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Mapping expertise in social science teaching: The professional development of a beginning teacher.

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Academic biographies:

Paul Reitano is a lecturer in geography and history education, and professional practice teaching at Griffith University. His research interests are rural teaching, the use of concept mapping and video stimulated recall to trace the professional growth of teachers. Before his appointment to Griffith University in 2011, he taught primary and secondary studies of society and environment and secondary geography and history at the University of New England (New South Wales) for 5 years. He is currently working in collaboration with academic colleagues and industry partners on an Australian Research Council Linkage Grant that is investigating the teaching of history in primary classrooms and early childhood settings.

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Abstract

This paper reports on a longitudinal study of a preservice teacher, Johannes, as he moved from his 4th (and final year) year of teacher education studies in an urban university in Australia, to his first year of social science teaching in a secondary school. From the outset of the study Johannes indicated a passion, commitment and understandings of good Social Science teaching. The study used concept mapping and think aloud protocol to elicit Johannes' evolving understandings over a twelve-month period. The findings indicate that he was well on his way to becoming an accomplished teacher in the Social Sciences. Johannes acknowledged that the concept mapping exercises assisted him in reflecting on his knowledge structures and facilitated him in making explicit his implicit understandings of classroom teaching.

Key words: teaching strategies, teaching situations, ownership, concept mapping, reflective teaching, pedagogical content knowledge, knowledge structures, knowledge bases, subordinate, superordinate, text, uncertainty, propositional, Social Science(s), assimilation, collection tool(s), Think Aloud Protocols (TAPs), explicit and implicit understandings, evidence.

Introduction

The evidence shows that it is the quality of the teacher and the teacher's skills that result in good learning outcomes, more so than the class size, school size, poverty, language background, race or parent education (Mayer, Mitchell, MacDonald & Bell 2005). According to Darling-Hammond (2000), the single most effective indicator of student learning is the teacher's capacity to use a range of teaching strategies to cater for a range teaching situations. In Australia, quality teachers are expected to promote positive relationships, and facilitate teaching and learning environments, which are supportive, inclusive and 'owned' by teachers and students (Teaching Australia 2007; Melbourne Declaration 2008).

The research also shows that there is a great deal of interest in reflective teaching and teachers' knowledge base and pedagogical skills. For example, there are descriptions of expert teachers (Loughran 2010; Turner-Bisset 2005; Taylor & Young 2004) and differences between the novice and expert teacher (Hattie 2003; 1991; Borko & Livingstone 1990; Berliner 1986). However, there is little evidence to show how Social Science teachers' knowledge changes and develops over time (Reitano 2004). A considerable amount of the research on preservice education learning has focused on general issues of cognition rather than the development of knowledge and understanding within specific subject/curriculum areas (Ruhama & Ball 2009; Wineburg 2001; Sosniak 1999). To date, there does not appear to have been any longitudinal studies conducted on the professional growth of teachers in the social

sciences. This study, then, seeks to make a contribution in this area. The study discussed in this article is timely as Australia is about to embark on national curriculum in which history and geography will be offered as core mandatory subjects in primary and lower secondary from 2013 onwards. These two core subjects will replace studies of society and environment curriculum currently taught in most states of Australia. Early career graduates like Johannes will be in demand because he possesses a clear understanding of the importance of content knowledge and pedagogical skills in the field of Social Science teaching.

The nature and significance of pedagogical content knowledge in Social Science teaching.

This study was conducted at a university in Queensland (QLD), Australia, where students have the option of enrolling in a one-year full time or two-year part time graduate diploma in education, or a combined undergraduate degree and education degree. At the time of the study, students who planned to teach in the Social Sciences were required to undertake Studies of Society and Environment (SOSE) in which this study was conducted. The course materials were structured in accordance with the requirements of the university's graduate attributes and expectations from the Queensland College of Teachers (2006).

The Queensland College of Teachers expect that initial teacher education programmes at universities will include content that covers, inter alia, knowledge of subject matter, knowledge of pedagogy, knowledge of students, and knowledge of the QLD curriculum. Similarly, the SOSE Syllabus (2000) expects students to develop the attributes of a lifelong learner, including a knowledgeable person, an active investigator, a complex thinker, and a reflective and self directed learner. The Queensland Productive Pedagogies articulates a four dimensional approach to quality teaching based around intellectual quality, connectedness, supportive classroom environment, and recognition of difference

(Queensland Department of Education Training and the Arts 2004). In their National Statement from the Teaching Profession on Teacher Standards, Quality and Professionalism (Australian College of Educators, n.d.), teachers should to be (a) knowledgeable about and skilled in subject matter and pedagogy, and (b) be effective in the care and development of all learners. The National Framework for Professional Standards for Teaching (Ministerial Council on Education, Employment and Training and Youth Affairs 2003) stated that "teachers know and understand the fundamental ideas, principles and structure of the disciplines... and they know how to effectively teach that content" (p.11).

The objectives outlined above suggest that upon completion of their Social Science methods course, early career teachers should possess knowledge of subject matter and associated pedagogical skills in history teaching. The relevant research literature also stresses the critical importance of subject matter knowledge, curriculum knowledge, knowledge of students, and the pedagogical skills needed to teach students (Shulman 1987, 1986). Shulman stated that good teaching is dependent upon the capacity of teachers to have "... deep and flexible understanding of what they are teaching" (Tell, 2001, p.6). Shulman (1987) argued that most teaching begins with some kind of 'text': a textbook, a unit of work, or a syllabus. Under a constructivist philosophy the concept of 'text' is broadened to a concept explicitly written or implicitly agreed that is the focal point for instruction. Lessons are about something, and while there may be several purposes to them, the means of attaining the learning are directed by the text or content. Content knowledge is the foundational knowledge base that contributes to pedagogical content knowledge. Content knowledge is the knowledge, understanding, skill, and disposition that are to be learnt by children (Shulman 1987) and indeed, the 'missing paradigm' of research on classroom teaching (Shulman 1986b). Feiman-Nemser and Parker (1990) state that the "understanding of subject matter is

sine qua non in teaching” (p.40). If teachers are expected to prioritise key ideas, skills, and concepts in subject matter knowledge and determine representation during the transformation process, they should have an understanding of the structural organization of the subject matter knowledge (Bruner 1977). While content knowledge is essential for teaching, the effective teacher is one who is then able to accommodate it into curriculum knowledge, that is, knowing the syllabi and work programs for a particular subject area, the particular topic, the level at which it is to be taught, the resources, and materials to be used. As Shulman (1986) explains:

The curriculum and its associated materials are the *materiamedica* of pedagogy, the *pharmacopeia* from which the teacher draws those tools of teaching that present or exemplify particular content and remediate or evaluate the adequacy of student accomplishments (p.10).

In order to successfully transform subject matter for student learning, teachers must also have a knowledge base of their learners; in fact, scholars such as Cochran, DeRuiter and King (1993) give students equal standing to content knowledge when identifying the components contributing to pedagogical content knowledge.

Pedagogical content knowledge is the knowledge base necessary for teachers to achieve effective teaching of their subject area to meet the cognitive and emotional needs of students. First enunciated by Shulman (1986) pedagogical content knowledge involves the blending of content and pedagogy into an understanding of how particular content knowledge is organised, represented and adapted to the diverse interests and abilities of students, and presented for instruction. That is to say, pedagogical content knowledge is that “...particular amalgam of pedagogy and content [that] makes teachers different from [other] scholars in the field...” (Gudmundsdottir, 1987, p. 4). The amalgam concerns:

...the most regularly taught topics in one’s subject area, the most useful forms of representation of those ideas, the most powerful analogies, illustrations, examples, explanations, and demonstrations... an understanding of what makes the learning of specific topics easy or difficult: the conceptions and preconceptions and misconceptions that students of different ages and backgrounds bring with them to the learning of those most frequently taught topics and lessons (Shulman 1986b, p. 9).

A feature of this kind of pedagogical content knowledge is that is nearly always requires public performance from students (Shulman 2005), and inherent in this visible role are the elements of uncertainty, unpredictability, and surprise. According to Schulman, “uncertainty produces both excitement and anxiety” (p.57). These pedagogies create an environment of risk taking, foreboding, exhilaration and excitement.

Chen and Ennis (1995) found in a study on high school physical education teachers that although they shared a common content knowledge; they differed in their personalized pedagogical content knowledge repertoire, based on their perceptions of students’ physical ability to deal with “basic” or “advanced” concepts and skills in volleyball. As the study’s recommendations from the findings stated, because students are different in abilities, prior knowledge, and learning styles, effective teachers should be able to teach a concept in “150 different ways” (Wilson, Shulman & Richert 1987). However, as Stimpson (2005) notes, the process of developing pedagogical content knowledge is a challenging one for beginning teachers as they try to accommodate the varying theories of classroom practice. Beginning teachers are inclined to make incorrect judgements about students’ misconceptions and tended to view teaching as telling rather than rather than representing content for student understanding (Hogan, Rabinowitz & Craven 2003). But Wilson (1991) states that we cannot expect beginning teachers to have

a wealth of representations that experienced teachers may have accumulated after years of practice. Instead, teacher education courses should at least equip preservice teachers with the skills and understanding necessary to generate representations of subject matter knowledge in ways that take advantage of what students already know and believe. The challenge, then, for lecturers in the Social Science field is to provide opportunities for preservice teachers to develop methods of effective History teaching, often in a limited amount of time.

**Developing pedagogical content knowledge:
Conceptual change for preservice teachers.**

A conceptual change model proposed by Posner, Strike, Hewson & Gertzog (1982), states that change occurs in a person's conceptions, as well as the addition of new knowledge. According to Hewson (1992), three broad interpretations of conceptual change exist: the extinction of one idea for another; an exchange of an idea for another; and, an extension of an idea. In short, for conceptual change to occur there must be the conditions and the context for conceptual change.

Vosniadu (2004) argued that conceptual change occurs when new ideas are in conflict with old ideas. Teachers' conceptions of teaching are influenced by conditions and context. For example, in the preservice education context in higher education, student teachers respond to their experiences with university teachers, professional practice teaching, induction, and professional development. In his study of conceptual change, Ausubel (1985) stressed the importance of prior knowledge in new learning. Ausubel said that learners use a process of "assimilation" in which "... the processes of acquiring information result in a modification of both newly acquired information and the specifically relevant aspect of cognitive structure to which new information is linked" (p.74). This new

information is generally linked to a relevant concept or proposition, which Ausubel called ideas "within the cognitive structure", the relationship of which may be subordinate, superordinate or a combination of both. Since cognitive structures are usually hierarchical in terms of ideas and abstractions, the inclusion of new propositional meanings typically involves a subordinate relationship to the existing cognitive structure. "Most meaningful learning is essentially the assimilation of new information" (Ausubel 1985, p.76). Research by Chi (2008) noted that this prior "in conflict with" knowledge is not about adding new knowledge or gap filling incomplete knowledge, rather learning is changing prior knowledge misconceptions. New understandings and reorganization of thought processes should be enhanced if beginning teachers are given the opportunity to reflect on their own understandings of teaching. Perhaps include a sentence or two about your "wonderings" which brought you to this research topic/question. As researchers and teachers in the field of teaching education we are interested in how beginning teachers conceptualise new knowledge, their understandings of newfound knowledge, and their knowledge growth as early career teachers at this critical phase in their teaching journey. For the purposes of this study, Johannes was given the opportunity to reflect on his knowledge structures by constructing concept maps on three occasions.

The study

The investigation into Johannes's understandings of effective Social Science teaching is a slice from a larger qualitative, longitudinal study of ten beginning teachers of Social Science conducted over a twelve month period – from the final six months of their teacher education to the first six months of practice teaching (Reitano, 2004). This paper focuses on Johannes's expertise teaching, that is, his conceptions of pedagogical content knowledge and demonstrates how concept mapping (and accompanying *Think Aloud Protocols* (TAPs) were

used to trace Johannes's knowledge growth, especially his pedagogical content knowledge, over a twelve month period. Concept map diagrams enabled the research to elicit the 'what' of teaching; and Think Aloud Protocols (TAPs) allowed the researcher to elicit the 'how' and 'why' behind his choices of concepts on his maps. Out of the ten participants in the study, Johannes demonstrated a complex understanding of the value of pedagogical content knowledge in teaching. This understanding was clearly borne out in his concept map constructions and commentaries during his think aloud protocol sessions.

The concept map as a data collection tool

The concept map is a schematic device that provides an external representation of structural knowledge (Novak & Gowin 1984) based on the author's finite system of cross-references between the personal observations s/he had successfully made of teaching and the personal constructs (Kelly 1955, 1979) s/he erected. In other words, concept maps "allow people to make explicit their views about how different concepts are related and why certain links are more or less valid" (Prawat 1989, p.11). Concept mapping was used by Novak and his graduates at Cornell University in 1972 as a tool to explore the nature of learning acquired by audio-tutorial instruction in schools. Since then concept maps have been widely used to examine how individuals organize their knowledge (Novak & Gowin 1984; Vosniadu 2004; Novak & Canas 2008).

A number of studies have shown that concept mapping is an effective method for assessing conceptual change (Novak & Masonda 1991; Morine-Dersheimer, Saunders, Artiles, Mostert, Tankersley, Trent, & Nuttycombe 1992; Markham, Mintzes, & Jones 1994; Jones & Vesilind 1995; Markow & Lonning 1998). It is regarded as particularly useful for those researchers who seek an insight into how teachers construct their concepts (Trowbridge & Wandersee 1994; Winitzky & Kauchak 1995; Zanting,

Verloop & Vermunt 2001). By comparing successive concept maps as the teacher develops mastery of a domain, "the researcher can see how knowledge is structured in the course of the acquisition" (Cary 1986, p. 1126). Morine-Dersheimer (1989) suggested that concept maps could provide teacher education students with valuable feedback on their knowledge growth. Lawless, Smee & O'Shea (1998) add that concept maps also show both the extent and organization of students' knowledge.

In a program of preservice teacher education, Johannes constructed concept map diagrams about "effective social science teaching", while at the same time, reflecting on the reasons for the selection of his concepts. *Think Aloud Protocols (TAPs)* are used in conjunction with the construction of a concept map diagram to provide further elaborations and facilitate the externalisation of the author's understanding and reasons for the selection of concepts (Rye & Rubba 1998). External verbalizations are considered reliable because the thinking aloud is occurring at almost the same time with the thinking process, and does not interfere with the task performance (Ericsson & Smith 1984; Schelling, Aarnoutse & van Leuwe 2006).

Johannes generated three concept maps over a twelve month period: (a) at the beginning of the final semester of his teacher education program; (b) six months later at the conclusion of his teacher education program; and (c) after six months of independent teaching practice.

Findings

Johannes's first concept map shows that he had a deep understanding of pedagogical content knowledge and its importance in the teaching and learning processes nomination of pedagogical content knowledge directly linked under the key concept of 'effective Social Science teaching' and its direct links to three of the four general concepts on his first concept map diagram (see Figure 1), clearly shows its importance in Social Science

teaching. The powerful linking words, 'must have clear understanding of' that links 'pedagogical content knowledge' to the key concept, demonstrates its central role in effective social science teaching. The propositional links 'Pedagogical content knowledge' forms with the general concepts of 'Knowledge', 'Pedagogy', and 'Classroom management', further indicate – and confirm – that pedagogical content knowledge is just not another concept but one which connects all of these knowledge hierarchies leading to cognitive and attitudinal outcomes. As he explained in *Think Aloud Protocol*,

...PCK becomes that...that real art of knowing...having the disciplinary knowledge ...that...you know through our academic studies...and then studying... pedagogy in our teaching studies ...finding that way of melding the two into something that is really appropriate and relevant to students...

However, Johannes also pointed out that were other challenges that had to be overcome first before one could engage in learner-centred teaching, such as striking the right balance of instructional strategies for students. He said that, if the instruction were teacher-centred, then you *...limit...the dominant students ...overtaking the meek students ...*

Six months later Johannes again nominated 'Pedagogical content knowledge' on his second concept map (see Figure 2) but this time as a propositional concept directly subordinate to the general concept of 'constructivism'. Nevertheless, its position within this hierarchy shows that its role as a propositional concept is crucial because constructivism 'relies on' pedagogical content knowledge, and in turn, is dependent upon and linked to a branch of propositional concepts – 'disciplinary knowledge', 'learner-centred approach' and 'scaffolding'.

He stated in his *Think Aloud Protocol* that constructivism was the,

...sort of ... over-arching principle that basically ...umm...for myself...for effective social science teaching...I think is getting away from the transmissive model... All teaching at the moment...I sort of...when I think of ...umm...executing the theory of constructivism in my practice...the focus is away from the teacher as the imparter of knowledge and students are deemed best to learn ...umm...among themselves...and the most valuable knowledge is that which they can construct among themselves...and although the teacher is still in that model of knowledge...() is always just outside that learning circle that can be used to bounce stuff off and draw new information from.

Johannes is reaffirming the critical role of constructivism, a construct that reflects the intentions of his concept map diagram. Johannes understand that the teacher is not just an imparter of knowledge but one who uses scaffolding and a learner-centred approach to unpack knowledge for students in a socially constructed environment.

Johannes's second teaching area was science, and because he was of the few staff members who replace an ill colleague in the science department, he was seconded into that department for twelve months at the expense of teaching Social Science. Despite his move into science, Johannes's third concept map, after six months of independent teaching practice, indicated shows that 'pedagogical content knowledge' is once again a propositional concept to the key concept and to the general concepts of 'Disciplinary knowledge' and 'Knowledge of learners' (see Figure 3). His concept map (see Figure 3) shows that pedagogical content knowledge is regarded as the overarching or superordinate construct that integrates the other knowledge bases on his concept map at the macro level. The use of the linking words, 'involves the ongoing development and refining of' that links 'pedagogical content' knowledge' with the key concept, indicated Johannes's powerful thinking about the developmental nature of pedagogical content knowledge in terms of

'disciplinary knowledge' and 'knowledge of learners' in effective science teaching. Johannes's *Think Aloud Protocol* stated that pedagogical content knowledge involves teachers confidently bringing

...their disciplinary knowledge ...to bear on students...how the teacher explains and scaffolds learning... experiences... and bridges the gap...between students' naïve concepts ... and my more scientific explanations of things... umm... pedagogical content knowledge... involves how the teacher...corrects those misconceptions of students ...have...and it recognises ... a constructivist approach in...that it ...acknowledges...that it is not enough simply ...to tell a student that they are wrong...but in fact they need to establish the student's knowledge base...and make the student aware of that and then...work out what... level...then provide ...using their disciplinary... provide ... learning experiences that... challenge the students to move... a little bit further outside of that ... umm... circle of knowledge that they are actually at...at that stage...And so just to cause just a little bit of conflict in the student ...enough that ...the student can start to redefine their knowledge ...

Two points emerge from this commentary. First, Johannes responds to students' misconceptions, not by shutting down the dialogue between him and his students because an answer may be incorrect, but by explaining and tailoring an explanation to the level of the students' abilities. His explanations are also about challenging students, so his understanding of pedagogical content knowledge is about balance – "just a little bit of conflict" to encourage the extinction of one idea for another.

Discussion and implications

Johannes's nomination of pedagogical content knowledge as a concept on his three concept map constructions indicate that he has read the literature about this type of knowledge for effective classroom

teaching. His first and third concept maps show that pedagogical content knowledge is located as a propositional concept to the key concept and to general concepts (see Figures 1 and 3) indicating its critical role in teaching. His commentaries include: catering for visual learners in class; relating concepts to students' prior experiences; melding content and pedagogy that is appropriate to students; scaffolding and bridging the gap; and moving away from transmissive knowledge to the most valuable knowledge which students themselves construct. Johannes's commentaries about his pedagogical content knowledge through his *Think aloud* sessions confirm Dewey's (1904/1974) concern that preservice teachers should be involved actively in the reflective inquiry process in order to understand what takes place when learning occurs. Reflection is not just seen as an incidental act but as a disciplined way of thinking that involves "reviewing, reconstructing, re-enacting and critically analysing one's own and the class's performance, and grounding explanation in evidence" (Shulman, 1987, p. 15). The value of concept mapping (accompanied by the *Think Aloud Protocol*) is that these techniques allow beginning teachers to engage in reflection on their classroom teaching – to make explicit their implicit understandings of their beliefs of teaching. Concept mapping can be introduced into students' first year of university studies as a means of instilling critical reflective practices and then using e-portfolio and digital portfolios to revisit their understandings, especially when they undergo professional practice experience. While this paper has focused on one beginning teacher, research with a larger group of students is reported in Reitano (2004) and Reitano and Green (Submitted 2012).

References

- Australian College of Educators (n.d.) *National Statement from the Teaching Profession on Teacher Standards, Quality and Professionalism*.
- Australian Institute for Teaching and School Leadership Limited, 2008, *Teaching Australia*.

www.aitsl.edu.au/

Ausubel, D.P. (1985) Learning as constructing meaning. In N. Entwistle (Ed.) *New directions in educational psychology: Learning and teaching*. London: The Palmer Press. 71-82.

Berliner, D.C. (1986) In pursuit of the expert pedagogue. *Educational Researcher* 15 (7): 5-13.

Borko, H. & Livingstone, C. (1990) Cognition and improvisation: Differences in mathematics instruction by expert and novice teachers. *American Educational Research Journal* 26: 473-498.

Cary, S. (1986) Cognitive science and science education. *American Psychologist* 41(10): 1123-1130.

Chen, A. & Ennis, C.D. (1995) Content knowledge transformation: An examination of the relationship between content knowledge and curricula. *Teaching and Teacher Education* 11 (4): 389-401.

Chi, M. (2008) Three types of conceptual change: Belief revision, mental model transformation, and categorical shift. In S. Vosniadou (Ed.) *Handbook of research on conceptual change*. Hillsdale, NJ: Erlbaum. 61-82.

Darling-Hammond, L. (2000) Teacher quality and student achievement: A review of state policy evidence. *Education and Policy Analysis Archives* 8 (1). Retrieved 21 March 2007 from: <http://epaa.asu.edu/epaa/v8n1/>.

Dewey, J. (1904/1974) The relation of theory to practice in education. In R. Archambault (Ed.) *John Dewey on education: selected writings*. Chicago: Chicago University Press.

Ericsson, K.A. & Simon, H. (1996) *Protocol Analysis: Verbal reports as data*. Cambridge, MA: MIT Press.

Feiman-Nemser, S. (2001) From preparation to practice: designing a continuum to strengthen and sustain teaching. *Teachers College Record* 103 (6): 1013-1055.

Gudmundsdottir, S. (1987b) Pedagogical content knowledge: Teachers' ways of knowing. Paper presented at the meeting of American Educational Research Association, Washington, DC. (ERIC Document Reproduction Service No.ED 290 700).

Hattie, J. (2003) Teachers Make a Difference: What is the research evidence? *Australian Council of Educational Research*. October 2003. Retrieved 18 September 2011 from: www.acer.edu.au/documents/RC2003_Hattie_Teachers_MakeADifference.pdf.

Hewson, P. (1992) Conceptual change in science teaching and teacher education. Paper presented at the

meeting of Research and Curriculum Development in Science Teaching, under the auspices of the National Center for Educational Research, Documentation, and Assessment, Ministry for Education and Science, Madrid, Spain, June, 1992.

Hogan, T.; Rabinowitz, M. & Craven, J.A. (2003) Representations in teaching: Inferences from expert and novice teacher. *Educational Psychologist* 38 (4): 235-248.

Jones, M.G. & Vesilind, E. (1995) Preservice teachers' cognitive frameworks for class management. *Teaching and Teacher Education* 11 (4): 313-330.

Kelly, G.A. (1955) *The psychology of personal constructs (Vols. 1-2)*. New York: Norton.

Kelly, G.A. (1979) *Clinical psychology and personality: The selected papers of George Kelly*. Huntington, New York: R.E. Krieger Publication Company.

Lawless, C.; Smee, P. & O'Shea, T. (1998) Using concept sorting and concept mapping in business and public education, and in education: An overview. *Educational Research* 40 (2): 219-235.

Loughran, J. (2010) *What expert teachers do: Enhancing professional knowledge for classroom practice*. Melbourne: Allen & Unwin.

Markham, K.M.; Mintzes, J.J. & Jones, M.G. (1994) The concept map as a research and evaluation tool: Further evidence of validity. *Journal of Research in Science Teaching* 31: 91-101.

Markow, P.G. & Lonning, R.A. (1998) Usefulness of concept maps in college chemistry laboratories: students' perceptions and effects of achievement. *Journal of Research in Science Teaching* 35 (9): 1015-1029.

Mayer, D.; Mitchell, J.; MacDonald, D. & Bell, R. (2005) Professional standards for teachers: A case study of professional learning. *Asia-Pacific Journal of Teacher Education*. 33 (2): 159-179.

Ministerial Council on Education, Employment, Training and Youth Affairs, 2008, *Melbourne Declaration on Educational Goals for Young Australians*.

Ministerial Council on Education, Employment, Training and Youth Affairs Ministerial Council on Education, Employment, Training and Youth Affairs (2003) *A National Framework for Professional Standards for Teaching*.

Morime-Dershimer, G. (1989) Preservice teachers' conceptions of content and pedagogy: Measuring

growth in reflective, pedagogical decision making. *Journal of Teacher Education* 40 (5): 46-52.

Morine-Dershimer, G.; Saunders, S.; Artiles, A.J.; Mostert, M.P.; Tankersley, M.; Trent, S.C. & Nuttycombe, D.G. (1992) Choosing among alternatives for tracing conceptual change. *Teaching and Teacher Education* 8 (5/6): 471-483.

Novak, J.D. & Canas, A.J. (2008) The theory underlying concept maps and how to construct them and use them. *Institute for Human and Machine Cognition*, Technical Report IHMC Cmap Tools 2006-01 Rev-2008, Florida, <http://cmap.ihmac.us/Publications/ResearchPapers/TheoryUnderlyingConceptMaps.pdf>.

Novak, J.D. & Gowin, D.B. (1984) *Learning how to learn*. New York: Cambridge University Press.

Novak, J.D. & Musonda, D. (1991) A twelve year longitudinal study of science concept learning. *American Educational Research Journal* 28: 117-153.

Posner, G.; Strike, K.; Hewson, P. & Gertzog, W. (1982) Accommodation of a scientific conception: Toward a theory of conceptual change. *Science Education* 66 (2): 211-227.

Prawat, R.S. (1989) Promoting access to knowledge, strategy, and disposition in students: A research synthesis. *Review of Educational Research* 59 (1): 1-41.

Queensland College of Teachers (2006) *Professional Standards for Queensland Teachers*. Retrieved 18 September 2011 from: www.qct.edu.au/standards/.

Queensland Department of Education and Training and the Arts (2004) Productive pedagogy. Retrieved 15 March 2008, from: <http://education.qld.gov.au/corporate/newbasics/html/pedagogies/pedagog.htm>.

Reitano, P. (2004) From preservice to inservice teaching: A study of conceptual change and knowledge in action. Unpublished doctoral thesis, Griffith University, Queensland, Australia.

Reitano, P. & Green, N. (2012) Concept mapping with beginning geography teachers: A study of conceptual change. Manuscript submitted for publication.

Ruhama, E. & Ball, D. (2009) *The Professional Education and Development of Teachers of Mathematic*. The 15th ICMI Study. New York: Springer.

Rye, J.A. & Rubba, P.A. (1998) An exploration of the concept map as an interview tool to facilitate the externalisation of students' understanding about global atmospheric change. *Journal of Research in Science Teaching* 35 (5): 521-546.

Schellings, G.; Aarnoutse, C. & van Leeuwe, J. (2006) Third-grader's think-aloud protocols: Types of reading activities in reading an expository text'. *Learning and Instruction* 16: 549-568.

Shulman, L. S. (1986b) Those who understand: knowledge growth in teaching. *Educational Researcher* 15(2): 4-14.

Shulman, L.S. (1987) Knowledge and teaching: foundations of the new reform. *Harvard Educational Review* 57 (1): 1-22.

Sosniak, L. (1999) Professional and subject matter knowledge for teacher education. In G. Griffen (Ed.) *The education of teachers* (98th Year Book of the National Society for the Study of Education, Part I). Chicago: University of Chicago Press. 185-204.

Stimpson, P. (2005) Coming to grips with change: The initial training of Geography teachers in Hong Kong. *International Research in Geographical and Environmental Education* 13 (2): 159-163.

Taylor, T. & Young, C. (2004) *Making history: A guide for the teaching and learning of history in Australian schools*. Curriculum Corporation. <http://www.curriculum.edu.au>.

Tell, C. (2001) Appreciating Good Teaching: A conversation with Lee Shulman. *Evaluating Educators* 58(5): 6-11.

Turner-Bisset, R. (2005) *Creative teaching: History in the primary classroom*. Abingdon: David Fulton Publishers.

Trowbridge, J. & Wandersee, J. (1994) Identifying critical junctures in learning in a college course on evolution. *Journal of Research in Science Teaching* 31: 459-473.

Vosniadou, S. (2004) Extending the conceptual change approach to mathematics learning and teaching. *Learning and Instruction* 14: 445-451.

Wilson, S. (1991) Parades of facts, stories of the past: What do novice history teachers need to know? In M. Kennedy (Ed.) *Teaching Academic Subjects to Diverse Learners*. New York: Teachers College Press. 99-116.

Wilson, S.; Shulman, L.S. & Richert, A.E. (1987) 150 different ways of knowing: representations of knowledge in teaching. In J. Calderhead (Ed.) *Exploring Teachers' Thinking*. London: Cassell. 104-125.

Wineburg, S. (2001) *Historical thinking and other unnatural acts: Charting the future of teaching the past*. Philadelphia: Temple University Press.

Winitzky, N. & Kauchak, D. (1995) Learning to teach: knowledge development in classroom management. *Teaching and Teacher Education* 11 (5): 215-227.

Zanting, A.; Verloop, N. & Vermunt, J.D. (2001) Student teachers eliciting mentors practical knowledge and comparing it to their own beliefs. *Teaching and Teacher Education* 17 (6): 725-740.