

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

It has been discussed for a long period time about how important teacher knowledge and subject knowledge is for becoming a successful teacher in a primary school. Schulman (1987) says that the debates regarding what teachers should know and know how to teach what they know has never been more active. This essay will look at teacher knowledge and subject knowledge and I will critically analyse the relationship between these when teaching in the primary school. I will also look back at my own experiences from PTE1 and evaluate how my subject knowledge affected the way I taught some lessons and what steps can be taken so that I can improve the way I teach these subjects in the future.

For the purpose of this essay the school from PTE1 will be referred to as school X and all children and members of staff will be kept anonymous in accordance with BERA (2018) guidelines.

The school in which I completed my professional teacher practice (PTE1) at is a school which consists of a Foundation Phase and Key Stage 2 with children ranging from 3 – 11 years old and within the school there are no mixed year groups. The school is relatively small consisting of 183 pupils, 7 full time teachers and 8 teaching assistants. Throughout the school 25.1% of the children receive free school meals, 13.6% of children have Special Education Needs (SEN) and a very small percentage, 1.8% of children have English as an Additional Language (EAL) (Welsh Government, 2018). I was placed in the year 5 class where there were 23 students (10 female and 13 males). The class teacher had no additional members of staff in the classroom but there were assistants who came in to help with reading and also take out children who needed extra support with certain aspects of the curriculum.

The importance for a teacher to have good subject knowledge to be able to teach appropriately and successfully has been researched over time. (Strong et al, 2011; Hamre et al, 2009) states that it can be difficult to implement the current methods of teaching and before we can start to promote these, we need to understand what these methods are and how they should be implemented. If we do not do this then we are at risk of using out of date teaching methods which are less effective than the methods which are currently in place. This could lead to the children being at a disadvantage in their education as they are not receiving the most up to date knowledge.

There have been many studies completed which have come up with different solutions on how much subject knowledge a teacher needs to be successful. One study which looks at this is the Knowledge Quartet, which was carried out by the University of Cambridge (Rowland et al, 2003). For the purpose of this study they looked at videoing 24 mathematics lessons which were conducted by a trainee teacher (Huckstep, Rowland and Thwaites, 2003) and then looking back at these to see what knowledge the teacher had used and passed on during the teaching process. In completing this study, they focused on the subject matter knowledge (SMK) and pedagogical content knowledge (PCK) (Shulman, 1986). From this they identified 18 categories which were later split into 4 main categories which were foundation, transformation, connection and contingency. The foundation category concentrates on what knowledge and understanding the trainee teacher has. Within this category it also covers why it is important to learn a particular subject and also what the ideal environment for this subject to be taught resulting in giving the best results to the children. The second category is transformation and this is where the knowledge gained is used when the trainee is planning their lessons and also the actual teaching of this knowledge to the children. This category is based predominantly on the observation that Schulman made by *"... the capacity of a teacher to transform the content knowledge he or she possesses into forms that are pedagogically powerful"* (1987, p. 15). An important part of this is how the teacher presents the information to the pupils. This can be done by using diagrams, explanations, practical examples, demonstrations or verbally telling the pupils (Shulman, 1986, p. 9). The connection category brings together all the choices made which makes up the lesson or series of lessons. This shows the relation between the lessons, the order of topics and instructions before, during and after the lessons and what tasks are going to be completed. This leads on to assessing the children to make sure that they have understood the knowledge you have passed onto them and also, they are able to use this knowledge. The contingency category looks at the events that are impossible to plan for and this is where you need to think on the spot to answer any question a pupil has thought of. This could be when a child asks a question which is not relevant to the current topic, do you ignore the child's questions and then they will never know the answer or do you go off topic to answer the child's questions satisfying the child's curiosity. Whichever route is taken has an impact on the way your lesson is going to be taught and the knowledge the children will gain from this (Brown and Wragg, 1993, p.20).

Williams (2013) study looked at an example of a trainee teacher Naomi who had completed her GCSE with an A* in Mathematics and in all her audit tests beforehand gave model answers to the questions. It is evident that Naomi has completed her lesson plans and has a clear focus on what the outcomes of the lesson is going to be. There are examples to show some of the difficulties that Naomi could face with the different language being used and she has taken this into account when

thinking of examples to demonstrate to the class. Naomi knows that there will be difficulties understanding the concept that subtraction can have different names so Naomi demonstrates this to class using the different mathematical language so the children become familiar with this language. Naomi challenges the children to think about patterns of numbers and number bonds. At first, she asks numbers which require little counting on to get to 10 and also 5 which the children know if doubled they will get 10. She repeats some numbers and some children recognise this and remember the answers from previous questions. Within this section Naomi has successfully graded the children, gone back over to check that the children have understood and also moved them on. This lesson allowed Naomi to show the children how different aspects of mathematics are connected. She was able to show the children that even though the two different types of subtraction look very different they come to the same correct answer at the end. It is important that children are aware of this as there are no one way to answer questions and its important as a teacher that you are able to explain to a child another method as they are unable to fully understand another. In this lesson a child had used another method which had not been discussed or modelled by Naomi. She chose to ignore this child's method of working out the answer and tells the class that she has a better way to answer these problems. This was not good practice by Naomi as this child's method could have helped other children in the class who were struggling and some time should have been spent even if it was to explain to the child that she would come back to that method later on as it was not appropriate to the learning that they were currently looking at.

Using the knowledge quartet when assessing and monitoring lessons is very important as it has been shown that when reviewing a lesson, the main focus will be the organisational of the class and lesson and not entirely on the subject knowledge passed onto the children (Brown, McNamara, Jones and Hanley, 1999). On most occasions the outcome will be predominately focused on if the child has understood what they have been taught. This is important but the monitoring may only look at one particular way that topic has been taught and not looking at all the other possible methods that could have also been used to solve the problem. Children need to understand that there are more than one way to solve problems and you will still get the same answer if completed correctly.

In the research carried out by (Coe, Aloisi, Higgins, Major, 2014) 'what makes great teaching?', it showed that there was an association between the knowledge the teacher has and what impact this has on the children's learning. It may seem obvious that if the teacher does not have the knowledge of a particular topic to teach, then the children will not understand and benefit from the teaching as the teacher will not teach them in enough detail or they will be taught incorrectly (Ball, 1991, p5). It has been suggested that if you have high academic qualifications then you are going to be a better

teacher. (Rockoff et al, 2011) has proved that this is not the case. He researched and proved that there is a link between the pedagogical content knowledge on how best to teach this material and the subject knowledge of the teacher leads to the children learning in the best way possible.

(Coe, Aloisi, Higgins, Major, 2014) says that there are six different principles for teacher feedback which will lead to better professional learning. They include that the attention should be on what they are going to learn as a whole not specifically to an individual person or imitating someone else. They also go on to say that teachers should be continually learning independently and the professional learning that they are undertaking should be supported and promoted by the school.

Timperley et al (2007) study suggests that the teacher needs to go on a 'knowledge building cycle'. This suggests that the way the teacher learns is very similar to the methods used to teach the children. They go on to suggest that the better the teacher learning is the more impact it will have on the children learning and becoming more successful. This report showed that when the teacher had feedback which was related to the learning the teacher was able to develop her subject knowledge and this led to the children achieving better and understanding the topic meaning they are able to adapt this knowledge later on in another way. To make sure that the children have completely understood what the teacher has taught them the teacher themselves needs to have a clear understanding of the curriculum that they are teaching, how to teach this topic best and also to be able to assess the children in the correct form so that you are able to monitor how the children are achieving (Timperley, 2008). All of these elements are equally important and lead to good teaching and improving children's achievement in the classroom and school.

Schulman (1987) study suggests that there is a knowledge base which can be used when teaching. The knowledge base includes 7 different areas. These include *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*. It is suggested that among the categories, pedagogical content knowledge should be focused on mostly because this looks at the way the knowledge needs to be taught. This is important as you need to know how to teach a particular topic not only know the knowledge of the topic.

With the new Donaldson curriculum coming into place in Wales in the next few years there has been many debates about how teachers are going to adapt their subject knowledge so that it suits this new curriculum. Donaldson (2015) says that the current curriculum which is split into subjects and taught over a period of time, where children get assessed and move on whether or not they fully understand is out of date. This curriculum is not giving the children the best opportunities to move forward as they may not understand a topic fully but they have to move on regardless.

It is also generally based on a belief that subject knowledge has stood the test of time and remains the best path to a sound and relevant education (Donaldson, 2015, p7).

With the new curriculum that Donaldson is bringing in it is going to take away the subjects and levels and it will be based on areas of learning where the children will continually progress with their learning. This will allow the children to build up their knowledge and be able to apply this knowledge in different scenarios (Donaldson, 2015, P31). With the addition to the new curriculum coming in there is also a push from the Welsh Government to increase the number of Welsh speakers within the country. Welsh and bilingualism are part of the current curriculum but evidence gained from the research shows that currently there is a *significant shortcoming in the Welsh language skills of the workforce and limited knowledge* (Donaldson, 2015, p61).

Donaldson (2015) review suggest that to be an excellent teacher with the new curriculum then you need to combine theory and practical knowledge with your own fine judgement and this is what will make the learning effective (Donaldson, 2015, p 65). The new curriculum will also enable children to develop their skills so that they are able to analyse and evaluate information, develop this information and use their knowledge and skills to solve new problems (Donaldson, 2015, p67). For the teaching to be good then the teacher must be able to review what they have already taught the children and be able to assess whether or not the children understand this. To move the children forward they will need to set the correct tasks which will challenge the children, select the appropriate resources so that these tasks build on the knowledge that the children have already learnt and making sure that all the children are engaged and learning from these new experiences. Where as before there was one route for all children, this will not be the case with Donaldson curriculum as he has realised that children have different outlooks on life and all children like to learn in different ways. This will eliminate the *one-size-fits-all approach to learning* (Donaldson, 2015, p69), that we have with the current curriculum.

During my time on PTE1 I taught many lessons from different subjects from across the curriculum. Some of these subjects I had a good knowledge and was able to teach the children confidently while other were new and I had to make sure that I completed my own research beforehand so that I had the appropriate knowledge to teach and also to make sure I was teaching the correct knowledge. The class topic for the term was Brazil. This was a topic that I had very little previous knowledge on and so before I was able to teach anything to the children, I had to complete some research of my own so that I had enough knowledge to pass onto the class. I asked the class teacher what areas of Brazil we were going to be teaching so that I had the correct knowledge to pass onto the children

but also looked at other areas so that if a child asked a question then I would have some knowledge I would be able to pass on and not disregarding their questions. I decided to look at other areas which had not been mentioned so that I could try and eliminate the chances of the contingency category of the knowledge quartet happening (Rowland et al, 2003).

One lesson in which I taught was about the Amazon rainforest. This lesson we looked at what each of the different layers were and lives and grown in each of these layers. This was a completely new topic to myself and so before I was able to teach, I had to make sure that I had enough knowledge to pass onto the children and also be able to answer questions that they may come up. My confidence was not the best when I was told that I would have to teach this topic but as the time went on by it was interesting to learn about this new topic and I was excited to pass on the knowledge that I had learnt onto the children. My foundation knowledge of this subject was very basic but I had gained enough knowledge to teach this topic. As in the transformation category in the knowledge quartet suggests, I then had to think of the best way to teach this information to the children (Rowland et al, 2003). This was taught to them by breaking up all the layers and then looking at each one. This lesson I was able to use lots of diagrams and images to show the children the animals and plants that live on this level. My basic knowledge was given to the children but they then had to go off and research some more on each level so that they were able to write a paragraph on what lives and grown on each level. The children successfully completed this task and it was interesting when they were feedbacking what they had found out how they had used my basic knowledge to expand and gain a broader knowledge on this topic. They did not only expand their knowledge but I also gained knowledge on this topic which I will be able to use if I have to teach about the Amazon Rainforest again.

Having completed my computing degree only a few years ago I was confident that I had a high subject knowledge and would be able to teach the children. During my time on placement there were many occasions where I had to use my knowledge of ICT with both students and teachers. I did not focus on teaching a particular aspect of the ICT to the children but I had incorporated it into most of lessons by following the digital competency framework. One particular lesson the children were creating brochures. Some were creating PowerPoint presentations while others were creating leaflets. One child had a problem with his presentation and using my knowledge I was able to solve this problem quite easily. Another child who was creating a leaflet wanted to move a picture which I thought was going to be easy using my knowledge but when I looked at the software, they were using HWB which was new to me so I had no foundation knowledge using this software. I had no contingency plan for this as I did not know this problem would have arisen. I managed to solve the problem for the child but taught me a lesson as I assumed that this program would be similar to

others but it not means that I make sure that I have the foundation knowledge in place beforehand and this will eliminate a lot of problems where I have to think on my feet and come up with a contingency plan (Rowland et al, 2003).

Over the course of a week the children went swimming. On the first day I was shocked to find out that I was required to teach one group how to swim. I was not prepared for this as whenever I had gone swimming previously there was instructors in the leisure centre to teach the children and the class teacher would sit on the side to make sure that there were no problems with the children's behaviour. In accordance with the foundation category in the knowledge quartet (Rowland et al, 2003) I had the basic knowledge on how to swim myself but not how to teach the children how to swim. I was assured that the following day I would be given some guidance on the outcome of the week and also some guidance on how to teach the children. I was given the children who had no prior knowledge of how to swim or found it very difficult. I had to transform the knowledge I had myself and also the guidance given me to teach these children how to swim. I was not able to get into the pool with these children but I would demonstrate to the children from the side and also have the children to demonstrate to other children in the class how it was to be done. As these lessons were over the course of a week, I had to make sure that they were connected and everything was followed in the correct order. The instructions had to be very clear as there was a danger to the children if they did not lesson correctly and also, I had to make sure that I was clear in the method they were to use. At the end of the week I was more comfortable with teaching another group of low ability as a number of the children had progressed well but I would not be comfortable with teaching a higher group but now I know teachers need to teach children to swim I can make sure that I have the correct knowledge to be able to do this. This should eliminate the contingency category within the knowledge quartet (Rowland et al, 2003).

With the introduction of the LNF there is a big focus on numeracy within the curriculum. I would like to think that I have quite a high subject knowledge in mathematics so one of the topics that I taught was division. I know that there are many different ways to teach division but I had to check with the school to see which method they used. I was told which method but they do use other methods if the children are struggling. I had planned a series of lessons that would cover the whole week where they would be using the knowledge gained from the previous lesson in the next. As the knowledge quartet says under the connection category that when planning a series of lessons then you take into account the order of the topics being taught and make sure that they are related correctly and also that you assessed whether the children understand correctly before moving onto the next section (Rowland et al, 2003). I took this into account as we started the week with basic division with whole number answers and by the end of the week, they had bigger number to divide and some of the

answers included remainders. Also following the transformation category of the knowledge quartet (Rowland et al, 2003), I introduced the children to new topic with a presentation and then demonstrated some examples on the board and getting children involved to check understanding before they moved onto completing some of their own. There were times that I had to use my knowledge of different methods to solve the problems as some children struggled. To assess whether the children understood I would mark the children's books at the end of the day and at the start of the next session recap with the children on the board getting the children involved. I felt confident at all times during my teaching of division as I had a good background knowledge of the subject as if one method did not work then I was able to demonstrate another without showing the children I had any doubt. When I was planning these lessons, I also had to be aware and make the children aware that there is a number of different names for dividing. During the course of the week I introduced to the children that dividing can also be known as sharing or splitting up (Rowland et al, 2003).

Another aspect of the maths curriculum that I covered was money and exchange rates. This was related to the Brazil and we looked at the Brazilian currency and how to exchange from British Pounds to Brazilian Real. I was unfamiliar with the Brazilian currency so I had to do some background research before I was able to teach the children on this. This lesson was very hands on where the children had the coins and money so they could use them like real money and I made scenarios up where the children had to work out how much items cost and then pay with the currency. Unlike Brazilian currency I am familiar with exchange rates from going on holidays. I had to check what the exchange rate but explained to the children that exchanges rates can fluctuate anytime. I was able to put my life experiences into practice and this was helpful to the children as they I was able to relate back to real life situations and explain the mathematical methods behind the process of exchanging money. With this knowledge the children will be able to apply the method to any amount of money or currency if they know what the exchange rate is. Looking back at the knowledge quartet I put into practice the foundation category by making sure I had enough knowledge to be able to teach this topic and the transformation category as I prepared some money resources so the children could use this like real money and this made the learning feel real to them (Rowland et al, 2003).

A primary school teacher is not going to have excellent subject knowledge in all areas of the curriculum but it is important that they have the basic knowledge and are prepared to build on this knowledge. After completing and reflecting on my time in PTE there were occasions where I did not have the subject knowledge needed to teach a particular topic but it was up to myself to research and teach myself so that I could teach the children. There were times when I thought that I had good

knowledge but I was up to date with the current teaching methods as the things being taught are everchanging and also there were times when I was presented questions in which I had not prepared for. This is why it is important to follow the knowledge quartet so these situations can be minimised and you are more prepared for these unexpected questions (Rowland et al, 2003). After looking at the studies that have been conducted over the years, I can say that subject knowledge is important but it is not solely what makes good teaching. Good teaching is having the correct balance of good subject knowledge and good pedagogical knowledge as displayed in the knowledge base Schulman (1987).

References

Bera (2018) *Ethical Guidelines for Educational Research, fourth edition 2018*, Available at :

<https://www.bera.ac.uk/researchers-resources/publications/ethical-guidelines-for-educational-research-2018> [Accessed 18 December 2018]

Brown, G. and Wragg, E. C. (1993) *Questioning*. London: Routledge

Brown, T., Mcnamara, O., Jones, L. and Hanley, U. (1999) 'Primary student teachers' understanding of mathematics and its teaching.' *British Education Research Journal*, 25(3), pp. 299-322.

Coe, R., Aloisi, C., Higgins, S. and Elliot Major. (2014) '*What makes great teaching?*' Review of the underpinning research. Centre for Evaluation & Monitoring (CEM), Durham University and Sutton Trust.

Huckstep, P., Rowland, T. and Thwaites, A. (2003) 'Observing subject knowledge in primary mathematics teaching'. *Proceedings of the British Society for Research into Learning Mathematics* 23(1) pp. 37-42

Rockoff, J. E., Jacob, B. A., Kane, T. J., & Staiger, D. O. (2011). Can you recognize an effective teacher when you recruit one? *Education*, 6(1), 43-74.

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

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

Timperley, H., Wilson, A., Barrar, H. & Fung, I. (2007) *Teacher professional learning and development: Best evidence synthesis iteration*. Wellington, New Zealand: Ministry of Education. <http://www.educationcounts.govt.nz/publications/series/2515/15341>

Timperley, H. (2008). *Teacher professional learning and development*. International Academy of Education, International Bureau of Education, UNESCO.

http://www.ibe.unesco.org/fileadmin/user_upload/Publications/Educational_Practices/Educational_Practices_18.pdf

Williams, J. (Ed.) Proceedings of the British Society for Research into Learning Mathematics 23(3) November 2003

Welsh Government (2018) *Mylocalschool.wales.gov.uk*. Available at:

<http://mylocalschool.wales.gov.uk/School/6712187?lang=en> [Accessed: 18 December 2018]