachers touch base, so that’s good there” (September 2013). She did not provide any information on what happened during these meetings or if she attended similar meetings when she was teaching Grade 9 and Grade 10 science in the following year.

The school perspective on numeracy seemed to be dominated by the need for students to perform well on national numeracy tests (NAPLAN). For example, Barbara described how her Grade 9 Science class prepared for NAPLAN in the lead up to the test:

> *They [her Grade 9 Science class] were getting it [questions from past NAPLAN tests] in their maths classes, then they were getting it in learning skills, and then we [other teachers] were all putting it in our warm-ups at the beginning of every [lesson].* (June 2014)

Towards the end of the second year of the study, Barbara’s school received a grant from the state government through an initiative designed to improve student outcomes in literacy and numeracy as measured by NAPLAN. The school used the finding to appoint a Literacy Coach and a Numeracy Coach (Barbara). These two positions equated to a full-time teacher’s load with continued funding dependent on improved student performance on NAPLAN.

The availability of appropriate technology appeared to be variable for science classes. About half the students in Barbara’s Grade 8 science class in the first year of the study had access to personal laptops, which was sufficient for the task she was planning to use in one of the observed lessons: “It [the school laptop hire scheme] was a by choice program. So I’d say in that group, 40% at this stage probably do, 40-50%, so that’ll be enough (November 2013). However, difficulty in gaining access to a computer laboratory impacted on her planning for her Grade 10 science class the following year: “I was thinking about access to laptops and the fact that I couldn’t without changing rooms and then I didn’t want to change rooms because they become very unsettled. It wastes too much time” (October 2014).

Background, numeracy, and teaching science

Barbara’s initial teaching qualification was a 3-year Diploma of Teaching with studies in mathematics, economics, and religion that she completed at a Teachers’ College (an institution devoted for teachers training that no longer exist in Australia) in a large metropolitan city. After teaching for a year she moved to another metropolitan city where she stayed for ten years. During this time she completed a Bachelor of Education as a part-time student. Barbara subsequently taught mathematics and religious education in a provincial mining area for ten years, and then moved to her current school. Both her teaching qualifications were completed before numeracy became a national priority (DETYA, 2000); not surprisingly, she could not recall any consideration of numeracy in these programs.

 Anne Bennison
a.bennison@uq.edu.au

There had been opportunities in the past for Barbara to participate in professional development activities related to literacy but she seemed to equate professional development for numeracy with that for mathematics:

> *Literacy and numeracy, mainly literacy … there would be lots of PD [professional development] I would have done I would've thought, from using graphics calculators and spreadsheets, you name it, as part of my maths role.* (September 2013)

The way in which Barbara saw numeracy appeared to be changing, possibly as a result of her participation in the Numeracy Project. Her personal conception of numeracy had been focused on mathematical competency but had expanded to include the critical use of mathematics in real world contexts:

> *I would have been much more narrow and said numeracy was basically can you do maths? Can you pass a competency test? And I wouldn't have added in the reflective, the critical, the real life, the making sense of our world. So I think it's [the Numeracy Project] broadened my understanding of what it really is to be numerate.* (November 2013)

Referring to her role as a mathematics teacher, she identified the importance of promoting positive dispositions towards mathematics: "We've got to have children where they're ready to take a risk. Ready to be wrong and not frightened of it" (October 2014). Taken together, these comments suggest that Barbara appeared to be developing a richer personal conception of numeracy.

Neither of Barbara's teaching qualifications provided opportunities for her to develop the knowledge needed for teaching science. Nevertheless, in the space of an 18-month period she was required to teach science at three different grade levels. Being expected to promote numeracy learning in science provided her with the additional challenge of needing to identify numeracy learning opportunities and design tasks that also enhance science learning, while at the same time developing the knowledge needed for teaching science.

When asked about numeracy in science towards the end of the study, Barbara only referred to mathematical knowledge and tools: "I'd say it's graphing and tables, statistics [pause] equation solving when you do a bit of chemistry" (October 2014). One possible reason for this response may have been that she was able to readily identify the mathematical aspects within the lessons she had taught. However, Barbara was able to identify numeracy in some of the science topics she had taught. For example, the importance of scale when using a microscope:

> *What's the rate we're zooming in at and the scale, so and when they've drawn pictures of cells under the, you know, so there has to be some perspective there on what scale they, what zooming factor they were using. So I guess there have been things but I haven't consciously introduced them. They're already there.* (November 2013)

Barbara was confident that she could deal with the mathematics she was likely to encounter when teaching science, but not as sure that she could make connections between numeracy and science because of her limited knowledge of science:

> *I'm not science trained, so, I mean I'm comfortable with the maths more than the science content, so maybe I'm not seeing the links as much as somebody trained in science would because I don't know the content beyond that curriculum that I'm studying to deliver.* (November 2013)

When asked to clarify how her lack of subject knowledge influenced her capacity to embed numeracy in science, she conceded that it might prevent her from seeing the full extent of numeracy learning opportunities that would readily be seen by experienced science teachers:

> *I don't believe I'm picking up the opportunities that could be there simply because I don't know the content. Um so, where somebody who's been teaching it [science] for years and years and years might say, "Oh that's a perfect time to bring in that graph or that table and analyse that ... It's just knowing that it's there. (November 2013)*

Not surprisingly, Barbara identified her greatest need in relation to promoting numeracy learning in science as assistance in being able to identify where and how numeracy could be embedded into this subject:

Anne Bennison
a.bennison@uq.edu.au

> *I think if there was PD [professional development] it would be more on being aware of opportunities, so if somebody was to say, "Oh, numeracy in science, here are some great ideas you can use." That sort of PD would be really helpful.* (September 2013)

Towards the end of the study, Barbara acknowledged that she was now more aware of the numeracy in subjects across the curriculum: "I think there's far more there and it's, when you have it at the front of your mind it's amazing how many explicit links you can make" (October 2014).

Promoting numeracy learning in science

The Australian Curriculum (ACARA, n.d.) has been progressively implemented in Australian schools since 2011. Icons and online filters identify numeracy demands for each curriculum area. The Australian Curriculum for Science has three interrelated strands: *Science Understanding*, *Science as a Human Endeavour*, and *Science Inquiry Skills*. The Science Understanding strand includes four sub-strands: Biological sciences, Chemical sciences, Earth and space sciences, and Physical sciences. The vignette presented in this section is from a lesson that Barbara taught in June 2014 that was part of a Grade 9 unit from the Biological sciences sub-strand in which students investigated the relationship between abiotic and biotic components of ecosystems. The numeracy demands identified by the numeracy icon in the relevant content description and elaboration are estimating and calculating with whole numbers.

The activity for the lesson was a virtual fieldtrip that involved collecting data from five sampling sites in a wetland and representing these data graphically. Barbara provided some initial instructions then students launched the Exploring Wetlands activity (no longer located at the URL used by Barbara). Students collected samples from each site by clicking on the appropriate tool (e.g., a net to sample for macroinvertebrates). These data were recorded as field notes that included a description of the site, abiotic measurements (pH, dissolved oxygen, turbidity, and temperature), and macroinvertebrate and aquatic plant species present. Students spent most of the lesson collecting and recording data. Towards the end of the lesson Barbara asked students how they could represent the data they had collected. Following a very brief discussion of possible graph types, Barbara provided students with a number of rules for graphing in Biology. These rules were written as she would have presented them to a mathematics class and were displayed on two PowerPoint slides (see Figure 2 for the second of these slides). Barbara did not attempt to connect these rules to the data students had just collected; seemingly focusing only on the mathematical meaning of this boundary object (Star & Greisemer, 1989). This decision may have been due to time constraints or because she expected students to be able to make the connections for themselves.

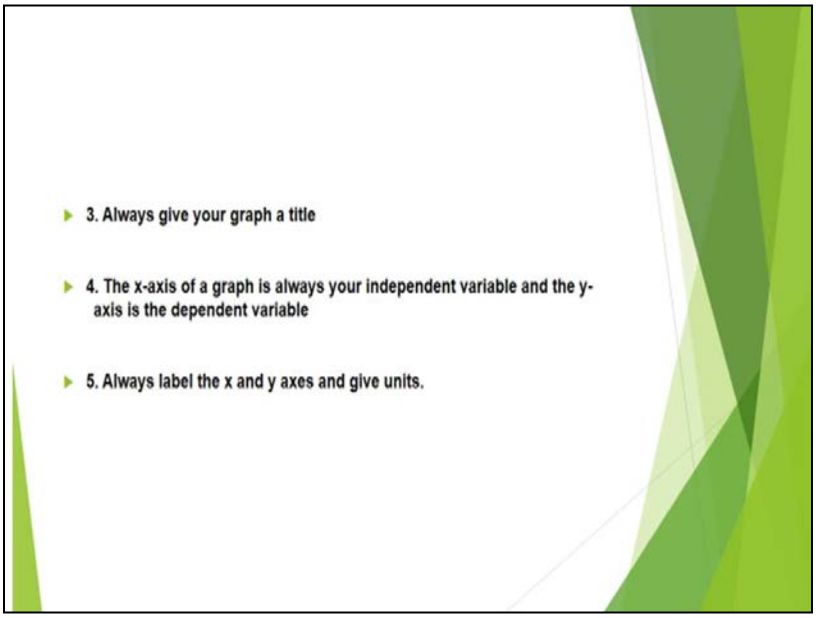

Figure 2. Barbara's rules for graphing in Biology (Slide 2) (Bennison, 2016, p. 162)

Anne Bennison
a.bennison@uq.edu.au

The lesson preceded a field trip to a local waterway during which students collected, recorded, and analysed data. The field trip was part of the culminating task for the Biological sciences unit. Barbara used the Exploring Wetlands activity to give students some experience in constructing graphs from tables of data prior to the field trip the following week:

> *They have to, in their assessment coming up, do a field study, identify the ecosystem, analyse data, tabulate and graph data and then have a look at the human impact. I thought, well, of doing it virtually first would be a good, safe way to introduce them to that.* (June 2014)

Barbara was able to link the activity to understanding the impact of human activity on ecosystems (Science Understanding):

> *Then I was thinking when they got back, and they had a look at their data, their graphs, and the organisms that lived in each environment, that they would then interpret and analyse. So that sort of critical reflection. So for example, at the site where the farm and tractor is, there's a lot less organisms, so will they be able to infer from that, is it possible chemical leach, or is there – I'm looking for that sort of analysis of the data. The pH of course, and the number of organisms, or what type, is a direct link.* (June 2014)

However, her primary goal for the lesson was for students to represent the data graphically. Thus, it could be argued that the lesson was targeted at developing Science Inquiry Skills in isolation, rather than in an integrated way as intended in the curriculum:

> *We collected data. It took forever. It took forever for some students to draw a table and that wasn't because they couldn't do it, they just weren't engaged in the activity, clearly. Um by the time they had their table filled in, [short pause] I think if I ever did that again I wouldn't try and do that and graphing in the one lesson, because they didn't have the energy or the focus, or I didn't, but it was too late then to try and make any crucial points about graphing, which is what the whole lesson was actually about … So the next lesson … let's look at the data we collected, how would you present it? What scale would you choose? Why? Scale? And then practice doing that.* (June 2014)

Several dimensions of numeracy seen in Goos et al.'s (2014) numeracy model were evident in this activity. Students tabulated and graphically represented the data they collected in the virtual field trip (representational *tools*) and made inferences (*critical orientation*) about the environmental impact of human activity on water quality (*context*). However, Barbara wanted students to develop the mathematical knowledge required to construct graphs from the data, rather than use graphs to mediate thinking about the situation; thus the opportunities for students to apply a critical orientation were limited by the time spent collecting the data. Furthermore, from a science perspective, there was no apparent purpose for constructing the graphs that would encourage students to employ a mathematical approach to the data; in other words, foster *dispositions* towards using mathematics in the situation. Posing some questions about the ecosystem at the beginning of the lesson would have given students a reason for constructing the graphs and may have helped them to engage with the task. Perhaps Barbara did not see this option because of her limited understanding of the discipline of science or because, as a mathematics teacher, she chose to emphasise the technical skills of graphing. In both cases it could be argued that she did not see the graphs from a contextual vantage point (Venkat & Winter, 2105).

Barbara's identity as an embedder-of-numeracy

The analysis of Barbara's identity as an embedder-of-numeracy draws on data that were collected in both years of the study. As a result, it is possible to give some limited sense of the trajectory of this identity. Barbara started the study teaching only mathematics, but by the end of the study had taught science to three different grade levels without being formally qualified to do so. Therefore, the analysis focuses on how she could be assisted to strengthen her identity as an embedder-of-numeracy in her role as an out-of-field science teacher. Thus, a useful starting point would be to provide opportunities for her to help her to develop the knowledge she needs for teaching science so that she is better placed to make connections between numeracy and disciplinary concepts.

Barbara's zone of proximal development (ZPD) includes possibilities for her to develop the capacity to promote numeracy learning in science. Her educational background and extensive experience teaching mathematics indicate that she has the expertise for the mathematics she is likely to encounter when teaching science. There had been few opportunities for Barbara to develop the knowledge needed for teaching science. She could see where numeracy was important for scientific understanding (the importance of scale when using a microscope); however, the current state of her science content ("I don't know the content"), pedagogical (would like some ideas), and curriculum knowledge (not picking up the opportunities) is likely to inhibit her development. Barbara recalled that her personal conception of numeracy had been very narrow at the start of the study but this had become somewhat richer as the study progressed (she saw numeracy as "can you do maths?" but would now include "the critical, the real life").

The zone of free movement/zone of promoted action (ZFM/ZPA) complex Barbara experienced was not overly supportive of her development. She had few opportunities to interact with others teaching science and it could be argued that, for Barbara as an out-of-field teacher, such interactions are essential to assist her to teach science, let alone identify numeracy learning opportunities in the new curriculum. Despite teaching out of field, she was expected to teach across a range of grade levels with few opportunities to work with qualified science teachers. The rich conception of numeracy and pedagogical approaches promoted by Numeracy Project were in conflict the school view of numeracy as NAPLAN and the expectations on her in her role as a Numeracy Coach. Furthermore, her access to computer technology for students' use depended on the class she was teaching.

When Barbara's ZPD is mapped onto her ZFM/ZPA complex, it could be argued that there is a crucial disjunction. Without opportunities to increase her knowledge for teaching science, Barbara is more likely to see opportunities in science for developing mathematical knowledge, as she did in the virtual field trip activity, than opportunities that enhance both numeracy and science learning.

Concluding Remarks

The larger study, from which Barbara's case was drawn, set out to identify ways to support teachers to promote numeracy learning through subjects across the curriculum. The study took place at a time of increased attention on numeracy, both internationally and in Australia. A major outcome of the study was a theoretical contribution to knowledge on teacher identity: a framework for identity as an embedder-of-numeracy and an adaptation of Valsiner's (1997) zone theory to capture the complexity and dynamic nature of teacher identity, respectively (Bennison, 2016). The ways in which out-of-field teachers promote numeracy learning was not a focus of the study but emerged as an area worthy of further research. Barbara's case allows a preliminary exploration of this area.

Barbara had no formal training in science, and so her knowledge for teaching this subject had mainly been developed through her experiences of doing so. She demonstrated in observed lessons (such as the one presented in this paper) that she was able to identify numeracy learning opportunities that were not identified by the numeracy icons in curriculum documents, and design tasks that addressed some aspects of numeracy in addition to mathematical knowledge. However, it could be argued that she could have utilised these tasks in ways that more fully exploited the numeracy learning opportunities she identified, and in ways that enhanced science learning. Limited opportunities to develop the subject knowledge (content, pedagogical, and curriculum) needed to teach science and the way in which she viewed the representational tools she employed were identified as contributing to the way in which she addressed numeracy learning opportunities in science. Further research is needed to investigate ways to assist out-of-field teachers to promote numeracy learning in ways that assist them to address the other challenges they face.

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Anne Bennison
a.bennison@uq.edu.au

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