

A critical analysis of the relationship between teacher subject knowledge and effective learning and teaching in the primary school.

Introduction

There has been much debate determining the influences a teacher's knowledge can have on effective learning. Within this essay I will analyse the relationship between teacher subject knowledge and the impact it brings to learning and teaching in the primary school.

Firstly, I will review the key literatures that focus on teacher subject knowledge for primary school teaching. Following on from this, I will reflect on and analyse my own knowledge base with reference to my first teaching placement.

For my teaching practice I was placed in a school situated in one of the most deprived areas in Wales, with 30.5% of its pupils eligible for free school meals. The school currently has 664 pupils in total, with 24 classes facilitating pupils from 3 – 11 years old. The school employs a Family Support Officer, Inclusion Manager and Inclusion Team to ensure the pupils are given enough support to succeed within the school environment (reference not stated for anonymity purposes).

Classified as one of Wales' Pioneer Schools, the school is currently working alongside the Welsh Government and its stakeholders to develop the new curriculum, following on from Professor Donaldson's recommendations with the vision to adapt to today's modern twenty first century society. (Donaldson, 2015).

For the purpose of anonymity, the name of the school and its pupils will not be acknowledged within this piece of work.

Literature Review

What qualities and experience are required to become an effective and exemplar teacher within primary school education?

As already mentioned there has been research spanning through the decades that have analysed and questioned the notion of teacher knowledge and pupil's learning within the primary school, all of which are still fundamental in today's education system.

The first account to focus on the requirements of teacher subject knowledge was written by educational psychologist Lee Shulman who highlighted several pioneering foundations of a new reform for teaching and learning. (Shulman, 1987)

Shulman focussed on how novice teachers learnt to teach and through his research identified what pedagogical methods should be used to successfully enhance learner's knowledge. He argued that an effective teacher needed to utilise and have a key understanding of the foundations of teaching knowledge and methods. In his work Shulman highlighted seven categories of knowledge base to enable effective teaching.

These categories are: (Shulman, 1987)

- 'General pedagogical knowledge', which has reference to certain strategies and classroom ethics.
- 'Knowledge of learners and their characteristics', meaning teachers should be aware of any pupils with additional needs or accessibility issues.
- 'Knowledge of educational contexts', such as a school's mission statement and its culture.
- 'Knowledge of educational ends', which demonstrates an understanding of the purpose and values of education.
- 'Curriculum knowledge', which refers to the academic content and subjects to be taught to specific cohorts.
- 'Content knowledge', which is a teacher's knowledge of a subject such as science or mathematics.
- 'Pedagogical content knowledge (PCK)', which combines a teacher's pedagogical knowledge and subject knowledge.

The three final points stated above are content- related which will be the main focus within this analysis.

Shulman's (1987) curriculum knowledge base refers to a teacher being aware of what the pupils are expected to learn at their given age or stage within education. It also highlights the importance of teachers familiarising themselves with suitable resources and materials to teach a specific session or subject. As this is an integral part of teaching, professionals and institutions need to ensure this is high importance within their pedagogy, as without this

knowledge a teacher would find it difficult to choose what content to cover in their lessons. Wales' statutory National Literacy and Numeracy Framework (LNF) which was introduced into Welsh Education in 2013 has been a valuable resource assisting and guiding teachers' curriculum knowledge. The framework was developed to improve literacy and numeracy standards in Wales with a continuum of developments and expected outcomes to be embedded into all subjects across the curriculum. (Welsh Government, 2013).

Within his review and recommendations for Wales' new curriculum Donaldson stresses the importance of digital competency in modern society and recommends that this should be a key driving force within Welsh education. He has introduced digital competency as one of the three Cross-curriculum Responsibilities, alongside literacy and numeracy. Each of equal importance the responsibilities will be embedded into all six of the new Areas of Learning and Experience within the reform. (Donaldson, 2015)

Teachers in Wales will be required to familiarise themselves with the structure and purpose of the new curriculum. Donaldson echoes Shulman in the importance of curriculum knowledge and has recommended specialised training to guarantee that teachers have the skills and confidence to deliver the new curriculum in their classrooms.

Shulman (1987) also highlighted the key importance of a teacher's content knowledge. He argued that teachers require a strong body of knowledge on the subjects they are going to teach, enabling them to facilitate new understandings to learners. Arguably, if a teacher does not possess content knowledge themselves then it is highly unlikely that they can interpret subject knowledge correctly to learners in the classroom. Thus, content knowledge has been described as a prerequisite of pedagogical content knowledge. Sternberg and Horvath's idea of the prototype expert teacher has a high level of subject matter knowledge (Sternberg and Horvath, 1995).

Shulman introduced the notion of pedagogical content knowledge (PCK) which has been influential within the focus of teacher's expert knowledge ever since. PCK is known as the combination of the use of subject knowledge and pedagogical strategies. Shulman believed that exemplar teachers utilise a high standard of PCK during their teaching making subject content accessible and transferable for learners (Shulman, 1987).

PCK demonstrates how teachers adapt their teaching to suit the needs and abilities of learners. Whether that is using the appropriate resources or the way they choose to break down concepts and explanations appropriate to the group of cohorts. 'An effective teacher designs creative learning activities and provides creative learning environments that are not only fun but also challenge the children' (Chalcraft and Mills, cited in Cremin and Burnett, 2018: 93).

PCK has been revisited by scholars who echo Shulman's views of its high importance. More recently researchers (Coe et al, 2014) highlighted the importance of PCK and explained that with a combination of additional methods such as a good classroom environment and effective questioning it demonstrates good teaching practice. They highlighted that whilst learners receive a well-structured understanding of concepts and are made aware of the common misconceptions by their teacher, they are more likely to achieve high quality learning outcomes.

A framework highly influenced by Shulman's seminal work was the creation of The Knowledge Quartet, which was based on an analysis of teaching during mathematics lessons (Rowland, T, Huckstep, P and Thwaites, A, 2003). The framework was shaped from the research and analysis of trainee teachers' lesson observations during mathematics. The research was primarily based on teachers' subject knowledge and how it was utilised, which resulted in the framework with four dimensions to measure and reflect on pedagogical quality. The four dimensions of the quartet are Foundation, Transformation, Connection and Contingency. (Rowland, T, Huckstep, P and Thwaites, A, 2003).

Foundation is the first component of The Knowledge Quartet and concentrates on a teacher's base knowledge, focussing on their theoretical beliefs, knowledge and understanding of mathematical concepts required in preparation for teaching. Thus, by a teacher possessing a strong foundation in the subject of mathematics they can determine their effective pedagogical choices and help scaffold pupils learning in a particular subject; 'Teachers cannot help children learn things they themselves do not understand' (Ball, cited in Coe et al, 2014:18). Teachers should question themselves and break down the most appropriate strategy to teach a particular subject. Shulman's (1987) model of Pedagogical Reasoning and Action includes the purpose of 'Comprehension' which has a distinct similarity to the Foundation component within the Quartet.

Transformation within the Quartet also has taken reference from Shulman's model of reasoning and action, meaning the teachers' choice of demonstrations and examples. Although not primarily focused on mathematics Shulman's work states '... in the capacity of a teacher to transform the content knowledge he or she possesses into forms that are pedagogically powerful and yet adaptive to the variations in ability and background presented by the students.' (Shulman, 1987: 8) An example of this in practice could be, when planning to introduce coin recognition to young children, would the colour of coins be the best way of representing their increase in value? Furthermore, it must be distinguished what resources and apparatus would be used when illustrating and demonstrating the value of coins, the use of play money, Numicon or both at different moments during the lesson?

This categorisation has also been reiterated by Ball (1988), who undertook the Permutations Project and studied prospective teacher's knowledge, beliefs and ideas on mathematics to determine their outlook on teaching the subject. Ball's research found that although the trainee teachers knew how to answer mathematical sums such as multiplication, they were unable to grasp the reasoning behind it, not having an explanation of 'why' we multiply. Thus, needing to know a variety of methods to suit different learners and being able to answer questions on the reasons behind problems is required in effective pedagogy.

A further important aspect of teaching is the ability to sequence and order tasks effectively, so the learners have a smooth process of learning and understanding a subject. Within the Knowledge Quartet this instance is known as Connection and demonstrates the ability of teachers to plan their sessions within a series of lessons by connecting with prior learning or concepts already been taught. Would it be beneficial to a learner to be taught percentages if they are unable to grasp simple fractions?

Although primarily based on the analysis and reflection of mathematical teaching The Knowledge Quartet is a suitable model to measure teacher knowledge within other subject disciplines, such as literacy. In reference to the Connection category, if children are unable to distinguish letters from the alphabet it could be problematic to expect them to understand phonics and phonemes.

The final stage of the Knowledge Quartet is known as Contingency, having that immediate ability to respond to a learner's challenges or misinterpretations. The framework highlights

that 'Thinking on one's feet' during classroom time is an essential teaching skill, as unexpected moments can arise at any point during a lesson (Rowland, T, Huckstep, P and Thwaites, A, 2003). Children often ask misconceived questions about the subject content to which teachers need to be prepared for with relevant explanations and examples to settle these misinterpretations. Shulman also highlighted this teaching quality in his work, although not a focus within the seven categories of knowledge base, he touches on adaption and tailoring to student characteristics where he considers misconceptions and self-concepts (Shulman, 1987). An example of this in the classroom could be a child questioning why the fraction $\frac{1}{2}$ represents a larger value than $\frac{1}{3}$. The quality of a teacher's response to such events will be determined on their subject knowledge, and it has been understood that teachers gain more of this skill as their teaching experience progresses.

The Knowledge Quartet is a highly regarded framework to enable mentors and trainee teachers to analyse and reflect on the effectiveness of classroom pedagogy. However, are observations of a teachers' performance enough to measure effective teaching and learning? Researchers (Coe et al, 2014) stated that high quality assessment of pupils is also a beneficial tool in measuring the outcomes of effective teaching. In his review, Donaldson (2015) also discusses in depth the importance of assessment to measure learning outcomes, and recommends a simpler assessment approach in Wales, both formative and summative, with a wide range of techniques to suit the curriculum's four purposes and Areas of Learning and Experience.

Various studies have demonstrated that a teacher's PCK improves during their practical teaching experience. (Gess-Newsome and Lederman, 2001). In contrast to this, a German project (Kleickmann et al, 2013) undertook a study by scoring mathematical content knowledge and pedagogical knowledge of teachers at different levels of their teaching career, contrasting from year one university students to in-service teachers with a wealth of classroom of experience. One of the study's findings indicated that the content knowledge and PCK of longer standing teachers hadn't improved as much as those trainee teachers in university, resulting in a recommendation for an educational reform to deliver effective professional development to in-service teachers.

Professional development is of high importance to the teaching profession and with new and innovative technology and culture constantly evolving across the world, educators need to be skilled and confident to interpret the information to the younger learners of this world. Donaldson (2015) asserts that teachers in Wales will require professional development to ensure they possess the skills and knowledge to deliver all areas of the new curriculum.

Analysis and evaluation of own subject knowledge

For my first teaching practice I was placed in the Foundation Phase. Although excited to begin my professional teaching experience I was somewhat apprehensive as my previous classroom experience was solely in Key Stage 2. However, having now completed the term I have developed more confidence and knowledge of the Foundation Phase having taken account of all constructive feedback from my mentors and by reflecting on my teaching each day.

At the beginning of my placement, as I hadn't had experience within a Foundation Phase class, understanding the expected capabilities of the children in year one was difficult. I recall asking the class teacher if the children were aware of certain literacy skills such as the use of question marks, capital letters and full stops. Following Shulman's recommendations (1987) I knew I had to enhance my curriculum knowledge and gain an understanding of the basic skill expectations of the year group.

In reference to The Knowledge Quartet, I will highlight the difficulties and challenging moments I experienced during my first teaching practice.

Foundation

During my placement, the first topic I was asked to teach was online safety. Firstly, I familiarised myself with the Digital Competency Framework, (Welsh Government, 2018) and chose the appropriate strand to focus on as well as the elements to cover within my lessons. From this, I was able to determine the appropriate depth of knowledge to cover with the children on the e-safety topic. As I have grown up alongside the continuous enhancing of technology, I believe I am digitally competent, which is a vital skill needed in delivering

Wales' new curriculum. My foundation knowledge aided my confidence in delivering this topic of lessons (Rowland, T, Huckstep, P and Thwaites, A, 2003).

In contrast to my subject knowledge for online safety, the following topic I had to cover was Christmas traditions around the world, which I had limited knowledge of, and so made me apprehensive. To overcome this issue, I spent a great deal of time researching into three countries. Although having chosen four countries to focus on for this topic, I already had sound foundation knowledge on British Christmas traditions, and so needed to gain more of an understanding on the additional countries in detail. I felt that choosing just four countries and going into detail on each one would be more beneficial for the children, rather than covering a range of countries which they may confuse with one another. In addition to this, as I had to learn the traditions prior to teaching them the research would be sufficient and manageable for me.

The importance of a strong base of foundation knowledge, beliefs and understanding when planning lessons enables effective learning and understanding in the classroom (Rowland, T, Huckstep, P and Thwaites, A, 2003).

Due to my preparation and research, when delivering the humanities lessons on Christmas traditions I felt comfortable and confident knowing that I now had a good understanding of subject knowledge. My subject knowledge also aided me in becoming more creative within my decision making in the structure of my lesson within my introductions, class activities and plenaries, as I was no longer apprehensive of the content. I also ensured that I embedded the Cross-curricular Responsibilities within the lessons. In one rotation children used digital VR goggles to explore a German Christmas market. Whilst another group had the task of independently creating a Mexican pinata by following instructional language, which they had previously learnt within literacy sessions at the beginning of term.

Transformation

The mathematical concept I covered in class whilst on placement was the management of money. Although mathematics is an abstract subject, I felt confident whilst preparing the lessons and tasks as I had good subject knowledge and had previously observed the way in which the class teacher had planned prior mathematic activities using concrete, pictorial and abstract representations. The skill from the LNF for year one was to 'use different

combinations of money to pay for items up to 20p' (Welsh Government, 2014), however as the class was managed into ability groups, I differentiated the group tasks.

During the main task for the concrete activity I chose to have a Christmas themed shop in the classroom where children were given real money and asked to choose two items and pay for them. Firstly, I demonstrated the activity, I choose two items for myself and added them together by counting aloud with my fingers to come up with the answer. I then chose the correct coins needed to pay for the total cost. During this I also used appropriate terminology such as total, adding together and value.

During the counting task some of the children had difficulty adding the two prices together and coming up with the answer, so I suggested as a group we count with our fingers, as I did in my demonstration. As I had intentionally priced up items that could be referred back to the number bonds they had learnt in previous weeks I presumed they would find the task manageable. However, due to the prices having pound or pence symbols attached to them this confused the children, they found it difficult connecting the addition concept as the representation was different.

During our counting the classroom teacher approached me and suggested that I use Numicon as a resource to assist the children in counting and working out the sums. By using the apparatus, the children then found the task more manageable as they had used it when counting and working out number bonds in previous lessons.

As I hadn't thought about using apparatus to support the children's counting, I struggled to make this task accessible for them. I presumed that they would be able to answer the problems by counting on using their fingers, which demonstrates my lack of transformation knowledge. If I would have demonstrated by counting with the Numicon at the beginning of the activity the children may have made the connection and grasped the task straight away. Having reflected on this lesson I have learnt that sourcing the appropriate materials and apparatus to support learners learning is vital. Also, that demonstrating and teaching appropriate methods must have an accessible approach familiar to children to gain effective learning and understanding (Rowland, T, Huckstep, P and Thwaites, A, 2003).

To ensure this doesn't happen again, I will research into how young children learn and not presume that they can independently solve mathematical problems mentally. I will also

have supportive learning resources and apparatus to hand to assist them building on their cognitive connections. My demonstrations and procedures will also be thoughtfully carried out, making them accessible to the learners.

Connection

As part of the literacy lessons during my placement the main focus was to write a letter to Father Christmas. For the first session of the unit I gave the children a cold task and asked them to write their own letter to Father Christmas independently, to identify their current skills and knowledge and inform my future planning. The cold task gave me an indication that the children were not familiar on how to structure a letter or ask questions, which I then incorporated within the series of lessons to develop their literacy further.

During one of the lesson introductions, as a class we constructed a 'success criteria' for the children to work towards in the run up to their hot task. One of the points within the criteria was to ask Father Christmas a question in their letter. As this was a skill they needed to develop before undertaking their hot task I covered questioning within a number of my introductions during the week.

The following week to connect the explanation of questioning, the LSA-led activity was for the children to create questions they wanted to ask Father Christmas in their letter. I believe that the sequencing of tasks I prepared for the children in the run up to the hot task demonstrated my connection knowledge with reference to The Knowledge Quartet. Thus, if I had asked the children to create questions before I had explained the concept of questioning then the LSA activity would have been difficult for the children to grasp.

During the hot task, in addition to writing their letter to Father Christmas children also used the digital app Adobe Spark to create an interactive letter, which covered cross-curricular elements. Prior to creating the video, children received training as they required the knowledge and skills to understand how to use the app before beginning the task.

The idea of the connection knowledge category refers to the sequencing of topics or ordering of activities and tasks which demonstrates the teacher's decisions of structural subject connections (Rowland, T, Huckstep, P and Thwaites, A, 2003).

Contingency

During the final week of my placement I had planned to teach a Welsh lesson, however as I was unable to perform the lesson on the scheduled day, I wasn't expecting another opportunity to arise for me to do it. However, on my final day the class teacher asked if I wanted to do my Welsh lesson and although I didn't have the appropriate resources with me, I did not want to let her down.

As I was familiar with my plan, I explained to the class teacher that I could perform the Welsh lesson with limited resources and improvise part of the session. Within my original plan I had prepared to teach the children the song 'Heads, Shoulders, Knees and Toes' in Welsh with the accompanying hand actions, which I continued to do as it required no resources. However, instead of labelling a cardboard cut-out of a body with Welsh words, I adapted the lesson with resources I did have access to in the classroom (*see Appendix for original lesson plan*).

I asked the pupils to pair up and gave each couple a mini white-board and pen. I spoke aloud each of the body parts in Welsh and asked the children to then draw a picture of the words I had spoken. I also implemented a competitive element to the task and had the girls against the boys which the class thrived on as it brought a fun and engaging element to the task.

Although I did not have my original planned resources for the Welsh lesson, I was pleased with how the lesson went as it proved that I could teach well under pressure within unexpected circumstances. My subject knowledge of the Welsh vocabulary also had a positive impact on the lesson, which will be of benefit to me in the future as the new curriculum aims to continue to promote the use of bilingualism within the school context.

However, despite the lesson going well, I felt out of my comfort zone just before the lesson began, as I was usually well prepared and equipped for my lessons. Nevertheless, the lesson demonstrates that I am able to 'think on my feet' during unexpected circumstances. This classroom event demonstrated my contingency knowledge within The Knowledge Quartet (Rowland, T, Huckstep, P and Thwaites, A, 2003).

Conclusion

Donaldson suggests that good pedagogy is a lot more than practical teaching in the classroom, and that it represents a variety of methods to ensure the needs of children's

learning are being met. “It combines theoretical and practical knowledge and skills with fine judgement about what is required to promote effective learning in particular contexts. It lies at the heart of what it means to be an excellent teacher” (Donaldson, 2015: 63).

To conclude, it is inevitable that teacher subject knowledge is an integral component to enable effective teaching and learning. However, a strong base of subject knowledge can be wasted if a teacher does not apply appropriate teaching techniques and explanations in an accessible approach to their learners. To become an exemplar teacher there must be a high foundation of Pedagogical Content Knowledge.

Welsh education is at an exciting time, with the new curriculum aiming for our young people to receive innovative learning experiences to help them develop into creative, ambitious citizens ready to lead fulfilling lives as valued members of society. It is the role of educators in Wales to ensure a confident and creative delivery of this curriculum is met. (Donaldson, 2015)

4177 words

Appendix

Original Welsh lesson plan

Name of Trainee: Gemma Hayward		Session ref: 11 th December 2018		1:1	Cynllun Ffocws y Cyfnod Sylfaen	
		Welsh: 1		Class:		
Targed(au) Hyfforddi Personol		S3.3.5		Number of learners: 26		2d
				Age: 5/6		
Learning objectives/intentions:	To identify each body part in Welsh	Success Criteria	Children can identify each body part in Welsh orally.	Meeting learners' needs:		
Introduction/plenary tasks		Main activities		Resources/ Key Vocabulary		
Introduction - Warm the children up by teaching them the song and actions to Pen, ysgwyddau, coesau traed. (5 mins) - Go through a PowerPoint presentation highlighting the body parts in Welsh. (5 mins)		Attach a cardboard cut out of a person to the flipart. Children will take it turns to label each body part with it's Welsh name with laminated labels. (15 mins)		Welsh key vocabulary: Head - Pen Shoulders - Ysgwyddau Eyes - Llygaid Ears - Clust Mouth - Ceg Nose - Trwyn Arms - Braichau Knees - Coes Toes - Traed Hair - Gwallt What is - Beth sy'n		
Plenary I will ask the children at the end of the class session to assess their knowledge on the body parts in Welsh. They will be asked to show their understanding by their thumbs.				Resources: - Powerpoint presentation - Flip board - Cardboard cut out of person - Board marker - Laminated labels - Blu-tac		
Curriculum coverage (range and skills)						
- Experience a range of stimuli including: - simple rhymes, nursery rhymes, songs, stories and poetry - Use context to perceive the meaning of familiar words and decode new words by means of clues in pictures, letter sounds and word form						
Literacy (LNF)						
				Numeracy (LNF)		
DCF		Thinking	ESDGC	YCC		
N/a	Identify and make links with prior skills and knowledge related to context.	Use of recyclable cardboard, and limited use of paper.	Teaching through the medium of Welsh and using incidental Welsh in the life of the school.			

Bibliography

Ball, D.L. (1988) 'Unlearning to teach mathematics', *For the Learning of Mathematics*, 8(1): pp40 – 48.

Coe, R et al. (2014) *What Makes Great Teaching?: Review of the underpinning research*. The Sutton Trust

Cremin, T. and Burnett, C. (2018). *Learning to teach in the primary school*. 4th ed. Abingdon: Routledge.

Donaldson, G. (2015) *Successful Futures: Independent Review of Curriculum and Assessment Arrangements in Wales*. Wales

Gess-Newsome, J. and Lederman, N. (2001). *Examining pedagogical content knowledge*. Dordrecht: Kluwer Academic Publishers.

Kleickmann, T. et al. (2013). Teachers' Content Knowledge and Pedagogical Content Knowledge: *The Role of Structural Differences in Teacher Education*. *Journal of Teacher Education*, 64(1), 90–106.

Rowland, T, Huckstep, P and Thwaites, A, (2003) 'The Knowledge Quartet' in William, J (Ed.) *Proceedings of the British Society for Research into Learning Mathematics*. (3): pp97 – 102.

Shulman, L. (1987). 'Knowledge and Teaching: Foundations of the New Reform'. *Harvard Educational Review*, 57(1), pp.1-23.

Sternberg, R. and Horvath, J. (1995). A Prototype View of Expert Teaching. *Educational Researcher*, 24(6), p.9.

Welsh Government. (2013) *National Literacy and Numeracy Framework: To support schools in introducing the National Literacy and Numeracy Framework*. Cardiff

Welsh Government. (2018) *Digital Competency Framework*: Available at: <http://learning.gov.wales/resources/browse-all/digital-competence-framework/?lang=en> (Accessed: January 2019).