

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

## **Introduction**

I shall conduct a literature review into the relationship between teacher subject knowledge and effective learning and teaching in the primary school and contemplate different perspectives given by varying authors. It is vital that professional knowledge is continually developed throughout the career of a teacher. This involves expanding knowledge on their subject and keeping up to date with relevant progressions in research in the field of teaching (Bourdillon and Storey, 2002). I shall concentrate on the use of Knowledge base (Shulman, 1987) and the 'Knowledge Quartet' (Rowland et al., 2003) and how these theories have shaped teaching and teacher subject knowledge to develop effectiveness of teaching.

With these ideas in mind, I shall also reflect on my own practise in Professional Teaching Experience (PTE) 1 and how my ideas have been shaped by previous experience and acquired knowledge. My PTE 1 was in a foundation phase class of 30 children in a medium sized school in the outskirts of Swansea. The school will remain anonymous to ensure that no breach of data protection occurs. Therefore, when mentioned, the school will be named as 'School A' for this assignment. School A is in an affluent area with many professional families.

## **Literature Review**

Many factors go into making a teacher a good teacher. A good teacher needs to consider a variety of features in their lessons. Shulman (1987) links various previous research and ideas, both his own and others to form his ideas and theories. The author states that the knowledge base can be categorised into at least 7 categories: 'Content Knowledge; general pedagogical knowledge; curriculum knowledge; pedagogical content knowledge; knowledge of learners and their characteristics; knowledge of educational contexts; and knowledge of educational ends, purposes and values and their philosophical and historical grounds' (Shulman, 1987)

Coe et al. (2014) later categorised these elements into 6 sections. These are: (Pedagogical) content knowledge (PCK), quality of instruction, classroom climate, classroom management, teacher beliefs and professional behaviours. These have been recorded in the order the authors believe to be of most importance. Therefore, through their research

and analysis, they have concluded that PCK has the strongest impact on student's achievements.

Shulman (1987) had a specific interest in pedagogical content knowledge (PCK) as it is more noticeable when a high performing teacher knows and understands an idea and is also able to implement it rather than just understanding the concept but not able to recreate and implement the idea in front of a class. Furthermore, it is clearer when a teacher is continually learning and not just recycling their previous knowledge and disregarding new information when it is discovered.

Another point that is presented by Shulman (1987) is that a teacher should not just understand the concept or idea, but also investigate other theories and ideas so that a holistic approach can be achieved. This can then allow for further discussion in class and allows for the adaptability of a teacher should a question arise from a student that they had not originally planned for. This is expected of teachers in Wales, as the change of the curriculum due to Donaldson's (2015) suggestions will lead to lessons and schooling being more child led, allowing the children to explore and investigate topics the way they prefer. This will hopefully lead to higher attainment and encourage further independence within children of school age.

Additionally, the holistic approach to teaching is also recommended in terms of assessing teaching principles. One cannot simply observe a teaching principle out of context and the whole construct of teaching should be viewed. In essence, a teacher could be implementing a recommended teaching principle but the lesson itself does not create the desired effect. This means that one cannot say a teacher is better than another, for example, because they were seen applying one factor that another hasn't, as each lesson will have their own merits and may be of higher quality looking at another area.

The Knowledge Quartet is a theory developed by Rowland et al. (2003) as a way of showing the necessary components of good teaching and how a teacher's subject knowledge is portrayed during a lesson. This model was formed for the use with mathematics teaching so some consideration should be taken when applying this model to other subjects and areas of learning. As the name suggests, the model is split into four categories: foundation, transformation, connection and contingency. These four areas coincide with Shulman's idea previously stated but are categorised differently. The foundation knowledge of this model is affected by what the teacher knows, their beliefs

and also their understanding of the subject. Transformation is where the subject being taught is linked with real life. This can be through a range of approaches including illustrations, analogies and demonstrations. Connection involves a knowledge of planning to enhance the order of teaching. This is to ensure that subjects that can be deemed sequential are taught after each other which allows the children to grasp ideas easier. Therefore, the children are making the connection. The final area that the authors have developed is contingency. This is where a teacher is able to act appropriately when needed to if a child asks questions that may diverge from the intended end point of the lesson. One must be able to adapt to the children's needs. (Rowland et al., 2003)

A difference between what is described as an expert teacher and an experienced teacher is discussed by Hattie (2012). He suggests that there is minimal difference between the amount of knowledge a teacher has between an experienced teacher and an expert teacher. The author creates the idea that to have the ability to use the knowledge and incorporate that within a lesson is important. The difference between an experienced and an expert teacher is that the expert teacher can link previous knowledge in their teaching, linking cross-curricular ideas between subjects and is adaptable to learners needs.

The idea that Hattie (2012) suggests about teacher ability level links in with the ideas incorporated by Donaldson's (2015) report and the suggestions for changes to the curriculum. The idea that a high level of subject knowledge is required is not the only aspect to consider. This knowledge must be utilised in the most pragmatic way and utilised fully within teaching. Donaldson suggested that the new curriculum brings together these pedagogical ideas plus more to allow the children to access as much as they can from school (Donaldson, 2015).

Hattie's approach can be compared to that seen by Shulman (1987). The author implies that it is not just a high level of subject knowledge that is needed, more the ability to use that subject knowledge alongside other pedagogical ideas and adapt teaching for the needs of children.

Throughout the literature, PCK is referenced to but there is no clear definition of what PCK specifically is (Ball et al., 2008). Through extensive reading of literature about PCK, a definition was created which is as follows 'PCK is teachers' understanding and enactment of how to help a group of students understand specific subject matter using multiple instructional strategies, representations, and assessments while working within

the contextual, cultural, and social limitations in the learning environment.’ (Park and Oliver, 2008 p.264). This definition helps explain PCK more clearly and can be adapted to fit the subject being analysed. The ideas of Shulman have been adapted here for the purposes of these authors which is to view the idea in terms of science teaching. As the PCK definition must be changed to be subject specific, it is hard to apply a definite description in terms of primary school teaching.

As found in research (Park and Oliver, 2008), self-efficacy should also be seen as a component of a teacher’s knowledge. Through self-efficacy, a connection was found between a teachers’ understanding and enactment. These are what have been previously found as components of PCK in the research by Park and Oliver. Self-efficacy was added to the existing five components of PCK that had been identified and developed to complete the full overview of PCK (Park and Oliver, 2008).

Park and Oliver (2008) also found that an awareness of common misconceptions within what was being taught allowed a teacher to be more confident and increased their teaching ability as found in the paper’s case study of participant teacher, Lucy. A teacher’s PCK is affected by a knowledge of children’s misinterpretation of certain ideas about the subject being taught. There was also a link between increasing their own experience through teaching allowing these components to actualise and giving the teacher more experiences to build their teaching on. The idea of a knowledge of student misconceptions and common mistakes aiding a teacher in their effectiveness is backed up by other researchers (Ball et al., 2008, Coe et al., 2014, Rowland et al, 2003, Shulman, 1987).

Voss et al. (2011) is an empirical study that was found to find a correlation between general pedagogical knowledge and learner outcomes. Teachers with greater general pedagogical knowledge found that their students were more engaged and that they were more likely to learn more successfully. This shows a correlation of just pedagogical knowledge and not PCK. There is an implication therefore, that it is just pedagogical knowledge that is needed for effective learning. As this study was completed with teachers, it is assumed that they would have the required content knowledge to become a teacher as there are certain academical standards that have to be met to enrol on an initial teacher training course.

Some research has led to the assumption that content knowledge is enough to develop PCK in the future (Lannin et al., 2013). This would mean that experts in a subject would

be suitable candidates to become teachers. This could also lead to many teachers qualifying after graduating from subject specific degrees. This does not relate to primary education as closely as primary school teachers teach cross curricular and are not just subject specific teachers, therefore, it could not be assumed that a Geography graduate, for example, would have the required subject content knowledge to teach the rest of the curriculum that isn't related to Geography.

This was disputed when looking at Maths teachers (Krauss et al., 2008). Where Maths teachers outscored mathematicians in tests based on PCK for Maths teaching. I consider that this may be as a result of teachers understanding common misconceptions of students and an ability to simplify concepts and build on them when teaching as mentioned by Park and Oliver (2008).

Another study based on Maths teaching effectiveness in primary schools found that subject knowledge was not actually that significant (Muijs and Reynolds, 2015). This study was based on teacher's own opinion on their subject knowledge and not based on any form of testing. This means that the data might be skewed as each participant could over estimate or under estimate their own ability.

Ball et al. (2008) formulate that PCK can be dissected into knowledge of content and students, and knowledge of content and teaching. This can be distinguished with thoughts that the individual student, the class and the topic and subject being taught influence pedagogical needs.

### **Analysis and evaluation of my subject knowledge for primary teaching**

During my professional teaching experience (PTE), I was working with a year one class in School A. From my point of view, the level of subject knowledge needed was not necessarily high in terms of what the children are required to learn. What was needed though, was an understanding of how a child will learn different concepts, as many of the children were new to them and were not necessarily building on previous knowledge although that is present at times and used if appropriate. Also, a knowledge of the progression of these concepts allows a teacher to not let the children form bad habits or misconceptions that will hinder their learning when utilising these new skills later in their school career and lives. Here is where the subject knowledge and pedagogical knowledge combine, and I have found that pedagogical content knowledge has been a necessity in

my teaching to achieve success and high levels of student outcomes. This is in line with and backed up by the previous research (Ball, et al., 2008, Coe, et al., 2014, Hattie, 2012 and Shulman, 1987).

As a trainee teacher, I may not have the experience required to become an experienced teacher or an expert teacher (Hattie, 2012) yet, as this will develop through increased involvement with teaching. Therefore, it would be irresponsible to not reflect on one's own practice and to improve on one's own teaching. Looking at subject knowledge and teaching, using Shulman's knowledge base idea or the knowledge quartet as a basis for evaluation could prove fruitful. As subject knowledge, and more defined, PCK, has been found to be the most impactful area of improvement to teachers (Coe et al., 2014), it is useful to use these frameworks to analyse my own teaching and subject knowledge.

The Numeracy area was the most common subject that I had the chance to teach. I feel I am confident with teaching maths, so fewer anxieties were felt in teaching this subject. I showed a good knowledge of the framework for Numeracy in my planning as was portrayed in my feedback from the class teacher and observations from tutors and mentors. As the Knowledge quartet was designed with mathematics in mind, in my opinion, it was best to use this model to evaluate and analyse my own knowledge and how I have used this throughout my first PTE. For this reason, I shall use each of the four dimensions as sub headings for my analyses and evaluation.

### *Foundation*

I had set a lesson based on adding ten more to a number. This skill was chosen as an appropriate skill to work on, in line with the Numeracy framework for the year group (Welsh Government, 2015). The introduction was very visual and active, using hundred squares. I displayed an interactive hundred square on the interactive whiteboard and each child had their own small hundred square to hold on the carpet. The majority of the class were ready to progress onto this part of mathematics. I had not had much contact with the class with number-based activities as I had previously taught shape and pattern with the class. During the task, three of the lower ability children found the whole concept very confusing and difficult after initially showing good understanding during the carpet introduction. I used my own knowledge of the concept and different strategies to demonstrate how adding on ten more could be completed, using counting on and adding a ten onto the tens column of the original number. The children in question still struggled

to understand the concept. I then probed further and found that these children's ability to add was not where most of the class were and the higher number of adding ten more put the children off and scared them initially. It was not necessarily the concept they did not understand, but more just a larger number than they were used to adding which did not allow them to engage in the task. Knowing this was the issue, I was able to then revise addition for those children to then allow them to eventually attempt adding ten more. Without prior pedagogical knowledge and more specifically PCK, I could have just left my demonstration as showing the children going onto the line underneath on a hundred square is how you add ten on. I had the belief that the children would have to understand how that number is acquired through addition as well as knowing the mathematical 'trick' of using the hundred square and adding a ten to the tens column. If I had just taught the method using a hundred square, the children may have then struggled to progress onto that type of addition mentally – which many of the higher ability and middle ability did during the lesson, unplanned. Therefore, my knowledge of the subject and my prior beliefs allowed me to shape the lesson appropriately for the future acquisitions of knowledge (leading to future use in the connections element). Good pedagogical skills to take away from this lesson is that I should always be prepared to explain a concept in an alternative manner. For example, a 'plan B' should always be available to ensure that all learners are catered for in each lesson. With greater foundation knowledge, I may have been more successful in this lesson by considering addition as a skill in a warm up to allow the children to be thinking in that way prior to the introduction of the new skill. This has been found to be beneficial if the activity as the warm up is linked to the learning (Sidney and Alibali, 2015).

### *Transformation*

A task that was designed to be cross curricular over several sessions was a Christmas based task involving a party. The use of transformation was used as we were looking at reasoning word problems based on the organisation of a party that the children were to plan and execute themselves in the classroom. This made the task very 'real life' as the children's answers would then correspond with what would be available to them for the party. The questions involved how many biscuits each child could have, how many plates were needed, how many balloons were needed etc. Therefore, as the children could see

that the tasks had a meaning to them and an end problem, this engaged them heavily. Allowing them to be in control of the components meant that they were not just answering questions for the sake of it but actually accomplishing something. When the party arrived, the children could see that the right number of each object were present and could then start organising plates of food with the right number of food items on. This further developed their mathematics skills of counting without them being aware of it. Some of the children found this very exciting and were telling their peers that they had worked out that you were allowed a certain quantity of cookies or that there were twelve green balloons and six red balloons etc.

### *Connection*

My first lesson I planned and taught was a maths lesson on patterns. This lesson allowed me to monitor the class and their abilities for the first time. The lesson consisted of continuing or creating patterns of different colours and/or shapes. As this was a new topic for the class there was no real way of knowing where to pitch the resulting lesson. For that reason, I created a contingency of different levelled tasks depending on how the introduction and initial plenary went. The following lesson I was due to teach was then going to be using objects to make patterns. These two ideas follow on quite nicely as they are very much connected. The first lesson on patterns led me to discover that many of the children in the class did not have a large amount of knowledge of the shapes that they were drawing and using. I used this as motivation to use the next maths lesson to revise shapes and introduce new ones and their properties. Making the connection between the shapes used in the patterns lessons and the new lesson on shapes was a great way to make the connection. The children then used their new shape knowledge to make patterns in their independent learning time and enhanced provision. Making these links and connections allowed the children to grasp ideas more clearly. As the lesson on patterns with objects was also related to the first lesson, I felt I could not skip this when patterns were still fresh in the children's minds. Therefore, I taught both pattern lessons first and then moved onto the shape lesson. Ensuring that all connections between the lessons were made apparent.

### *Contingency*

The previous example shows a level of contingency as I was able to adapt to the children's abilities and shortcomings to then extend their knowledge. Although it did not happen in one lesson, I was still able to rectify any missing elements of the knowledge to ensure that this did not hinder them in the future. One of my lessons planned, this time in the Language, literacy and communication skills area of learning, had some deficiencies in its infancy. The lesson consisted of the children discussing and deciding what elements made a good friend. The first focus group attempted the task I had planned with me. I soon grasped that the task had not been set at the appropriate level and the children needed far more support than I had originally anticipated. As one of the professional standards in Wales for teachers is 'The teacher provides appropriate levels of challenge and expectations for the range of student abilities and characteristics, motivating learners to achieve' (Welsh Government, 2017, p36), It is clearly important that I needed to change the task to an appropriate level. I therefore had to think instinctively how to adapt the lesson before the next focus group attempted the task. In reflection I could see that the learners were not being taught badly, it was just that due to the timeframe of lessons, that the task would be too time consuming and not all learners could be included if the lesson continued as it was. The work the children were completing was of a good standard and they were receiving good teaching. Unfortunately, the task did not promote much independence of the children which was originally planned. With this in mind, I changed the activity to allow the children to achieve greater levels of involvement and independence. This was completed by giving the children a model of what they could write for them to adapt, rather than them formulate the structure of their sentence independently. In hindsight, this would have been the appropriate method to instruct for this task. This ability to change and adapt allows for more effective learning to be completed as without the change, not all learners would have been given the opportunity in this lesson. If I had had to continue this lesson at another time, other learning opportunities would have had to be sacrificed which is far from ideal.

Due to the curriculum in Wales changing due to Professor Donaldson's (2015) suggestions, it is interesting to view how the research will affect teaching throughout the country. As the curriculum will be categorised into 'areas of learning and experience' and literacy, numeracy and digital competency is recommended to be taught cross-curricular throughout schooling, there are multiple facets of knowledge that are required by new

and existing teachers. It is difficult to be an expert on all aspects of the curriculum and have the pedagogical knowledge also due to the vast variety and breadth of the curriculum at primary school level. This is a challenge that has faced existing teachers and is what future teachers akin to me must overcome. As a primary school teacher teaches the wide spectrum of subject areas, I feel it is even more necessary to understand and remember all pedagogical knowledge available to them. This will allow myself and others to link between subjects, using the connection model (Rowland et al., 2003). As multiple areas of learning may be taught cross-curricular, and different framework elements inter linked, this offers more availability for a child to ask questions that may diverge from the lesson's intended direction. This is welcomed in the new curriculum to offer children the chance to lead their learning path.

## **Conclusion**

After viewing completed research related to the effectiveness of teaching related to subject knowledge, I can conclude that there is a shared view that subject knowledge is important to teach effectively as there needs to be the basis of content knowledge to be able to teach that subject. Moreover, it has come to my attention that this is not enough alone, and pedagogical skills should also be considered. The most effective teaching occurs when both subject knowledge and pedagogical knowledge combined into the amalgamation of pedagogical content knowledge. Reflection on a teacher's own practice should also be completed to view whether these components have been included in one's teaching to ensure that one is teaching in the most effective way.

My teaching experiences thus far have been enlightening when reflected on as I have been able to see what components have been effective and those that have not been. With this in mind, and continuing to do so, I can start to shape my teaching in a positive way to ensure effective teaching through use of subject knowledge commences and that I continue to adapt to developing pedagogy and changes to the curriculum. I shall utilise both my furthering pedagogical knowledge and content knowledge and combine them and use them intertwined through pedagogical knowledge to achieve success in teaching.

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