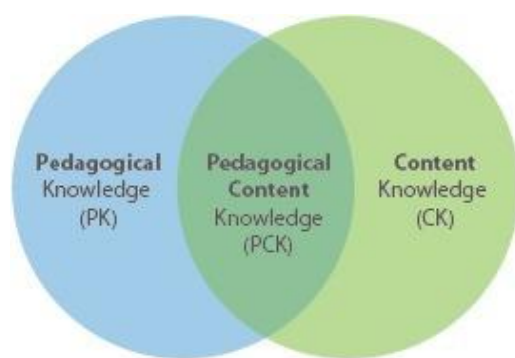


A critical analysis of the relationship between teacher subject knowledge and effective learning and teaching in the primary school.

In this essay I will look at the importance of teacher subject knowledge. I will begin by researching relevant literature surrounding the subject before basing my findings from the literature review on my own teaching experience from PTE1. Throughout the essay the school, pupils and staff will remain anonymised. This is in relation to BERA guidelines (BERA, 2018). School A is situated in Mid Wales and educates pupils from 3 to 11 years old in both mainstream settings and also Special Educational Units. There are approximately 63% of pupils currently on the SEN register, 58% of which are in mainstream education. 38% of its pupils are entitled to Free School Meals. During my PTE I spent time teaching twenty pupils from Year 4. This year the school are trialing a new approach to teaching English and Mathematics. These lessons are taught every morning and pupils are set by ability in accordance to National Testing results. The sets are made up of children ranging from all years in Key Stage Two. My class followed Year Four Mathematics and English skills, however the class included pupils from all KS2 year groups. The following paragraphs focus on literature surrounding teacher subject knowledge.

Throughout the reading of literature surrounding teacher subject knowledge, it became apparent that although there are several view point and prospective, it is clear that subject knowledge is important. Sir John Holman, a professor of Chemistry and former headteacher stresses the importance of subject knowledge (Morrison, 2014). However, he noted that it is often difficult for schools to recruit new teachers with excellent subject knowledge, particularly in Science (Morrison, 2014). He concluded that having good subject knowledge is of upmost importance, especially at Primary level as it is here that teachers must inspire the love of a subject (Morrison, 2014). Whilst engaging with the literature, it became apparent that Shulman was a leading figure in the field of subject knowledge. According to Shulman (1987) both policy makers and educators have been agreed that teaching requires basic skills, content knowledge and a general pedagogical awareness and in most areas, most interviews for teaching posts require some form of basic-skills test, an examination of competency and an observation of them being taught. He continues by pointing out that often the knowledge of the subject being taught is often ignored. Shulman (1987) argued that too much emphasis is placed on how to teach, with little attention paid to what

teachers are actually teaching (Pollard & Bourne, 1994, p. 84). He argues that a more equal balance is needed between how teachers teach and what teachers teach as both are of equal importance in developing children's learning (Pollard & Bourne, 1994, p. 84). Shulman (1987) argues that a knowledge base for effective teaching does exist and that research into effective teaching and the results produced cannot be solely relied upon when discussing effective teacher subject knowledge. Shulman developed seven knowledge based categories for teaching because he believed that content and pedagogy were seen as to separate things. In his view they should be combined as this would better prepare teachers (Burton, 2018, p. 124). He identified seven categories of teacher knowledge. The first four: general



(Perrier, 2015)

pedagogical knowledge, knowledge of learners, knowledge of context and knowledge of the purpose of teaching and learning as classed as generic (Rowland, et al., 2009, p. 19). The other three: subject matter knowledge, curriculum knowledge and knowledge of educational ends are related to content specific knowledge (Rowland, et al., 2009, p. 19). These will be discussed in more detail in the paragraphs below.

Content Knowledge (CK) is the 'what' of teaching. Learning about the subject, the vocabulary attached to it and also the skills the children need to learn (Burton, 2018, p. 124). According to Lenon (2015) good subject knowledge is important because you need to be able to push those MAT learners but also because research shows that teachers with good subject knowledge make more interesting lessons. An in depth understanding of the CK is needed to provide high quality standards (Burton, 2018, p. 124). With regards to Content Knowledge Pollard and Bourne (1994, p. 85) point out that teachers must have the same level of Content Knowledge of a subject to that of their colleagues. They must understand a subject they are teaching is depth so that they can explain to pupils not only what something is (fact) but also why it is like that and furthermore be able to answer if challenged with a different view point (Pollard & Bourne, 1994, p. 85). According to an article written in the Telegraph and reported by Barnaby Lenon (2015) a NASUWT poll found that majority of parents wanted 'qualified teachers' to teach their children. Lenon (2015)

continues by say that is unsurprising until we scratch beneath the surface and explore what is meant by qualified. There are four elements that came out of the pole, topping it was teacher subject knowledge. Teacher subject knowledge and their passion for the subject according to Lenon (2015) go hand in hand. In secondary education, the article highlights that some schools have appointed high level graduates in subjects such as physics, who don't necessarily have a teaching qualification (Lenon, 2015). This shows the importance of a solid understanding of subject knowledge. Seurete of State for Finland, Pilvi Torsti, said in a report that in their country the recruitment of teachers focuses heavily on the quality of a candidates subject knowledge, this she believes is why Finland scores very highly and is the top European country according to Pisa's reading and Science tests (Morrison, 2014).

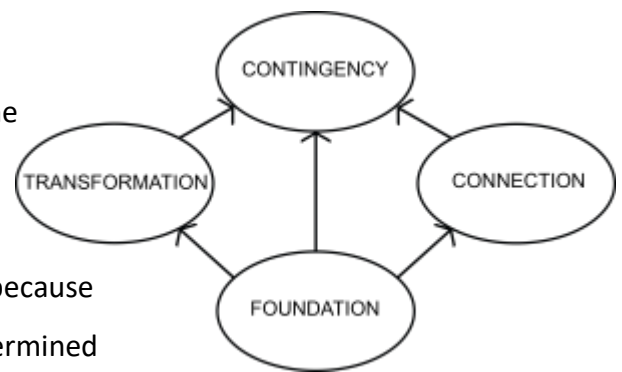
Pedagogical Knowledge (PK) includes the 'how' of teaching. This is the understanding of how children learn, which includes classroom management, the delivery of lessons and how to assess learners (Burton, 2018, p. 124). PK is of utmost importance according to Cremin and Burnett (2018, p. 11) because this is where teachers need to understand how children learn and how they are best going to learn the skills being taught to them. This area involves understanding your audience and making the curriculum accessible to the individual. PK begins to be developed in teachers while they train, however it is always something that must be added to throughout a teachers professional career (Cremin & Burnett, 2018, p. 11). It is not a static knowledge base, it is forever changing (Guerriero, 2017, p. 30). Teachers have to be understanding f external factors that can have an impact on the way children learn (Guerriero, 2017, p. 30). Linking to the article in the previous paragraph where Lenon (2015) reported that some secondary schools were appointing graduates without teaching qualifications, surely it can be argued these graduates would not have the necessary PK to teach, therefore their knowledge base is lacking.

Pedagogical Content Knowledge (PCK) is a combination of both the 'how' and 'what' of teaching or the knowledge of how to teach a subject. Shulman (1987) noted that PCK is developed over time as you must get to know and understand your pupils and also gain a good understanding of the school context (Burton, 2018, p. 124). A teacher with good PCK

can adjust their lessons, however, in order to do this they must first have good CK and PK (Burton, 2018, p. 124). The better the understanding of CK and PK the higher the children can achieve (Burton, 2018, p. 124). Good quality PCK is also a view point held by Coe, et al (2014) who believed that there are six components that make up a good teacher. A good quality teacher possesses elements of all six. One of which was PCK. The most effective teachers have a very good understanding of the subject being taught (Coe, et al., 2014, p. 2). When a teachers knowledge of a subject falls below this level it has a massive impact on their ability to teach (Coe, et al., 2014, p. 2). A good teacher not only has a good understanding of the subject knowledge but also a clear understanding of how the children interpret the knowledge and information and be able to identify where students have gone wrong (Coe, et al., 2014, p. 2). “Good teaching depends on good subject knowledge and excellent pedagogical skills. You can’t do it without being in possession of both.” (Morrison, 2014). According to Glazzard (2016, p.38) good subject knowledge is of upmost importance because teachers can teach with confidence, they can answer pupils questions and therefore move children’s learning on tailoring lessons to suit individuals (Glazzard, 2016, p. 38). Good PCK also means you can take the learning back a step if children do not understand. This Glazzard (2016, p. 38) also means that you can differentiate the learners needs to suit the pupils and help them progress.

The Knowledge Quartet differs to Shulman’s distinction between Content Knowledge and Pedagogical Knowledge (Rowlands, 2017). The Knowledge Quartet identifies situations in which knowledge can be seen in a teacher’s lesson (Rowlands, 2017). The Knowledge Quartet was devised from a research project in which twelve PGCE student were observed on how they displayed their Mathematical subject knowledge in the classroom (Rowland, et al., 2009, p. 26). The range of students differed, with some having A level Mathematics and others having studied up to GCSE (Rowland, et al., 2009, p. 26). Analysing the data the team found eighteen recurring themes throughout the observation process and after discussion and reasoning these themes were split into four bigger categories (Rowland, et al., 2009, p. 26).

The first element of the Knowledge Quartet refers to the knowledge a teacher has required from their own education (Rowland, et al., 2009, p. 29). The other three elements of the Quartet all rest on this element because being able to make connections in your teaching is determined heavily on your foundation knowledge (Rowland, et al., 2009, p. 30). At this stage teachers are able to identify pupils errors and use appropriate subject specific vocabulary (Rowlands, 2017). This category links with Shulman’s knowledge base. Foundation incorporates Shulman’s content knowledge and knowledge of purpose category (Rowland, et al., 2009, p. 32). According to an Ofsted report in 2009, there has been notable training in developing teacher subject knowledge in Literacy and Mathematics, due to the heavy impact on the subjects. This however Ofsted (2009) states has had a somewhat negative impact on other Primary subjects because so much time has been spent improving teacher subject knowledge in Literacy and Numeracy, other subjects are generally weaker. In Wales, Donaldson’s new curriculum will see Literacy, Numeracy and DCF at the core and developed as a cross-curricular subject (Donaldson, 2015, p. 39). Therefore developing teacher’s subject knowledge in Literacy, Numeracy and DCF are vital within the new Welsh Curriculum.



(Rowlands, 2017)

Rowland, et al., (2009, p. 31) note that the second category, transformation is the core of means to teach a subject. Like Shulman’s PK, this element focuses on the knowledge a teacher has to transform what they know into a way in which children will learn it (Rowland, et al., 2009, p. 30). Deborah Ball (1998) cited in (Rowland, et al., 2009, p. 31) writes that the difference is knowing something for yourself and knowing something in order to enable others to learn it is vital in developing children’s skills. Teachers must provide different ways and ideas to represent things, for example positive numbers. These can be represented in several ways, a number line, base 10 blocks or place value cards (Rowland, et al., 2009, p. 31). It is important that children are exposed to different ways of representing something in

order to maximise their opportunity to learn (Rowland, et al., 2009, p. 31). Teachers must be confident in modelling different examples of what is being taught (Rowlands, 2017).

Transformation was a term also used by Shulman when describing what was meant by Pedagogical Content Knowledge and these two ways of categorising subject knowledge are closely linked (Rowland, et al., 2009, p. 32).

The third part of the Quartet is connection. This is where pupils can make links between what they have already learnt and what they will be learning. They build on their learning (Rowlands, 2017). Rowland, et al., (2009, p. 31) state that mathematics is notable for its ability to fit together and that it's important to make connections when planning lessons or teaching a series of lessons. It is important to decide in which order to deliver tasks (Rowland, et al., 2009, p. 31). For a teacher to be able to do this successfully Rowland, et al., (2009, p. 31) note that it is down to having a good understanding of subject knowledge of mathematics and understanding how different skills can be used and interlinked to help teach other skills. This category does not directly link to any single one of Shulman's knowledge base (Rowland, et al., 2009, p. 33). However the connection of teacher's mathematical knowledge is an aspect of Shulman's subject matter knowledge (Rowland, et al., 2009, p. 33). Also being able to make connections for learners is part of a teacher's PCK (Rowland, et al., 2009, p. 33).

The final category in the Knowledge Quartet is Contingency. Rowland, et al., (2009, p. 31) note that however detailed and planned your lesson may be, there is always things that will arise. Contingency looks at the teacher's response to unexpected events (Rowland, et al., 2009, p. 31). Rowlands (2017) points out that from a constructivist learning point of view, by putting aside the child's point of view on a particular subject can be damaging to their learning. Donaldson's new curriculum would also be of the opinion that lessons should have the child at the centre (Donaldson, 2015) therefore the teacher should be prepared to deviate off the plan. It can be argued that the greater the teacher's subject knowledge the less likely an event like this would occur (Rowlands, 2017). Rowland, et al., (2009, p. 32) point out that often teachers are put in situations where they must think on their feet and the way in which a teacher responds to these unexpected events can often make a huge difference to the lesson. According to Rowland, et al., (2009, p. 33) this final category compasses of all seven elements of Shulman's knowledge base. Being able to think on your

feet and make appropriate decisions can require a combination of any of Shulman's knowledge base categories (Rowland, et al., 2009, p. 33).

Rowland, et al., (2009, p. 33) conclude their findings by pointing out that it was not surprising that the way in which teacher's mathematical subject knowledge was seen could be closely linked to Shulman's knowledge base, however what sets the Knowledge Quartet to be different is the fact that it has been developed from directly observing and analysing mathematical lessons, where as Shulman's model was not. Both note the relative importance of teacher subject knowledge in developing children's learning. However John Hattie, a New Zealand education academic noted that subject matter knowledge was only a minor contribution to student achievement (Haggart, 2016). Hattie conducted a meta-analysis of over 1,000 educational studies of which 138 different factors were found to contribute to children's achievement (Haggart, 2016). The effect size of good teacher subject knowledge was 0.19, far less than other factors such as classroom management (0.52) or effective teacher feedback (0.75) (Haggart, 2016). According to Hattie (2012, p. 25) Teacher's beliefs and commitment are what have the greatest influence on children's development. Hattie (2012, p. 28) noted that in visible learning, a teachers subject content knowledge had little effect on the children's outcome. He continues to say that visible learning is less about CK and PK and more about how the teacher views the subject that they are teaching (Hattie, 2012, p. 28). It is more about the teacher's beliefs regarding the subject (Hattie, 2012, p. 28). Hattie (2012, p. 28) argues that teachers do not differ in the amount of CK or PK they have. They do however differ in their approach and how they use the knowledge.

This part of the essay will focus on my reflection of my PTE 1 experience. During my time on PTE I taught range of curriculum subjects at KS2 level. I will use the Knowledge Quartet to structure this part of the essay.

Foundation

It was discussed earlier in the literature review that the other three elements of the Quartet all rest on the foundation element because being able to teach at a good standard is determined heavily on your foundation knowledge (Rowland, et al., 2009, p. 30).

Throughout PTE I taught a number of different mathematical skills, some I felt by foundation

knowledge was good and in others it was lacking. One particular lesson I taught in mathematics was managing money. I knew from my own knowledge that different mathematical skills were involved Rowland, et al., (2003, p. 31) note that mathematics is notable for its ability to fit together and that is important to make connections when planning lessons or teaching a series of lessons. Although confident to teach money to the class I delivered a series of lessons beforehand on addition and subtraction. This would enable me to understand how the children learn. I was able to do this because of my foundation knowledge, knowing that managing money involved addition or subtraction skills. Shulman would identify this as Content Knowledge. An in depth understanding of the CK is needed to provide high quality standards (Burton, 2018, p. 124). The depth of my knowledge was shown in my PTE tutor feedback (Appendix A).

However, my foundation knowledge was called into question when I was asked to teach a Science lesson on the Human Body. Identifying that my foundation knowledge on this particular element of the curriculum wasn't good enough I set about researching around the subject. This also included speaking to the schools Science coordinator in order to develop my foundation knowledge. I spent time learning about the subject and this was of benefit as I then felt more confident in delivering the lesson. Although the lesson went smoothly my lack of foundation knowledge showed and this was reflected in the ARC (Appendix B) as I set out the tasks in the wrong order. Having a better foundation of the subject in reflection would have allowed me to set up the series of tasks differently.

Donaldson's new curriculum will see literacy, numeracy and digital competency taught across all areas of learning and experience (Donaldson, 2015, p. 39). This according to Donaldson (2015) is because literacy, numeracy and digital competency are foundations for almost all learning and children must be confident in these subjects to develop and play a part within the modern world and therefore they must become cross curricular responsibilities for teachers. With Donaldson's new curriculum in mind I knew the importance of ensuring my foundation knowledge in numeracy, literacy and DCF were of an excellent standard. Numeracy and Literacy were easier to gain a good foundation knowledge as these were subjects I was taught in school. Teaching DCF was something that in truth frightened me. The complex set of skills baffled me. I knew I needed to develop my

foundation knowledge in this area as I often found myself lacking elements of DCF in lessons.

Transformation

From reading the literature surrounding teacher subject knowledge it has become clear to me that my understanding of the curriculum is a fraction in the bigger picture of subject knowledge. Transformation means to portray that foundation knowledge in a way in which children will understand. Like Shulman's PCK, this element focuses on the knowledge a teacher has to transform what they know into a way in which children will learn it (Rowland, et al., 2009, p. 30). Through discussions with my mentor and the class TA as well as my pedagogical knowledge of the children I was able to group the children into differentiated groups for their lessons. According to Cremin and Burnett (2018, p. 11) PK is of upmost importance because this is where any teacher needs to understand how individuals learn. I had taught a lesson on properties of 3D shapes. The children engaged well, although some children found it difficult as the concrete shape was not there. In reflection of this, moving the children's learning on to classifying 3D shapes I ensured there was a range of 3D materials available. These includes flash cards, concrete shapes and 3D shapes that are represented in real life (Pringle tin = Cylinder) (Appendix C). I found this engaged the children more. Through my PK I had developed my understanding that children learn in a variety of ways, and I had provided different ways of representing 3D shapes, which Rowland, et., al (2009, p.31) notes is an important and can maximise a child's learning.

Having developed my PK and gaining a better understanding of the children in the class I had grouped the children into three groups (LA, MA and HA) Having a good foundation knowledge of calculating change, I knew that good subtraction skills were needed. The children had previously learnt subtraction and were confident in using different methods. Using Rowland's Knowledge Quartet I decided that in order to maximise children's learning I needed to represent the skills (calculating change) in a variety of ways. For my LA group I had set up a shop in the hall where they would choose up to three items, physically pay for the items and calculate the change using real money. My MA group were given a set of items with different prices. They were asked to work out the cost and calculate the change using

methods that suited them. For my HA group I set up an online resources which allowed them to calculate the cost of items and calculate the change. I had decided to use the online resource in order to bring in elements of the DCF with Donaldson's curriculum in mind. I felt I had been able to transform my foundation knowledge into a way children could maximise their learning.

Connection

As highlighted in the literature, mathematics intertwine and it is vital to make good links between lessons and build a series of lessons (Rowland, et al., 2009, p. 31). In order to do this a teacher must have good foundation knowledge. Looking ahead at the skills in Mathematics I knew that I would be teaching lessons on function machines using all four operations. Planning ahead I knew that in order for the children to achieve this they must first have a good understanding of all four operations. As a result I planned a two lessons which involved the children recalling and developing addition, subtraction, multiplication and division skills. If my foundation knowledge on function machines was not good enough then I would not have been able to plan ahead and allow the children to recall their previous learning in order to move their learning on. By using my foundation knowledge I was able to maximise the children's learning. The children were able to make connections between previous learning and apply them when learning about function machines.

Contingency

The final part of the Knowledge Quartet was the one that I feared the most. As Rowland (2017) put it the 'thinking on your feet'. As I started my PTE I structured the lessons regimentally, not allowing myself or the children to divert the learning. This I soon learnt would not suit the constructivism learners in my class. As I began to learn more about the children, the classroom environment and the setup of the school I felt I became more confident.

In one lesson I had planned to teach the children, addition using the inverse to check their answer and also estimate the answer. Having a good foundation knowledge of the relationship between addition and subtraction and having good pedagogical knowledge of the class I believed this lesson planned would work. However as I began the lesson I soon noticed my pedagogical knowledge was lacking, I had placed too many elements into the

lesson. Focusing on addition and inverse operation would have been plenty. Having decided to use estimating also, I had lost the children. On this occasion I adapted the lesson and took the estimating element out. Upon reflection (Appendix D) I had realised during the lesson that there were far too many elements going on and by braking them down the children would have a better understanding. Having a better understanding of the pupils, I would have broken the skills down as not to overload them.

Towards the end of my PTE I taught a Science lesson on the organs in the human body. Planning the lesson I had decided to show a power point on the different organs, their functions and their location within the human body. As I began the lesson it became clear that the children wanted to know more information about the organs than I had planned for. I knew I had to think on my feet. After answering some questions based on my foundation knowledge of the subject, I decided to deviate of plan and allow the children to work in small groups to research facts about the human organs. The focus of the lesson had changed, however the children developed their own knowledge and understanding of the human organs.

In conclusion, the literature emphasises heavily on the link between teacher subject knowledge and effective learning and teaching in the primary school. The literature suggests that there is more to teaching than understanding the curriculum. Shulman identified the need for a balance between content knowledge and pedagogical knowledge with the most effective teacher displaying a balance of both (PCK). With the developing curriculum in Wales, there will be greater need for teachers to have good foundation knowledge as the curriculum develops to suit the modern needs. In relation to this, in future I will ensure I have a good pedagogical knowledge of the class and the learners. I believe it is vital to firstly understand how the children learn because, this then allows you to develop the lesson and skills maximising a child's learning. As well as this I will ensure that I develop other areas of my professional practice, such as classroom management and feedback, as this in accordance to Hattie also has a valuable contribution to children's development.

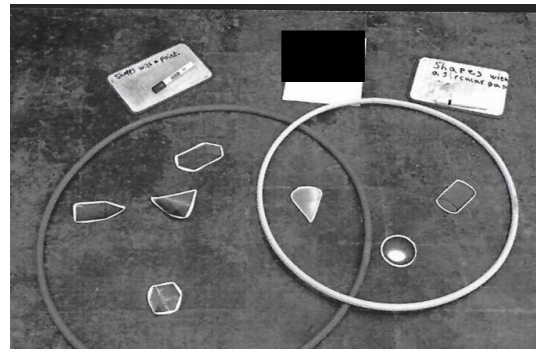
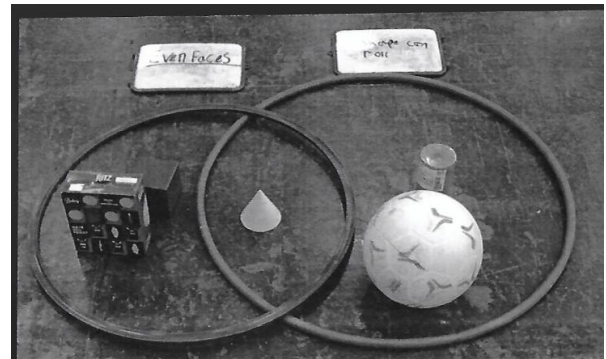
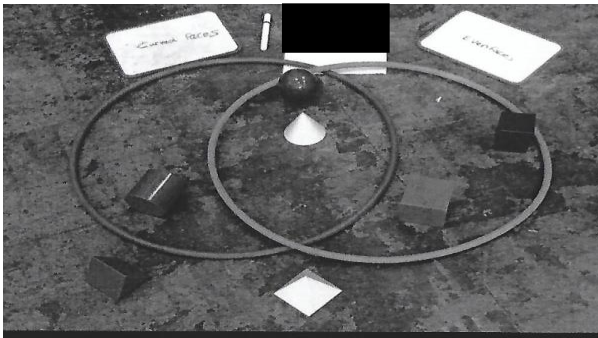
Appendix A

Excellent mathematical subject knowledge and understanding was demonstrated throughout the lesson. Effective and appropriate teaching strategies to support pupils' mathematical skills, application and reasoning were also evident. The class were set a 3-minute TTRockstarts challenge at the beginning of the lesson followed by the 'daily do'. This followed the current vision of the school and ensured that pupils' mental maths skills were being developed in preparation for the remainder of the lesson which demonstrates very good practice. Mathematical terminology was modelled throughout the lesson e.g. operation, inverse, tens, units etc. and pupils were encouraged to use these when explaining their thought processes.

Appendix B

Cofio a Deall/ Remember and Understand Allwch chi restru'r agweddau ar y profiod dysgu a oes yn ddol? "Can you list the aspects of the learning experience that went well?" Pa elfennau o'r profiod dysgu oedd yn siomedig? "What were the elements of the learning experience that were disappointing?" 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?"	independently. Went well * Children listened well to the powerpoint * Could sort the statements out with some help. Disappointing * labelling the diagram Power point to show facts about the organs & allowing children to read the information. I would switch the lesson around so that the children labelled the diagram first.
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Appendix C



Appendix D

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

Dyddiad/Dde: 23/11/18
Ddiwyddiad critigol (Focus)/Critical Incident (Focus): Maths

Profiad/ Experience	
Teimladau/ Feelings Beth yw eich teimladau ynghyd y profiad? "What are your feelings regarding the experience?"	Children felt confident with the addition. They could use the method which suited them.
Cofio a Deall/ Remember and Understand Atwech chi reatd'r apwyddau a'r profiad dyddio a oeth yri ddi? "Can you tell the aspects of the learning experience that were well?" Pw eiddonau a'r profiad dyddio oedd yn ddiffficult? "What were the elements of the learning experience that were disappointing?"	Went well + Addition - Confident at using the method best for them. + Interactive game. Disappointing Too many elements to the lesson. Children couldn't cope with adding taking away & estimating.
Gwerthuso a dadansoddi/ Evaluate and analyse Beth fyddwch chi'n caelw'r un peth i sicrhau dyddio a'r dyddio a'r dyddio? "What will you keep the same to ensure effective teaching and learning in the future?" Beth oedd ochr y'r eiddo a'r eiddo a'r eiddo? "What was the cause of the most important disappointing element?"	Letting the children add using the method that suits them. Children showing different ways on the board. Too many elements, children found it difficult to do.
Casgliadau a chamau gweithredu/ Conclusions and actions Beth yw eich atebion posibl i'r materion a'r dyddio a'r dyddio? "What are your possible solutions to the disappointing issues identified?" Beth ydych yn mynd i'w wneud nesaf? "What will you do next?"	Break The lesson down. Get rid of the estimating element. Inverse - Work on subtraction. Keep estimation as a different lesson.
Y profiad newydd / Transformed experience	

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