

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

This essay will first review the literature based around the notion of subject knowledge of teachers in the primary teaching setting. Leading on from this I will focus on my own experiences of subject knowledge as a trainee primary teacher. I will analyse and evaluate my Professional Teaching Experience (PTE) within my first placement school. In accordance to guidance provided by BERA (2018) I will keep the PTE placement school anonymous and the identities of staff and pupils confidential. During this essay I will refer to the PTE school as school X.

My first PTE was based in school X, a large primary school located in West Wales. It is an English medium school which caters for a deprived area in West Wales. The school is a three-form entry, with a flying start facility and a Learning Resource Centre for pupils who are diagnosed with autistic spectrum conditions. *The school is a “pioneer school, working with the Welsh Government and other pioneer schools to develop a national model of professional learning and to develop and pilot a new curriculum for Wales”.* (Estyn, 2016) I was placed in a Year 5 class with 29 children aged 9-10. Adults within the class were myself, the class teacher and one Learning Support Assistant.

Literature Review

The consideration of teacher subject knowledge and its importance notably began with Shulmans (1987) article analysing teaching reform and developing the theoretical framework of *The Knowledge Base* for teaching. Rowland et al's (2003) paper on the concept of the Knowledge Quartet was based on research carried out studying Shulman's (1987) ideas on Subject Matter Knowledge and Pedagogical Content Knowledge, in particular focusing on mathematics.

Rowland et al (2003) provided a study which Warburton (2015) described as, considering knowledge in practice rather than categories and forms of knowledge. (pg. 13) This study supported the creation of the Knowledge Quartet. (Rowland et al, 2003) The study was based on the notion that often trainee primary teachers are

observed by their mentors and provided with very little feedback regarding the mathematical content of the lesson. Emphasis is placed during Shulman's (1987) report on good teaching practice not only being based and considered on good behaviour management and control of a classroom, but also on how highly the subject knowledge of the teacher should be observed. Strong and Baron (2004, cited in Rowland et al, 2009) also state that research has shown how during trainee teachers observation lessons by mentors, the vast majority of the feedback comments provided are generic in nature. More often than not, little is discussed of the content that was taught within the lesson bringing less opportunity for reflection of the knowledge base of the teacher.

It is important to consider that Shulman (1987) discusses that much of his work was conducted in the secondary teaching setting. As this essay focuses on the primary teaching setting it should be recognised that the pedagogy of subject knowledge discussed may have a varying effect dependent on the pupil's in question.

Shulman's (1987) work relates to teaching and knowledge in general, rather than referencing subject specific knowledge. Shulman (1987) suggested Pedagogical Content Knowledge (PCK) as being the third major element of expert teaching, along with teachers' subject knowledge and general knowledge of instructional pedagogy. (Cochran, 1997) The report suggests the requirement of the teacher to appreciate how they will deliver and communicate the subject content, making it comprehensible. Bucat (2005) (cited in Fernandez, 2014) explains content knowledge looks at what the teacher knows about the topic, PCK stems further to look at the knowledge needed to know how to teach and learn about the topic. Shulman (1987) defines PCK as;

"It represents the blending of content and pedagogy into an understanding of how particular topics, problems, or issues are organized, represented, and adapted to the diverse interests and abilities of learners, and presented for instruction". (Pg. 8)

The three main elements of the PCK which Shulman (1987) proposes are;

- Knowledge of regularly taught topics for a specific subject area;

- The knowledge of representing and demonstrating ideas and;
- Knowledge of how the pupils learn the ideas.

Eaude (2011) discusses the need for a teacher to require both subject knowledge and craft knowledge. Referencing the work of Alexander (2010) he continues to encourage the importance of understanding how pupils learn and the activities which will motivate and challenge pupils.

Shulman (1987) meets four questions (pg. 1);

- *What are the sources for the knowledge base for teaching?*
- *In what terms can these sources be conceptualized?*
- *What are the processes of pedagogical reasoning and action?*
- *What are the implications for teaching policy and educational reform?*

There are four main sources for a teacher Knowledge Base, which Shulman (1987) discusses as being;

- *Scholarship in content disciplines;*
- *Educational materials and structures;*
- *Formal educational scholarships;*
- *Wisdom of practice.*

Donaldson (2016) puts emphasis on education being focused around pupil-led learning. The report claims that the current curriculum in Wales has shaped a framework of subjects to be taught over a given period of time, working at particular stages dependent on age. The framework has been described as descriptive, with expected behaviours and inputs of pupils instructed. Donaldson (2016) calls for an alternative approach, arguing learning should be shaped by developing key skills, capacities and competencies across personal, social and economic needs.

Shulman (1987) writes that content knowledge should consist of *two foundations: the accumulated literature and studies in the content areas, and the historical and philosophical scholarship on the nature of the knowledge in those fields of study.* (pg. 9) In the case study of Nancy, she is a secondary teacher and specialises in English,

for primary teachers there is the requirement of needing to be generalists to a subject. Although the proposals for the new curriculum in Wales call for a less prescriptive scaffold and therefore teachers will not be bound to textbook style teaching, with current pioneer schools developing the new curriculum in Wales by teachers themselves, this will mean the curriculum will be tailored more significantly to teacher subject knowledge and pedagogy developed from experiences. It cannot be escaped that the educational system that we provide and which skills us today, is shaped around extensive scholarly knowledge and research by significant influencers.

The case study of Nancy analyses an incredibly experienced and knowledgeable teacher who is able to adapt her teaching strategies to the learners, the environment and the subject matter. At times, Shulmans (1987) writing indicates that Nancy's ability to apply effective subject pedagogy to her lessons has developed through time and great experience. It is expected that Nancy would have had many opportunities through her teaching career for reflection, to recall her lessons and consider what went well and what did not.

Rowland et al (2003) developed the four dimensions that compose the Knowledge Quartet as Foundation, Transformation, Connection and Contingency. The Knowledge Quartet is defined as *the theoretical framework for the analysis and development of mathematics teaching*. (Rowland, 2017) When reflecting on the application of teacher knowledge of mathematics subject-matter the Knowledge Quartet has acted a useful tool in studies of recent years. (Rowland, 2017) Much like the Knowledge Base, the Knowledge Quartet provides a means to reflect on teaching and teacher knowledge, with a view to developing both. (Rowland and Turner, 2007)

The paper focus' on one out of 24 mathematics lessons recorded. Although the Knowledge Quartet can be applied to other subject areas, it must be noted that the work by Rowland et al (2003) was based on the subject of mathematics. The paper also does not take into account or report on the content on the other 23 mathematic lessons recorded.

The case study of Naomi in Rowland et al's (2003) paper demonstrates a trainee teacher who has clearly endeavoured to prepare herself in relation to the content knowledge on the mathematics lesson based on subtraction. The pedagogy on how she would transform this information to the pupils was perhaps not prepared as comprehensively. Focusing back to Nancy (Shulman, 1987) it could be questioned here that did Naomi not transform the ideas to the pupils as well as Nancy perhaps had due to lack of experience in the profession? Haylock and Cockburn (2013) (pg. 7) write that teachers are helped significantly in their teaching of mathematics when their perception of a subject is shifted away from their recall of recipes and rules, and shifts towards developing an understanding of mathematical concepts, principles and processes. They write that in order for pupils to form equivalences and identify transformations, the teacher needs to engage with how the pupil understands ideas and his understanding of the concept, which Naomi instantly disregarded.

Rowland et al (2009) highlight that although an online unit plan may have been highly relevant to the content being taught by Naomi during the mathematics lesson, such pre-planned resources would not allow for Naomi's own knowledge on subtraction and how to teach it to be uncovered. A constructivist view on learning is based on the premise that the learner must construct their own learning, influenced by making connections with prior knowledge.

Shulman (1987) defines teaching when investigating subject knowledge, as being the comprehension and reasoning, and transformation and reflection of a pupil's learning.

When investigating the pedagogy linked with subject knowledge, Shulman (1987) generated *The Model of Pedagogical Reasoning and Action (MPRA)*;

- Comprehension;
- Transformation;
- Instruction;
- Evaluation;
- Reflection and;
- New Comprehensions.

The MPRA proposes that to comprehend the content and ideas is not simply to understand what they teach but also the purpose of the ideas they are teaching, whether it be an educational purpose or for the personal and well-being development of the pupil. Once the teacher has discovered the purpose of the subject matter it is then their role to transform the ideas into a means that is comprehensible to the pupil. A range of abilities within a class does not allow for this to be a straightforward process as the teacher must transform the content into a suitable level for the pupils in question. This model takes the facts and ideas of subject knowledge and instructs how to use the knowledge in furthering learning in pupils. Fernandez (2014) describes the MPRA as *a model of teacher reflection and action*. (pg. 3)

The Foundation element of the Knowledge Quartet focuses on the teachers' understanding of the knowledge and philosophical beliefs of the subject. It considers how the teacher comprehends the knowledge and what they can do with the knowledge, much comparable to the first process of the MPRA however Shulman (1987) does not consider beliefs in his model. (Warburton, 2015)

Just like the second process of the MPRA, the next element of the Knowledge Quartet (Rowland et al, 2003) is Transformation. Both the Knowledge Quartet and MPRA incorporate the element of transformation, putting how the teacher crafts the knowledge and uses the information and ideas in practice, as a highly important component of teaching. Pedagogical knowledge is used to deliver the content knowledge to the learner in a manner which *assists their concept formation, language acquisition and to demonstrate procedures*. (Rowland et al, 2003 pg. 98) Rowland et al (2003) touches upon the notion of *behaviour directed towards the pupil* (pg. 98). Shulman (1987) considers the task of adapting the content knowledge specific to the learner and their needs and abilities. Shulman (1987) considers his next process of instruction as one of the most crucial aspects of pedagogy. Although Rowland et al (2003) appear not to include the activities and behaviours visited in the lesson as part of the quartet. A teacher with good PCK is able to structure their lesson to encourage and drive pupils to develop the learning themselves. Dewey (cited in Gray and MacBlain, 2012) emphasized the importance of teachers and children learning together through experiential learning, with the child's learning involving their social world and community.

Shulman's (1987) article demonstrates the use of the MPRA model by an experienced teacher. On the occasion where she was unable to speak, Nancy maintained full control and influence of the class, she had to use her flexibility and trust in her pupils, to change the style of her lesson. The knowledge of the novel was already embedded within the pupils and Nancy trusted that the pupils would be able to answer the questions on the subject matter with minimum support from herself as they were able to transform their own prior knowledge. The conceptual framework that Nancy (Shulman, 1987) developed created a scaffolding for her pupils to organize their own thinking and ideas. Although this model was developed on the basis of English as the core subject, it is not unreasonable to apply its notion across the curriculum.

Montero (2001) (cited in Fernandez, 2014) states that

“teaching goes far beyond what you teach and encompasses a number of less visible and less socially recognized activities performed by teachers with an empty room”.

Fernandez (2014) goes on to write that when considering the knowledge of teachers through preparation and analysis, the planning and assessment of the lesson that takes place should also be considered, as these two elements support the evaluation and reflection of learning. Carroll and McCulloch (2014) (pg. 140) talk of combining a subject-based curriculum with opportunities for more integrated learning experiences, which connects the subject areas with one another, as a vehicle for the pupil's own skills development on how to learn. They go on to discuss that such interdisciplinary learning opportunities comes with a planning task which incorporates curriculum principles and the abilities and development of learners in the classroom.

Personal Reflection

Generally, primary trainee teachers are graduates with a degree in a range of disciplines who are trained to be generalists of the whole primary curriculum. (Rowland and Turner, 2007) What trainee teachers must know, understand and be able to do in order to gain Qualified Teacher Status (QTS) is set out by a number of outcome statements known as the QTS standards. (Education Wales, 2009) Standard 2 (S2) refers to Knowledge and Understanding. Within S2 the Welsh Government do not refer to simply the subject knowledge, such knowledge should involve an understanding of the curriculum, expectations and guidelines.

I was allocated with the responsibility of delivering the maths sessions. Due to previous experiences being in the Foundation Phase, my initial anxieties and concerns instantly had me questioning; "How will I be able to teach these topics in a way the children will understand?" I did not feel apprehensive due to my own subject knowledge, as I had enjoyed the subject during my own school experiences and gained a high grade during my GCSE's. It was the pedagogy of that subject knowledge that I was concerned about in my delivery.

Parallel to the work of Dewey (cited in Gray and MacBlain, 2012) who believed Education should hold the purpose of creating children to become effective members of their society, it is currently an exciting time in Wales with the development of a new curriculum under the influence and recommendation of Professor Graham Donaldson. (2016) As identified in the Successful Futures report (2016), the curriculum will transform teaching in Wales to create students through four main purposes;

- Ambitious, capable learner;
- Enterprising, creative contributors;
- Ethical, informed citizens;
- Healthy, confident individuals.

These four purposes will be developed across the Six Areas of Learning and Experiences (AoLE);

- Languages, Literacy and Communication;

- Mathematics and Numeracy;
- Expressive Arts;
- Health and Well-being;
- Humanities;
- Science and Technology. (Donaldson, 2016)

The new curriculum is unique to Wales as it is being developed by teachers themselves, at the forefront of teaching. There is also a drive for the new curriculum to be less prescriptive and give the teacher opportunities to adapt the lesson to meet the needs of the pupils. I was fortunate to be placed at one of the pioneer schools developing and piloting the new curriculum. This gave me ample opportunities to connect my lessons and planning to the four purposes.

There are curriculum documents still standing that Educational practitioners construct their teaching and planning upon. The Foundation Phase follow the Foundation Phase Framework, a document for 3-7-year olds setting the curriculum and outcomes. (Welsh Government, 2014) The Foundation Phase currently have areas of learning, similar to those AoLE established by Donaldson (2016). The Framework covers outcomes for all areas of learning.

Key Stage 2 is developed slightly different to the Foundation Phase, with each subject having their own Programme of Study, *for each subject, in each of the key stages, programmes of study set out what learners should be taught and, for Key Stages 2 and 3, attainment targets set out the expected standards of learners' performance.* (Welsh Government, 2016)

In Wales there are three cross-curricular responsibility; Literacy, Numeracy and Digital Competences. The framework for these three cross-curricular responsibilities are intended to develop these particular skills in learners to be used across a wide range of subjects and scenarios. (Welsh Government, 2016)

Shulman (1987) talks regularly about the importance of understanding the individual pupils needs and abilities as good practice of PCK. I entered the classroom with very

little knowledge of individual pupils and the levels or outcomes they were working towards. This was evident in the feedback of the first maths session I delivered, factors. (Appendix 1) I had planned my lesson under the assumption the pupils would have had more prior knowledge of the concept of factors. I had also assumed their multiplication skills would have been stronger than they were, this meant during my first focus group (of the lower ability) I had pupils working at very different paces with varying understandings, this was due to my lack of modelling of factors in the introduction and at the start of the focus task. (Appendix 2) The reflection that would take place through the feedback would include vast amounts of support in what went well, what did not and what I could do the next time. Often, reflection was based on my modelling and how I delivered the content to the pupils, I was often not clear enough in my modelling.

Teachers themselves have difficulties in articulating what they know and how they know it. (Shulman, 1987, pg. 6) A re-occurring concern, was the difficulty in understanding *how* I could deliver the knowledge and the next steps for myself provided by my tutor, in an approach that would suit all learners and provide them with the greatest opportunities. Throughout my time in school X modelling of methods and concepts became a strong priority in my personal targets, with this required emphasis to be placed on my own development of transforming the knowledge I had to the pupils. I found it beneficial to have a sound knowledge of the curriculum, recognising skills from the Programme of Mathematical Development (Welsh Government, 2016) supported me in my forward planning. Having an understanding of the skills the pupils should or shouldn't have already acquired determined how much of a scaffold I would provide within my lessons, and what prior knowledge I could expect from the pupils.

My confidence in maths subsided slightly as I felt the pupils had a greater knowledge of the multiple maths strategies available. Prior knowledge from the pupil's had a great impact on the process it would take to come to an understanding on the new subject. The pupils had less knowledge of multiplication than I had expected, leading to finding factors independently challenging.

Shulman (1987) talks of the “exchange of ideas”, for the teacher to be able to understand an idea, comprehend it and then be able to view the idea from different aspects and perspectives which can be delivered to the pupils. He discusses however, that such ideas and concepts should be presented as a means to provoke further constructive thinking by the pupil and pupils should not become dependent on the teacher. School X is a visible learning school who adopt various approaches to teaching, one of these approaches being Singapore maths. Singapore maths focuses on mastering a limited number of concepts, not simply learning material for a test. The goal with the Singapore maths approach is to develop a deeper understanding of the knowledge. (pbs.org)

Singapore maths required a great deal of prior planning of the maths topic, the lesson I will be reflecting on was fractional quantities. I needed to ensure that I had a sound understanding of the various different methods that the pupils could potentially discover for themselves within the lesson. I posed a question to the class from a past paper of the Procedural National Tests. I felt I had planned more appropriately for instruction. (Appendix 3) Reflected in my ARC for that particular day (Appendix 4) the majority of the pupils were able to gain a sound understanding of the first method proposed to the class. The difficulty I had with the second method, the bar model method, was that the more I endeavoured to model the method, as the pupils were not grasping the concept, the more complicated I was finding the method myself and therefore was not demonstrating confidence in my knowledge, regardless of the depth I had put in my planning. The class teacher did however reassure me that she saw no errors in my modelling of the method. The pupils were failing to recognise the value of the bar in relation to the question. The class teacher advised me to encourage them to choose this method when working on further questions independently. I stated that I felt this was not the appropriate method for some pupils and it was hindering their learning rather than opportunity to progress, however she stated this was the method the Head Teacher preferred.

Shulman (1987) discusses how the teacher must be flexible in the face of student diversity, able to *impart alternative explanations of the same concepts or principles*. (pg. 9) The class being taught were grouped based on their abilities for the maths sessions. There was a higher ability (Kit Kats), a middle ability (Maltesers) and a

lower ability (Mars Bars). The learning objectives would always be centred around the skills which could be found in the Programme of Study for Mathematics document (Welsh Government). To challenge the higher ability pupils, it was recommended that these pupils worked towards the year 6 and 7 maths skills, where appropriate. This meant I needed a strong understanding of the skills for the three-year groups in my planning. (Appendix 7)

Two the elements for effective teaching developed by Carroll (1963) (cited in Guerriero, 2017) are controlled by the teacher, the opportunity to learn and the quality of instruction. Students of a lower ability or motivation are likely to require more time for instruction. That being said, Guerriero (2017) goes on to discuss that the higher the quality of instruction, the less time needed for the lesson. During my initial maths sessions, my mentor would be feedback that she felt I was often repeating myself during the focus task. She explained if I was to model more clearly to the whole group at the start of the focus task then I would not find myself repeating myself to individuals. Towards the end of my PTE experience I was beginning to overcome the issue of time keeping during the focus task as my modelling became clearer and pupil engagement and productivity became stronger.

The final lesson I will reflect upon from my PTE experiences will be on a topic-based lesson, observed by the University mentor, looking at plastics and recycling (Appendix 5). I wanted to use a form of ICT to develop Language, Literacy and Communication (LLC) skills as my focus task, developing Digital Competence at the same time. I chose the Book creator app by the recommendations by the class teacher that the pupils had previous experiences using the app. My experiences of the app were small, I created a WAGOLL beforehand of a leaflet. While my tutor described my Knowledge and Understanding of the lesson to be very good (Appendix 6), I could feel in myself that I was not confident in the LLC skills I should have been delivering to the pupils in order for them to create a persuasive leaflet independently. The pupils did not make the connections between the information provided and their prior learning of persuasive language. In my reflection after with my tutor (Appendix 6) it became evident that I spent a large amount of time in preparing resources and ensuring the independent activities were well equipped and had clear instructions of the skills and knowledge to be used, with my tutor

commenting on my planning for various ability groups. (Appendix 6) I did not put in enough preparation to ensure I had a sound content knowledge of my own focus group being persuasive language. My tutor (Appendix 6) stated that in order to move forward I needed to start including a greater amount of “doing detail” in my lesson plans, by actioning this I will be able to show to myself and others that I have a sound understanding of the content knowledge. I endeavoured to action this feedback in my future lesson plans by developing more detailed steps of methods during the maths lessons. (Appendix 3)

Reflecting on the recycling lesson, I planned for a mini-plenary and self-assessment throughout the lesson (Appendix 5), however I only gave the pupils an opportunity to reflect at the end. If I had asked all pupils to take a moment during the focus task to self-assess and indicate any difficulties, this would have allowed me to deal with any mis-conceptions about the leaflet. This would have allowed pupils to go back and make changes to their work. It would have also provided me with a clearer indication of the pupils’ progress which I could have used in forming my planning for the next lesson.

Conclusion

To conclude, the review of both Shulman (1987) and Rowland et al (2003) on the notion of the effect Subject Knowledge, and in particular, Pedagogical Subject Knowledge has on teaching and its learners has fundamentally developed an awareness in my reflection of my own teaching. Shulman (1987) has re-shaped the understanding of how the teaching profession should be delivered by educational practitioners, scholars and policymakers. I have become more mindful in my own teaching practices through the development of modelling subject content, of how imperative it is blend content pedagogy with my own knowledge, to ensure learners are given the maximum opportunity to develop their learning.

Appendix 1 – First maths lesson delivered – Factors

Session Plan – Key Stage 2			
Name of trainee: Laura Colligan		Session ref: 05/11/18(1) Mathematics	
Personal target(s) in relation to QTS: S2.1 They have a secure knowledge and understanding of the subject they are trained to teach			
Year group: 5	No. of learners:	ALN: Adventurers x 2	
Additional Adults: 1			
Learning objective(s):		Success criteria:	
- Year 5 skill - Identify multiples of 2, 3, 5, 6, 8 and 10 - Year 6 skill - Identify multiples of numbers up to 10 - Year 6 skill - Identify common factors of two numbers - Year 7 skill - Identify and use the highest common factor of two or more numbers			
Links to previous learning:		Success criteria:	
- Prior knowledge of multiplication and division - Curriculum coverage of multiplication and division			
Key vocabulary:		Key questions & Assessment for Learning opportunities	
Factor, multiple, prime number, organisation and management			
Time	Session	Key questions & Assessment for Learning opportunities	
11:20	Mental Maths - 5 minutes		
11:25	Introduction - 5/10 minutes		
11:30	Kit Kat - 20 minutes		
11:35	Maltesers - 20 minutes		
11:40	Mars Bars - 20 minutes		
11:45	Plenary - 5 minutes		
Mental Maths:		MASTERY SKILLS:	
- ICT would be useful here - http://mathszone.co.uk/calculator - Interactive whiteboard - Active learning - Objectives and success criteria - Introduce factors. Using interactive whiteboard, start session with 'FACTORS ARE NUMBERS WE CAN MULTIPLY ANOTHER NUMBER'. However, one important fact to remember is that ANY NUMBER CAN HAVE MANY FACTORS! - Good visual hook - Video https://www.youtube.com/watch?v=gkxkK8rDrl "MULTIPLES AND FACTORS ARE BEST EXPLAINED BY USING		- What is a factor? - How do we know this number is a factor?	

Timing

- Modelling will help you hang when in groups massively

You Must model -

- show them - presentational layout - bring your questioning in whilst modelling so ch are engaged + contributing
- if you model properly learners will achieve quicker + move on!

WAYS TO MOVE FORWARD

- Ensure ALL Pupils are engaged + participating in mental maths / eg. all recording... that way share ideas e.t.c.

You must instruct your LSA!

- Ind not just assume she'll know what she's doing

Could they talk to the person next to them - tell each other? All participating

Appendix 2 – ARC – Factors Lesson

Model Beirniad Wedi Adfyfyrrio (BWA) Assisted Reflective Conclusions (ARC) Model

Dyddiad/Date: 5/11/18

Digwyddiad critigol (Ffocws)/Critical incident (focus):

Maths Lesson - Focus task.

Profiad/ Experience	
Teimladau/ Feelings Beth yw eich teimladau ynghylch y profiad? "What are your feelings regarding the experience?"	I feel the experience went OK. It could have went a lot worse and I feel I can identify where I need to improve. Relieved to have gotten the first lesson done.
Cofio a Deall/ Remember and Understand Allwch chi restru'r agweddau ar y profiad dysgu a aeth yn dda? "Can you list the aspects of the learning experience that went well?" Pa elfennau o'r profiad dysgu oedd yn siomedig? "What were the elements of the learning experience that were disappointing?"	I ran over on time and therefore the ending was rushed. I feel I did not model the activity well enough and so perhaps the understanding from the children was not clear. The children did not layout their work in a neat manner.
Gwerthuso a dadansoddi/ Evaluate and analyse Beth fyddwch chi'n cadw'r un fath i sicrhau dysgu ac addysgu effeithiol yn y dyfodol? "What will you keep the same to ensure effective teaching and learning in the future?" Beth oedd achos yr elfen siomedig bwysigaf? "What was the cause of the most important disappointing element?"	I did not model the factors method on the board well enough for the children to understand and this led to the focus task not going as fluently as I would've liked

Appendix 3 – Singapore maths lesson plan.

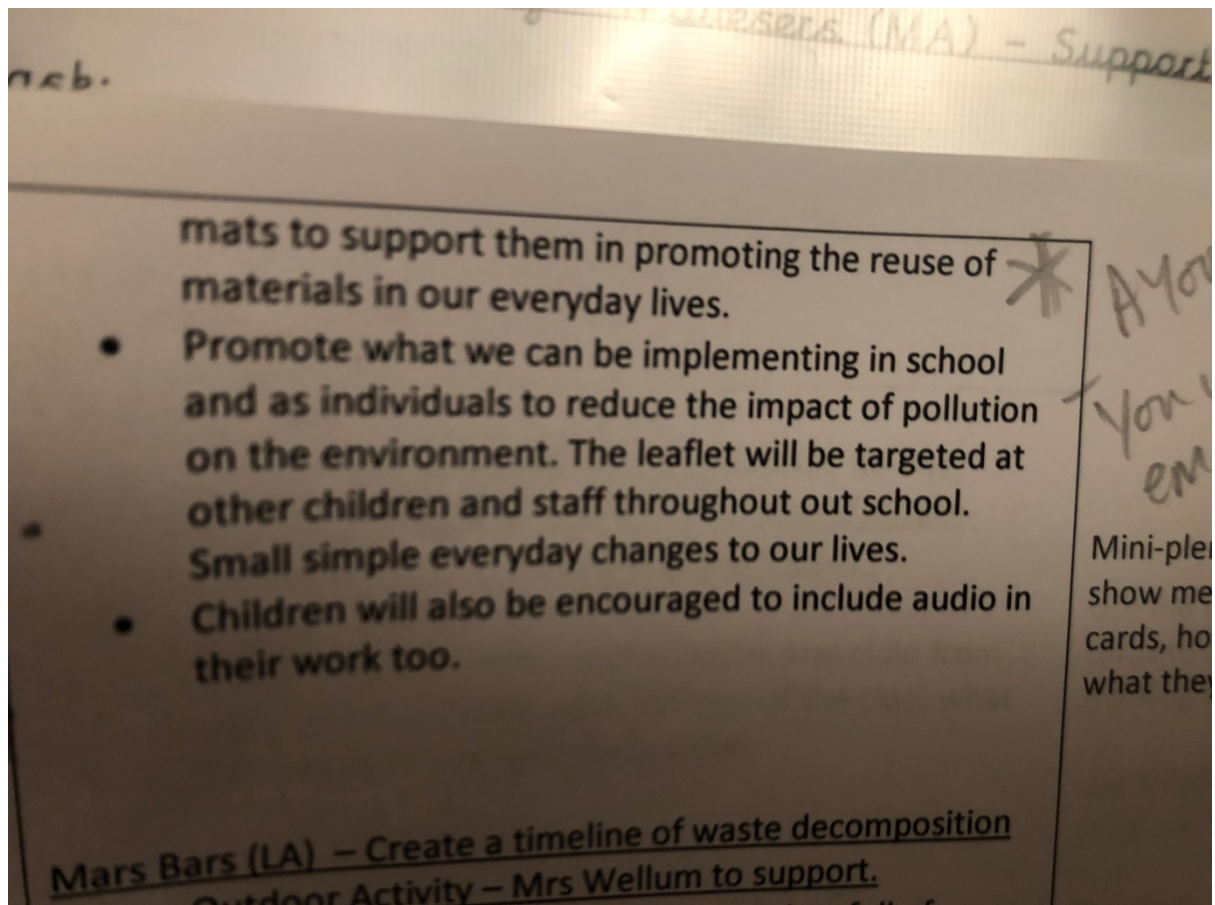
Main activities • Bring children back together. • Give one or two children the opportunity to demonstrate how they worked their answer out. • Display methods on the board. • If no children have shown method, model how we can work the answer out by looking at how many times the denominator will go into the number. Using our 8 times tables we know that 8 goes in to 72 9 times. This gives us 1 eighth however and we need to find out what 5 eighths are; we can do this by multiplying the sum of 1 eighth by 5. • 5 multiplied by 9 is 45 therefore 5 eighths are 45 children. • Once children have written this method in their books after following my modelling on the board we will look at the bar model. • Explain to the children they will need to draw a bar. The whole bar represents 72. Draw a line across the top of the bar to represent 72. • The bar needs to be split into equal parts, we look at the denominator to identify how many parts we need to split our bar into. In this case it is 8. • Explain to children that each separate part is worth 1 eighth. • How many times do we know 8 can go into 72? 9, we will need to write 9 in each part of the bar to show that each separate part of the bar represents the value of the number 9. 1 eighth is 9 children. • To find out what 5 eighths are we can count 5 parts of the bar. 5 lots of 9 is 45. • Children will need write this method in their book. • Once all children are clear with both methods they will then be given a set of fractional quantities questions to complete in their books. • Children may choose which method they are most comfortable to work using.	Mini plenary – ask children to RAG rate how they are feeling about the methods after showing first method. Use smiley face RAG cards.
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Appendix 4 – ARC – Singapore maths lesson.Assisted Reflective Conclusions (ARC) ModelDyddiad/Date: 29.11.2018Digwyddiad critigol (Ffocws)/Critical incident (focus): Singapore maths session.

Profiad/ Experience	
Teimladau/ Feelings Beth yw eich teimladau ynghylch y profiad? "What are your feelings regarding the experience?"	For my first singapore maths session I feel the session was quite successful. As it was a new approach I felt apprehensive about delivering the session and its structure.
Cofio a Deall/ Remember and Understand Allwch chi restru'r agweddau ar y profiad dysgu a oeth yn dda? "Can you list the aspects of the learning experience that went well?" Pa elfennau o'r profiad dysgu oedd yn siomedig? "What were the elements of the learning experience that were disappointing?"	Modelling the two methods I feel went ok. Children recorded both these methods in their books well. Children had quite a good understanding of method 1 but method 2 which was the bar model was not understood as well, I felt I had modelled the bar method fairly simply.
Gwerthuso a dadansoddi/ Evaluate and analyse Beth fyddwch chi'n cadw'r un fath i sicrhau dysgu ac addysgu effeithiol yn y dyfodol? "What will you keep the same to ensure effective teaching and learning in the future?" Beth oedd achos yr elfen siomedig bwysicaf? "What was the cause of the most important disappointing element?"	I would continue to encourage the children to have an independent go at the question first off. Some children don't have confidence in their own abilities and I feel this can help boost them. Children weren't understanding that the number inside the bar was how much the space was worth - even with several class modelling moments.
Casgliadau a chymau gweithredu/ Conclusions and actions Beth yw eich atebion posibl i'r materion siomedig a nodwyd? "What are your possible solutions to the disappointing issues identified?" Beth ydych yn mynd i'w wneud nesaf? "What will you do next?"	As it was singapore maths I needed to model various methods but I feel the children were getting confused between the two. All learners would benefit from a stand alone maths session focusing on the bar model method.
Y profiad newydd / Transformed experience	

Appendix 5 – Observed Lesson – Recycling

<i>All Pupils discussing what she'd asked.</i> <i>Afl- lolly sticks</i>	<i>Engaging</i> <i>hook -</i> Introduction • Show video. https://www.youtube.com/watch?v=xKzqLdkui6I Ocean of the future. Children will need to think during this video how would they feel? • In talk partners, children to discuss do they want this to be the ocean of their future? How does the video make them feel? • If we had arrived at Amroth 2 weeks ago and found the pebbles to be replaced by plastic waste, what would our day have been like? • Children will carry out a small experiment on their table. Each group will have a bowl of water. • One group will have plastic rubbish to tip in their water. • One group will have salt to pour in their water. • One group will have white vinegar to pour in their water. • One group will have food colouring to pour in their water. • Children will need to answer the question "Is my water polluted?" They will discuss in their groups. • On the paper provided for them the children will need to write down descriptive words relating to their water. They will need to think of their five senses. • Bring the class back together for a whole class discussion. Look for children who can identify that just because we cannot see or smell what is in our seas or rivers doesn't mean that they aren't polluted. • Briefly re-call Reduce, Re-Use, Recycle. • Introduce today's activities, display on the board the learning intentions and what each group will be doing and where. <i>9:15 - 9:30</i> <i>Could they predict first? Go through senses first.</i> <i>You were talking over the children as they were more interested in the water!</i> <i>You need to start writing down here... You didn't tell them to!</i> <i>Recalled prior knowledge - Emotive language - How make you feel?</i> <i>She physically moved groups.</i> <i>Why do you feel this way?</i> <i>What makes us feel like this?</i> <i>Use lollypop sticks to question children.</i> <i>Linking back to previous lessons</i> <i>How are these waters different?</i> <i>Can they still cause similar harm?</i> <i>Write a long time one the water - ch beg to get a little silly not listening</i> <i>Heat or temperature? corrected Pupil.</i>	<i>Recalled prior knowledge - Emotive language - How make you feel?</i> <i>She physically moved groups.</i> <i>Why do you feel this way?</i> <i>What makes us feel like this?</i> <i>Use lollypop sticks to question children.</i> <i>Linking back to previous lessons</i> <i>How are these waters different?</i> <i>Can they still cause similar harm?</i> <i>Write a long time one the water - ch beg to get a little silly not listening</i> <i>Heat or temperature? corrected Pupil.</i>
<i>missed opportunity</i> <i>Define the meaning of pollution</i> <i>9:30 - 10:00</i>	Main activities – Whole Class Kit Kats (HA) – Focus Task – To create a persuasive leaflet from a specific point of view. • Children will be creating a leaflet on book creator to spread the message of the impact plastic pollution is having on our oceans and sea life. • There will be a WAGOLL of a book creator for children to follow. • There will be key facts and figures displayed for the children to use within their book creator. • They will have emotive and persuasive language	<i>ch knew what they were doing + the skill</i> <i>What words could we use here?</i> <i>What impact do these facts have on you?</i>



Appendix 6 – Feedback from University tutor.

daily development, you take on board advice and coaching immediately.

S2: Knowledge and Understanding: Very Good

Laura, you are starting to demonstrate a clear understanding of how a variety of factors can influence your pupils learning and you are planning to address some of these in your learning experiences. An example of this is that you are starting to understand the need to plan for the various ability groups to give them every chance of being successful. Laura, already you have a good understanding of what is required within the key stage two setting for effective sessions. A very good understanding that the children need to be hooked into the learning experience. You understand the possible benefits of using ICT within the learning environment.

S3.1: Teaching: Planning, Expectations and Targets: good

Laura, I was pleased to see that you were extremely well organised and prepared. This is evidence of very good engagement. Class teacher reports that you actively seek to take on board more classroom responsibility. I would encourage you to chunk your timings on your plan. Learning objectives were clearly outlined for the activity. Your file is very well organised and contains all necessary paperwork. At present there is only one mid-term plan for maths and I would encourage you to work with class teacher to plan more if you can, demonstrating good continuity and progression. Short-term plans are completed to a good standard, clear links to the curriculum and key skills are starting to be considered. Lesson plans have good links to four purposes of the new curriculum, LNE, DCF and the wider curriculum. There was evidence in your file that you are starting to develop understanding of success criteria for the identified LO. This is an area in which to continue to develop further. As we discussed, your plans would benefit from a greater amount of 'doing detail' for the delivery of the focus task. I would encourage you to move forward with guiding your children to engage with appropriate AfL during the act of production itself so they can self and peer assess their progress and still have time to make any changes required for even greater success. You have planned some good questions and I would challenge you to plan key questions for all phases of the session. I would now encourage you to plan for even greater creativity within your introductions. I would now reinforce what was discussed in debrief, and plan for learners meaningful engagement with your well-made resources to further aid the learning and skill development.

Appendix 7 – Example of a maths skills slip.

17.12.18

STUDENT		MATHEMATEG: FLIPPED LEARNING	
MATHS AND NUMERACY - USING NUMBER SKILL- USE NUMBER FACTS AND RELATIONSHIPS			
Pg. 11			
What is your Learning Intention? - Year 7: Justify whether a number is a prime number or not. - Year 6: Know prime numbers below 20. - Year 5: Identify prime numbers below 10.		What is your Success Criteria? - Recall teaching facts from Flipped Learning clips. - Recall your multiplication and division facts. - Identify whether the number can be divided with no remainders, by any number other than 1 or itself. - Use teaching facts to explain whether a number is prime.	
Learning Intention: I have some prime numbers and I can explain.		Success Criteria: Refer to success criteria/steps for success to use my teaching facts to help me understand even more.	

Gwyneth Clarke 10/12

Prime numbers below 20

Reference List

British Educational Research Society (BERA). (2018) *Ethical Guidelines for Educational*

Research. 4th Ed. London: BERA. Available at: https://www.bera.ac.uk/wp-content/uploads/2018/06/BERA-Ethical-Guidelines-for-Educational-Research_4thEdn_2018.pdf?noredirect=1 (Accessed on 8th January 2019)

Carroll, M. & McCulloch, M. (2014) *Understanding Teaching and Learning in Primary Education*. 1st Ed. London: SAGE Publications.

Gray, C. and Macblain. S. (2012) *Learning Theories in Childhood*. 1st Ed. London: SAGE Publications.

Cochran, K.F. (1997) *Pedagogical Content Knowledge: Teachers' Integration of Subject Matter, Pedagogy, Students, and Learning Environments*. Available at: <https://www.narst.org/publications/research/pck.cfm> (Accessed on: 6th January 2019)

Donaldson, G. (2015) *Successful Futures: Independent Review of Curriculum and Assessment Arrangements in Wales*. Available at: <https://gov.wales/docs/dcells/publications/150225-successful-futures-en.pdf> (Accessed on: 5th January 2019)

Eaude, T. (2011) *Thinking Through Pedagogy for Primary and Early Years*. 1st Ed. London: SAGE Publications.

Estyn. (2016) *Inspection report (name removed for anonymity) 2017*. Estyn, Her Majesty's Inspectorate for Education and Training in Wales.

Fernandez, C. (2014) *Knowledge Base for Teaching and Pedagogical Content Knowledge (PCK): Some useful models and Implications for Teachers' Training*. Available at: <http://oaji.net/articles/2015/457-1421876658.pdf> (Accessed on: 7th January 2019)

Guerriero, S. (2017) *Teachers pedagogical knowledge: What it is and how it functions*. Guerriero, S. (2017) *Pedagogical Knowledge and the Changing Nature of the Teaching Profession*. 1st Ed. Paris: OECD Publishing.

Haylock, D. & Cockburn, A. (2013) *Understanding Mathematics for Young Children*. 4th Ed. London: SAGE Publications.

PBS Parents. (2019) *What's Singapore Math?* Available on:
<http://www.pbs.org/parents/education/math/math-tips-for-parents/whats-singapore-math/> (Accessed on: 9th January 2019)

Rowland, T. & Turner, R. (2007) *Developing and Using the "Knowledge Quartet": A Framework for the Observation of Mathematics Teaching*. The Mathematics Educator 2007, Vol. 10, No.1, 107-123

Rowland, T. et al (2009) *Developing Primary Mathematics Teaching: Reflecting on Practice with the Knowledge Quartet* 1st Ed. London: SAGE Publications.

Rowland, T. & Huckstep, P, & Thwaites, A. (2003) *The Knowledge Quartet* Williams, J. (Ed.) Proceedings of the British Society for Research into Learning Mathematics 23(3) November 2003

Rowland, T. (2017) *The Knowledge Quartet*. Available at:
<http://www.knowledgequartet.org> (Accessed on: 8th January 2019)

Shulman, L.S. (1987) *Knowledge and Teaching: Foundations of a New Reform* Educational Review: April 1987, Vol. 57, No. 1, pp. 1-23.

Warburton, R.K (2015) *Learning through teaching: factors influencing teachers' mathematical knowledge*. Available at:
<http://etheses.whiterose.ac.uk/11886/1/R%20Warburton%20Final%20thesis%202016.pdf> (Accessed on: 7th January 2019)

Welsh Government. (2016) *Digital Competence Framework*. Available at: <http://learning.gov.wales/resources/browse-all/digital-competence-framework/framework?lang=en> (Accessed on: 10th January 2019)

Welsh Government. (2015) Curriculum for Wales. *Foundation Phase Framework*. Available at: <https://beta.gov.wales/sites/default/files/publications/2018-02/foundation-phase-framework-revised-2015.pdf> (Accessed on: 10th January 2019)

Welsh Government. (2014) *National Literacy and Numeracy Framework*. Available at: <http://learning.gov.wales/resources/browse-all/nlnf/framework?lang=en> (Accessed on: 10th January 2019)

Welsh Government. (2016) Curriculum for Wales. *Programme of Study for English Key Stages 2-4*. Available at: <http://learning.gov.wales/docs/learningwales/publications/150717-nc-english-en-v3.pdf> (Accessed on: 10th January 2019)

Welsh Government. (2016) Curriculum for Wales. *Programme of Study for Mathematics Key Stages 2-4*. Available at: <http://learning.gov.wales/docs/learningwales/publications/150717-nc-maths-en-v2.pdf> (Accessed on: 10th January 2019)

Welsh Government. (2009) *The Qualified Teacher Status Standards Wales 2009*. (2009 No.25) Available at: <https://gov.wales/legislation/subordinate/nonsi/educationwales/2009/3220099/?lang=en> (Accessed on 9th January 2019)