

A Critical Analysis of the Relationship between Teacher Subject Knowledge and Effective Learning and Teaching in the Primary School.

Teachers educate children by scaffolding their knowledge and understanding through effective teaching and learning strategies, which requires a depth of knowledge (Alexander et al., 1992; Prestage and Preks, 1999; Berliner, 2001; 2004, Rowland et al., 2009). This assignment will critically evaluate the relationship between teacher subject knowledge and effective teaching and learning. Shulman (1986)'s seminal work will be evaluated, focusing upon, three of the seven categories of teacher knowledge which he identified in his research: Subject matter knowledge (SMK), Pedagogical content knowledge (PCK) and curricular knowledge (Shulman, 1986:9). The Knowledge Quartet (KQ), which is a theoretical framework used for analysis and development of teaching mathematics will be discussed (Rowland, 2017; Rowland et al., 2005). The four dimensions of the KQ will be critically evaluated and how they can be related to the categories of teacher knowledge identified by Shulman (Rowland, 2017; 2014; Rowland et al., 2009; 2005). The new curriculum for Wales will be drawn upon, highlighting how subject knowledge is interpreted within it (Donaldson, 2015). Key points, similarities, differences and implications will be reviewed from the three perspectives (Shulman, 1986; Rowland, 2014; Donaldson, 2015).

An analysis and reflection of the writer's subject knowledge for primary teaching will be evaluated, making reference to key points outlined from the three perspectives discussed in the review of literature. The personal reflection throughout this assignment will be based upon the writer's personal professional teaching experience (PTE). Which took place in a large primary school, situated in the seaside town of Porthcawl in the local authority of Bridgend. In the foundation phase reception class, with children between the ages of 4 to 5 years.

Literature Review

'Effective teaching and learning *requires a myriad of knowledge and skills, knowledge about pupils, systems and structures...styles of teaching...management, resources and assessment as well as knowledge about a subject*' (Prestage and Preks, 1999:1). There is a depth of existing research dating from the late 1980's to early 2000's on teacher knowledge, including professional knowledge as well as definitions of different

forms of knowledge that a teacher possesses (Shulman, 1986; Wilson et al., 1987; Browne and McIntyre, 1993; Marks, 1990; Aubrey, 1997; Berliner, 2001; Berliner 2004). These literature sources support the debate surrounding teachers' knowledge and the role of supporting effective teaching and learning. For this assignment subject knowledge will be evaluated. Begle, (1979); Alexander et al. (1992); Watt (1996) and Harlen (1996)'s early research supports the view that only teachers with sound and secure subject knowledge can scaffold children's knowledge and understanding through effective teaching and learning. Nevertheless, Brants (2006)'s later research states that the importance of a teacher solely processing sound subject knowledge, is a medieval view and that the pedagogical skills of the teacher in support of good subject knowledge actively promotes effective teaching and learning. Furthermore, Sammons and Bakkum (2014) states, effective teaching and learning is generally referred to and measured in the terms of student outcomes and academic achievements. Additionally, Coe at al. (2014)'s research added that a teacher's subject knowledge and their understanding of how pupils engage in the subject both impact on outcomes and academic success. Hill et al. (2005) study supported the opposing view, that insufficient teacher subject knowledge and confidence results in learners achieving low academic standards. Highlighting that both 'content knowledge' and PCK are important when analysing effective teaching and learning in the primary school. This supports the research by Shulman (1987) in that the subject knowledge and knowledge of pedagogy and the way it is applied during the teaching, supports effective learning. Despite Shulman's clear theoretical distinction, Guerriero (2017) highlighted the debate in whether, content knowledge and PCK fall into the same concept or if they are independent of each other. Shulman (1987; 1988) places them into separate categories but this is opposed by Depaepe et al. (2013)'s review and Hill et al. (2004) where they believe they are combined.

Shulman (1987; 1988)'s research suggested that there was a rareness in teachers as experts and that the purpose of the new reform was to professionalise teachers. This is recently supported by the European Commission (2013) who outline that 'national policies to promote the profession are lacking' and changes need to be made.

Shulman (1987; 1988) believed in order for teachers to become professionalised, there must be a standard of academia (like the trainee Qualified Teaching status standards (QTSS)). Shulman's study of Nancy demonstrated she possessed high

standards of subject knowledge. Although the research showed that it was not the only element that enabled her to become professionalised. For Nancy, the research focused on the way which she managed the class and how she passed her subject knowledge on to the learners deemed her to be classed as professionalized. Berliner (2001; 2004) states teachers are the key participant in improving their own professionalism, there are variation which exist in qualification level, area of expertise, PTE which affects one's professionalism. The research on Nancy does not make reference to where she acquired her high standards of subject knowledge and success of passing on that knowledge. BREa (2014) added engaging in and becoming better consumers of research would empower the profession and teachers to become more informed by research in a systematic way. Using it to improve knowledge to inform and influence effective teaching and learning.

According to Rowland and Turner (2007), Shulman's seminal work in the 1980's, identified seven categories of teacher knowledge. However, only the three which focus explicitly on subject content knowledge will be discussed. Subject matter knowledge (SMK), pedagogical content knowledge (PCK) and curricular knowledge (Rowland and turner, 2007:108; Shulman, 1986:9). SMK involves both 'substantive' and 'syntactic' knowledge (Rowland et al., 2009:20). According to Garvey (1996) substantive knowledge refers to facts, skills, concepts and how they are linked; such as knowing how to count to ten. Whereas, the syntactic knowledge refers to the methods of inquiry; based on the process of doing mathematics rather than the product outcome (concept of one more that will be discussed in the reflection section) (Garvey, 1996; Rowland et al. 2009). Donaldson (2015)'s new curriculum focuses less upon SMK and more upon the PCK, referring to the skills, dispositions and attitudes essential for effective teaching and teaching in the successful futures document. Shulman (1986)'s research states PCK goes beyond SMK, this is the way in which a teacher represents and formulates the subject to allow it to be comprehensible to the learners. This involves an understanding of age and stage related conceptions which makes the learning of specific subjects easy or difficult and the way the teachers break down and explain ideas (Guerriero, 2017). Shulman (1986; 1987) highlights curricular knowledge, which refers to what the learners are expected to learn, including the knowledge of related resources and curriculum documents (National literacy and numeracy, digital competence, national curriculum and foundation phase

frameworks). Hume (2017) reports that the new curriculum is causing implications at present for trainee teachers in Wales, as not all schools are being proactive in their approach of adopting the new style. Resulting in implications for trainee teachers working towards refining a sound and secure curricular knowledge (Hume, 2017). This will be reflected upon later in the assignment. However, Rowland et al. (2017) states the acquisition of knowledge for teaching neither begins nor ends during initial teacher training, however the PTEs and training institutions are key environments for raising and refining the pedagogic awareness and develop curricular knowledge, becoming aware of the national curriculum.

When evaluating Schulman's first research, it focused upon the medical profession and his later longitudinal study researched teachers in a secondary context (Elstein et al., 1978; Shulman, 1986). However, Rowland et al. (2009) claims that all professionals such as lawyers and architects have specific knowledge that is distinct to their domain of operation, and teaching is no deviation, in the primary or secondary context.

The theoretical frame work KQ arose from Rowland's research on primary mathematics teachers, unlike Shulman (1987; 1986)'s research which was based on secondary teachers. The KQ categorises particular events in lessons, with particular reference to the subject matter being taught and the knowledge teachers call upon. Whereas, Shulman's identifies the difference between SMK and PCK underpins this consideration of teaching (Schulman, 1986; Rowland et al., 2009). Therefore, Shulman's work focuses on knowledge base and the KQ focuses on the process. The KQ consists of four dimensions that can be related to the seven categories of teacher knowledge identified by Shulman (Rowland et al., 2017; Shulman, 1986; 1987).

The first dimension being, 'foundation' which surrounds the SMK category. The second dimension, 'transformation' was also a term used by Shulman (1987; 1986) when describing the meaning of PCK. Both the KQ and Shulman stated that these two ways of categorising subject knowledge are closely related but classified separately. Unlike researchers previously mentioned who state they are combined (Depaepe et al., 2013; Hill et al., 2004). The third dimension, 'connection' is not straight forwardly linked to any singular categories of Shulman's research (Rowland, 2017). It links with both SMK and PCK; making connections between both. The last dimension, 'contingency' involves all seven areas of Shulmans categories (Rowland, 2017). This

dimension involves 'thinking on one's feet' (Rowland, 2017:33). And this may require any combination of the seven categories identified by Shulman's research (1986; 1987).

From the literature reviewed it is evident that subject knowledge in relation to producing effective teaching and learning is difficult to identify. However, Rowland et al. (2005) designed the KQ to help tutors, class teacher-mentors and trainee teachers reflect and identify aspects of content knowledge that affected or supported effective teaching and learning. The theoretical framework will be used for analysis of reflection later in the assignment.

According to Donaldson (2015) recent year's curriculums have been based on a belief that subject knowledge is the best path to a sound, relevant and effective teaching and learning. However, the Welsh Government (WG) commissioned research which recognised a need to move away from a knowledge taught curricular and for a move towards a more 'skills-based curricula... focused on identifying and defining essential overarching competences alongside the more traditional subject-based curriculum content' (NFER and Arad Research, 2013). Involving teachers to have both SMK and PCK; as Donaldson (2015) highlights the 'subject against skill/competence' debate, he believes both make important contributions to fulfilling the purposes of the curriculum. Donaldson (2015) highlights the knowledge but places more emphasis on the skills to connect and apply that knowledge in different contexts. So less on the SMK and more on the PCK. Donaldson (2015) states the new curriculum will support a broad education. Willingham (2009) highlighted that teachers' knowledge in the primary context has to be broad as well as deep. According to Rowland et al. (2017) a larger scope of knowledge in subject areas allows teachers to be more confident, flexible in their approach and can help develop students thinking through processes such a Bloom's taxonomy of questioning; which focuses on the PCK; how teachers teach and how they help learners fully comprehend what is being taught.

Therefore, Shulman (1986; 1987)'s work focuses on knowledge base and Rowland et al., (2005)'s KQ focuses on the process. Whereas, Donaldson focuses heavily on the pedagogy and the experiences created for the learners, with less emphasis on subject knowledge and dictation of how we should teach.

Reflection

I disagree with the point made in the literature review that, only teachers with sound and secure subject knowledge can scaffold children's knowledge and understanding through effective teaching and learning (Begle, 1979; Alexander et al., 1992; Watt, 1996 and Harlen,1996). On reflection, during my PTE I was asked to support a group of children by reinforcing their phonic sounds. My knowledge of phonics is based upon the training and knowledge I have of the 'Read Write Inc.' programme. Nevertheless, my school use the 'Letter and Sounds' Programme. Both quite different programmes. Although, using my SMK which was limited and my PCK which was not, I was able to motivate and engage the learners, reinforcing their sounds and using questioning techniques which promoted their creative thinking and their understanding. Which is recognised by Rowland (2017) as an effective teaching strategy for ensuring learners understand what they are learning. Furthermore, on reflection I will take responsibility in upskilling myself with the Letter and Sounds programme. Which is supported by Berliner (2001; 2004) who states teachers are the key participant in improving their own professionalism.

I have decided to reflect on my subject knowledge using my PTE and relating my experiences to the four KQ dimensions (Rowland, 2017; Rowland et al., 2005).

Foundation: this involves SMK; as well as beliefs on the subject, it involves the pedagogy that is brought to the teaching of the subject (Rowland, 2017:35). On reflection of this dimension, during a mathematics lesson I showed evidence of this. I made my own resources which supported my own teaching strategies rather than adhering to unit plans or textbooks. I made and collected a range of resources and created an interactive supporting power point to introduce the mathematical concept of 'one more' up to ten. I used relatable characters (Paw patrol, Peppa pig and Frozen princesses) and the birthday theme. We opened birthday cards which expressed the age of each character being one more than their matching friend. The children then had to express their ages using how many candles were needed for their matching friend, then add one more. I used the correct mathematical language; one more, bigger number. On reflection my SMK was secure and my understanding of how the learners engaged impacting positively on each child's academic success which I tracked in relation to outcomes (Coe at al., 2014). In relation of Shulman's (1986; 1987) the knowledge of numbers 1-10 and understanding numbers in a sequence- would come

under my SMK. The use of and knowing how to use the interactive teaching resources come under the PCK; and thirdly the curricular knowledge of teaching the Mathematical development concept outcome of 'understanding one more from one to ten' (WG, 2016). From this reflection it is evident that effective teaching and learning is more than what I knew about the subject, it was how I represented the subject by making connections to prior knowledge.

Transformation: This involves how well I am able to transform what learners already know in ways which are accessible and understood by all children. The dimension moves way from the acquisition of knowledge, to knowledge in action which is demonstrated in both planning to teach and the act of teaching itself (Rowland et al., 2017). On reflection of this dimension I have started to use questioning effectively to access and develop children's knowledge and understanding. However, this has not always been the case. After my first observation, it was evident to my tutor that I needed to improve my questioning capabilities to maximise effective teaching and learning. I did this by up-skilling myself once again using a variety of sources; more knowledgeable other (Vygotsky), social media sharing groups for thoughts and ideas, educational research and information from lectures. Again, upskilling myself, being the key participant in improving my own professionalism which in turn will impact on my teaching and learning (Berliner, 2001; 2004).

Connection: this is the third dimension, it involves the decisions regarding a sequencing of lessons which help by connecting and building upon prior knowledge (Rowland et al., 2017). During my PTE I planned a sequence of cross curricular lessons involving mathematical development and the digital competence framework (DCF) (WG, 2018). The first lesson included a message from the 'Sleepy Shepherd' who is a relatable character from the Christmas concert; he had lost his sheep and needed help to find them and asked for the data to be interpreted using a tally chart. The first lesson introduced data collection and one way of collecting it. The second was another message from the sleeping Sleepy Shepherd asking for an explanation of what a tally chart is, what the marks mean and what it tell us about the data. He had also lost his sheep again and was hoping for the children to digitally interpret the data and send it to him via HWB. HWB is a platform which hosts a collection of digital resources and tools to support education in Wales, which will support effective teaching and learning (WG, 2014). The platform helps support one of the new cross-

curricular responsibilities from the new curriculum (Donaldson, 2015). On reflection the sequence of planned lessons related to the previous learning and the pupils' knowledge. Allowing them to connect their understanding and to learn complex concepts of data interpretation by breaking it down into steps that can be easily understood (Rowland et al., 2017). Reflecting upon this, I can see I clearly helped the children build new knowledge upon prior knowledge and to acquire skills to enable the learning to be transferable into relatable experiences, supporting the new skill-based curriculum (Donaldson, 2015).

The sequence of lessons brought implications to my PTE. My tutor was unhappy for me to plan to use the DCF and HWB platform, as she is not confident with the new changes of the curriculum. This supports Hume (2017) who recognises that trainee teachers are finding it difficult to secure a sound knowledge of the new curriculum because not all schools and teachers are being proactive to the change and are following on from 'what we have done' approach. However, Donaldson (2015) implies that, theoretical foundation to guide instructional decisions are a must, rather than relying on the imitation of another teacher or a trial and error basis.

Contingency: is the fourth and final dimension. It involves the ability to 'think on one's feet', responding to the unexpected, rather than the ability to make predictions at the planning stage (Rowlands, 2017:37). On reflection, I experienced this during my PTE and had to call upon my SMK and PCK to help me during my mathematic lesson on chronological ordering. The misconception adopted by the children was: if you are bigger, you are older. My supporting resources involved a slide with an old lady who was much shorter than the teenager. The children were adamant that the old lady was younger because she was shorter. One child exclaimed that you grow, so the older you get, the taller you become. I thought on my feet and used the adults in the class to help the learners understand this misconception. The oldest adult was shorter, with wrinkles and grey hair and the youngest, tall with dark hair. I also used the children as some were five years old and others still four years. I used effective questioning and 'pose, pause, pounce, bounce' to ensure pupils were listening to their peers and I found the answers given pushed the learning deeper (Lamb, 2016). It allowed the learners to reevaluate the misconception and draw upon the right conception. According to Allen (2007) misconceptions often lead to learning difficulties in mathematics and are a result of previous inadequate teaching, informal thinking or

poor remembrance. Lamb (2016) adds that these misconceptions should be addressed sooner rather than later to ensure effective teaching and learning.

Donaldson (2015) states that teaching of the Welsh language is to remain compulsory up to the age of 16 in the new curriculum documents. Although the new expectation is that learners gain “transactional competence” by end of their studies. To enable learners to converse in Welsh and English. On reflection of this I have very limited SMK of Welsh. In support of Shulman (1986; 1986) research, I have the ‘curriculum knowledge’ by understanding what policy states that I should be teaching, although I do not have the SMK. I must take responsibility in upskilling my subject knowledge to enable me to become successful in my SMK of Welsh, to ensure I promote successful and effective teaching and learning. However, not only my SMK, but my PCK; how to transfer this knowledge to the learners (Rowland et al., 2017). I believe that through the process of planning and teaching specific content, myself as a trainee teacher can develop more powerful forms of subject matter knowledge (Shulman, 1986; 1987).

Conclusion

In conclusion, teachers educate children by scaffolding their knowledge and understanding through effective teaching and learning strategies, which requires subject base and pedagogical knowledge (Alexander et al., 1992; Prestage and Preks, 1999; Berliner, 2001; 2004, Rowland et al., 2009). It has been argued that only teachers with a secure and sound subject and curriculum knowledge can support effective teaching and learning (Harlen, 1996). While others state, that the pedagogical knowledge must be secure (Brants, 2006).

The research reviewed critically evaluated Shulman’s (1986) seminal work, Rowland et al.’s (2009) KQ and the new curriculum according to Donaldson’s (2015) recommendations. Its highlighted similarities, differences and implications in all three in relation to their views on subject knowledge for teachers and trainees. Shulman (1986; 1987)’s work focuses on the knowledge base, with Rowland et al., (2005)’s KQ focusing on the knowledge process. Donaldson focuses heavily on the pedagogy and the experiences created for the learners, with less emphasis on subject knowledge and more on the transferable skills taught to enable children to access more knowledge, enabling them to be ‘successful, capable contributors’ in an ever-changing world.

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On reflection of my PTE in relation to the KQ and Shulman's categories and from the literature reviewed, teachers are the key participants in improving their own professionalism, SMK and PCK in order to promote effective teaching and learning.

From reflecting on my own PTE, I believe my subject base knowledge is important and needs to be broad as well as deep to enable me to teach and the pupils to learn effectively. However, SMK alone will not secure effective teaching, the PCK, the way in which I transfer the knowledge to teach the children is of upmost importance to ensuring effective teaching and learning.

Reference List

Alexander, R., Rose, A. and Woodhead, C. (1992) *Curriculum Organisation and Classroom Practice in Primary Schools: A Discussion Paper*. London : DES.

Allan, D. (2007) *Student Thinking*. A and M University: Texas.

Aubrey, C. (1997) *Mathematics teaching in the early years, An Investigation of Teacher's subject knowledge*. Falmer Press: London.

Baumert, J. (2010), 'Teachers' Mathematical Knowledge, Cognitive Activation in the classroom, and Student Progress', *America Education Research Journal*, Volume 47, 1, pp: 133-180.

Brant, J. (2006) 'Subject knowledge and pedagogic knowledge: ingredients for good teaching? An English perspective', *Edukacja*, Volume 94, 2, pp: 60-77.

Begle, E. G. (1979) *Critical Variables in Mathematics Education: Findings from a survey of the Empirical Literature*. Washington DC: Mathematics Association of America and National Council of Teachers of Mathematics.

Berliner, D, C. (2001) 'Learning about and Learning from Expert teachers', *International Journal of Education*, Volume 35, pp: 463-482.

Berliner, D, C. (2004) 'Describing the Behavior and Documenting the Accomplishments of Expert Teachers', *Bulletin of Science, Technology and Society*, Issue 24, pp: 200-212.

Brown, S. and McIntyre, D. (1993) *Making Sense of Teaching*. Open University Press: Buckinghamshire.

Coe, R., Aloisi, C. and Higgins, S. (2014) *What Makes Great Teaching? Review of the Underpinning Research*. Sutton Trust: Sutton.

M6X02149

Student Number: 1052467

Word Count: 3866

Depaepe, F., Verschaffel, L. and Kelchtermans. (2013) 'Pedagogical Content Knowledge: A Systematic Review of the way in which the Concept has Pervaded Mathematical Educational Research', *Teacher and Teaching Education*, Volume 34, pp: 12-25.

Donaldson, G. (2015) *Successful Futures- Report on the Curriculum and Assessment Arrangements in Wales*. Available at: <http://www.uwtsd.ac.uk/media/uwtsd-website/content-assets/documents/wcee/successful-futures.pdf> [Accessed: 19th December 2018].

Elstein, A. S., Shulman, L. S. and Sprafka, S. A. (1978) *Medical Problem solving: An Analysis of clinical Reasoning*. Harvard University Press: United States of America.

Garvey, J. (1996) 'Subject Knowledge Content in Primary Initial Teacher Education Courses in Design and Technology', *The Journal of Technology Education*, Volume 1, 3, pp: 268-273.

Guerriero, S. (2017) *Pedagogical Knowledge and the Changing Nature of the Teaching Profession*. CECD: Paris.

Harlen, W. (1996) *Primary Teachers' Understanding in Science and its Impact on the Classroom*. Proceedings of the BERA annual conference.

Hume, C. (2017) 'New Wales Donaldson Curriculum Facing 'Challenges''. BBC News, 17th February. Available at: <https://www.bbc.co.uk/news/uk-wales-38855531> [Accessed: 19th December 2018].

Hill, H. C., Rowan, B. and Ball, D. L. (2005) 'Effects of Teachers' Mathematical Knowledge for Teaching on Student Achievement', *American Educational Journal*, Volume 42, 2, pp: 371-406.

Ko, J., Sammons, P. and Bakkum, L. (2014) *Effective Teaching*. Education Development Trust: Berkshire

M6X02149

Student Number: 1052467

Word Count: 3866

Krauss, S., Brunner, M., Kunter, M., Baumert, J., Blum, W., Neubrand, J., & Jordan, A. (2008). 'Pedagogical content knowledge and content knowledge of secondary mathematics teachers', *Journal of Educational Psychology*, Volume 100, pp: 716-725.

Lamb, M. (2016) '*Five Steps to Effective Questioning*'. TES, 4th August 2016. Available at: [Accessed: 23rd December 2018].

Marks, P, R. (1990) 'Pedagogical Content Knowledge: From Mathematical Case to a modified conception', *Journal of Teacher Education*, Volume 41, 4, pp: 3-11.

NFER and Arad Research (2013) *A Rapid Evidence Assessment on the Impact of Curriculum and Assessment Arrangements within High Performing Countries* Welsh Government. NFER: Cardiff.

Prestage, S, A. and Perks, P. (1999) *Subject Matter Knowledge in Experienced and Novice Teachers of Mathematics*. British Educational Research Association Conference, University of Sussex: Brighton.

Rosenshine, B. (2012) 'Principles of instruction: Research based strategies that all teachers should know'. *American Educator*. Volume 36, 1, pp: 12–19.

Rowland, T., Huckstep, P. and Thwaites, A. 'Elementary teachers' mathematic subject knowledge: the knowledge quartet and the case of Naomi', *Journals of Mathematics teacher Education*, Volume 8, 3, pp: 255-281.

Rowland, T. (2014) 'The Knowledge Quartet: the genesis and application of a framework for analysing mathematic teaching and deepening teachers' mathematics knowledge', *SISYPHUS Journal of Education*, Volume 1, 3, pp: 15-43.

Rowlands, T., Turner, F., Thwaites, A. and Huckstep, P. (2009) *Developing Primary Mathematics Teaching: Reflecting on Practice with the Knowledge Quartet*. London: Sage.

M6X02149

Student Number: 1052467

Word Count: 3866

Rowland, T. and Turner, F. (2007) 'Developing and Using the 'Knowledge Quartet': A Framework for the Observation of Mathematics Teaching', *The Mathematics Educator*, Volume 10, 1, pp: 107-123.

Shulman, L. S. (1988). A Union of Insufficiencies: Strategies for Teacher Assessment in a Period of Educational Reform. *Educational Leadership*, 46, 3, pp: 36-41.

Shulman, L. S. (1987) 'Knowledge and Teaching: Foundations of the New Reform', *Harvard Educational Review*, Volume 57, 1, pp: 1-22.

Shulman, L. (1986). Those Who Understand: Knowledge Growth in Teaching. *Educational Researcher*, Vol. 15, 2, pp. 4-14.

Shulman, L. (2009). Assessment of teaching or assessment for teaching? In D.H. Gitomer (Ed.), *Measurement issues and assessment for teaching quality*. Washington, DC: Sage Publications.

Watt, D. (1996) *An Analysis of Teacher Questioning Behaviour in Constructivist Primary Science Education*, in *International Journal of Science Education* , Volume 18, 5, pp: 601-613.

Welsh Government. (2014) 'National Literacy and Numeracy Framework'. On-line: <http://learning.gov.wales/resources/browse-all/nlnf/?lang=en>. [Accessed: 19th December 2018].

Welsh Government. (2014) 'HWB', On-line: <https://hwb.gov.wales>. [Accessed: 23 December 2018].

Welsh Government, (2018) 'Digital Competence Framework'. On-line: <http://learning.gov.wales/resources/browse-all/digital-competence-framework/?lang=en>. [Accessed: 19th December 2018].

Wilson, S, M., Shulman, L, S. and Richert, A, E. (1987) *150 Different Ways' of Knowing: Representations of Knowledge in Teaching in Calderhead J (1987) Exploring Teacher's Thinking*. Cassell Education: London.

M6X02149

Student Number: 1052467

Word Count: 3866

Willingham, D. (2009) *Why Don't Students Like School?* . San Francisco: Jossey-Bass.

Murphy, C. (2005), 'The role of subject knowledge in primary trainee teachers' approaches to teaching in the topic of area', in D. Hewitt and A. Noyes (Eds), *Proceedings of the sixth British Congress of Mathematics Education held at the University of Warwick*, pp. 113-119. [Accessed on www.bsrlm.org.uk 12/12/14]

Bennett, N. (1993) *Knowledge bases for learning to teach*. In N. Bennet and C. Carre (Eds) *Learning to Teach*. London: Routledge.

Cremlin, T. and Arthur, J. (2014) *Learning to Teach in the Primary School (3rd Ed)* London: Routledge

Poulson, L. (2001) "Paradigm Lost? Subject knowledge", *Primary teachers and education policy, British Journal of Educational Studies*, 49, 1, 2001, pp.40-45 [Accessed on <http://www.jstor.org/stable/3122059> 13/12/14]

Wilson, V and Kendall-Seatter, S. (2010) *Developing Professional Practice 7-14* Oxon: Routledge.