

Module: Learning and Teaching in the Primary School

Module Code: M6X02149

Module Lead: Rachel Wallis

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

The aim of this assignment is to analyse the correlation between teacher subject knowledge and effective teaching and learning in Primary Schools in Wales through initially conducting a literature review. The subsequent part of the assignment is an analysis and evaluation of my own subject knowledge through personal reflection of my initial Professional Teaching Experience (PTE). The personal reflection from my PTE was from a large Primary School in the South Wales Valleys. The school has high levels of deprivation with 40% of pupils eligible for free school meals which is considerably higher than the average in Wales of 21% (Estyn, 2015). The school has identified around 34% of its pupils as having additional learning needs (Estyn, 2015). During PTE I was assigned in a Year 3/4 class with 29 pupils; 27 Year 4 pupils and 2 Year 3 pupils supported by a teaching assistant. In accordance with the BERA (2018) guidelines, the name of the school, teachers and the children will remain anonymous throughout the assignment.

The subject knowledge necessitated as a Primary School Teacher is comprehensive due to the sizable range of subjects encompassed within the Foundation Phase and Key Stage 2 of the National Curriculum. In addition to subject knowledge the application of subject knowledge is equally important, known as pedagogical subject knowledge. This necessitates the ability to construct the knowledge, understanding and skills of subjects accessible and meaningful to children. Teachers throughout the UK are required to encompass strong subject and curriculum knowledge (Ofsted, 2014).

The issue of subject knowledge for a primary teacher is more complex than that of a Secondary teacher who typically has a minority of subjects to teach albeit to a more advanced intellectual level. However, primary teachers are required to have good subject

knowledge of all subjects within the National Curriculum. Over recent years there has been a major drive to improve children's attainment which requires improving the quality of teaching in schools. In recent years the Welsh Government has had a major drive to improve literacy and numeracy skills through the implementation of the Literacy and Numeracy Framework (LNF) and Information Communications Technology (ICT) across the curriculum through the implementation of the Digital Competence Framework (DCF). High quality teaching and learning is pivotal to raising standards and tackling underachievement. The new curriculum specifically designed and implemented in Wales holds the largest overhaul of education in a generation and should be delivered in all schools in Wales by 2021.

Donaldson (2018) aims to deliver a curriculum that "constructs capable, healthy, well-rounded individuals who can thrive in the face of unknown future challenges". Welsh Government's reform of Wales' national curriculum affords the foundations for a twenty first century curriculum designed via the latest thinking of education. The consecutive dissatisfying PISA results for Wales has been and will endure to be at the core of the necessity for revolution.

The objective of teaching is to support children in the development of intellectual resources that empower them to partake the foremost realms of human belief and enquiry and not simply know about them. An imperative attribute of a teacher is to be impartial as Conant (1963) claims that teachers who are principally ignorant and informed can have a detrimental effect on children's education. Teachers who perceive subject knowledge in constricted views or encompass erroneous information are liable to transfer these misconceptions to their students and therefore restricting their knowledge and

understanding. These teachers may not challenge children's misconceptions and those with strong subject knowledge to further develop their understanding. Ultimately teachers' subject knowledge characterise their practice beginning with the initial planning, resources, questioning and the philosophies they underpin. Shulman (1986) contends it is essential teachers can provide explanations to specific propositions, the significance and the correlation to other propositions and subjects and not simply explain specific subject fields. The magnitude of subject knowledge is emphasised in the 2008 Ofsted Report which recognises the diverse qualifications and experiences primary teachers possess. Ofsted (2008) proposed schools should provide access to an expert subject leader who supports and trains other staff, develop teachers' subject knowledge as part of their School Development Plan, share good practice with other schools and exploit exclusive subject prospects for continuing professional development.

There is extensive agreement around the substance of teaching, specifically how to depict and measure the most effective practice remains unclear (House of Commons Education Committee, 2012). Furthermore there has been little or nil correlation between teacher qualities and standards and pupil attainment (Rockoff et al, 2011). An international review of teacher evaluation reports to execute an impartial and dependable teacher evaluation model necessitates reference standards to appraise teachers practice. Shulman (1982-1987) developed and trialled teacher assessment models that laid the fundamentals for the National Board for Professional Teaching Standards methodology to appraise teaching quality. In Wales this would be the recent 'Professional standards for teaching and leadership' that focus on the fundamental components of teachers practice; pedagogy,

collaboration, leadership, innovation and professional learning (Welsh Government, 2017). The new standards are hoped to advance the teaching profession during the revolution of the education structure through the implementation of the new curriculum. There are numerous terms expended that include 'expert teaching' (Turner-Bisset, 2001), 'veteran teachers' (Shulman, 1987), 'excellent and outstanding' (McBer, 2000) and 'quality teachers' (McLaughlin and Burnaford, 2007). Whichever term is exhausted it will define a teacher that is at the upper scale of quality teaching and can be classified as commendable role models within the profession. Expert teachers have an expertise with their subject and conducts at elevated degrees in filtering, reorganising, associating and advancing their own knowledge which is required to teach. Experts retain specialist knowledge that manages their authority of reasoning. Additionally they have virtuous ability of 'chunking' which requires the recollection of patterns which are amassed in the permanent memory. This valuable skill is accomplished due to a teacher's expertise and experience with the content which is strengthened through repetition. Contemporary research states that the 'chunking' skill is prospectively an innate proficiency and not necessarily due to hard work (Feigenson and Halbreda, 2008).

Lee Shulman (1987) an educational psychologist introduced the Pedagogical Content Knowledge (PCK) which defines how good teachers have the ability to construct subject content accessible to learners. Shulman (1987) identified that student teachers with an expert subject knowledge delivered lessons which encouraged children to reflect and advance multifaceted ideas of their own instead of deliver arranged content that was dependent on children memorising information. Shulman (1987) believed the fundamental

aspect to understanding the knowledge base of teachers occurred within the intersection amid pedagogy and content. However the knowledge base does not specify what teachers ought to know, accomplish or profess that will depict teaching as more than a configuration of personal industry never mind a studied profession. Teachers with robust subject knowledge have the aptitude to composite the 'what' and 'how' to teaching. This amassed knowledge and intellect encompasses children, pedagogy, subject material and the curriculum to yield a high quality teacher. Bruner (1966) contends influentially that the principal and defining philosophies within a subject can be encountered significantly by children if the content is not made accessible by the complex skill of the teacher. Shulman believed that teaching was as cognitively multifaceted as medicine and that teachers employ decision making on a daily basis to inform their practice. These beliefs laid the foundations for a panel report for the National Institute of Education on future objectives for educational research titled 'Teaching as Clinical Information Processes' (National Institute of Education, 1975).

Expert teachers unlike inexperienced teachers have the ability to extract and organise knowledge from an increased knowledge base using increased complexity to link methodology and areas of subjects. Research into the difference between inexperienced and expert teachers identified experts have the ability to arrange their knowledge adequately (Glaser, 1999). As a teacher you have an imperative role in scaffolding children's knowledge and understanding through sharing of your own expert subject knowledge. It is imperative for teachers to continually advance their own subject knowledge through reading, guidance from subject experts and attending courses. There will continually be

areas of weakness within your knowledge of subjects that necessitate further study and development especially with the continually advancing curriculum.

The knowledge quartet was a research programme carried out by the University of Cambridge commencing in 2002 to present day researching the mathematical content knowledge of trainee primary school teachers. The research not only investigated subject knowledge but how this knowledge is evident within planning and in their teaching. This research facilitated the development of a framework for the observation, development and evaluation of mathematical teaching with an emphasis on the influence of the teacher's subject knowledge. Shulman (1986) notes the disparity between subject knowledge and pedagogical knowledge supports this regard to mathematical teaching. Within the principles of the knowledge quartet, the knowledge and theories demonstrated in the teaching of mathematics can be perceived in four elements; foundation, transformation, connection and contingency. Within each element there are a collection of subsections that were considered to be of comparable characteristics.

The foundation element of the Knowledge Quartet encompasses knowledge, theory and understanding attained during preparation afore the commencement of their role as a teacher. An attribute of teacher's mathematical subject knowledge is the implementation of a theoretical perspective to influence teaching choices rather than be dependent on replication of a fellow teacher or trial and error. The underpinning of theory and knowledge fund pedagogical elections and approaches in an imperative approach within the classroom. The transformation aspect of the Quartet comprises of the practice of knowledge as

exhibited within planning and teaching subjectively. At the core of this is Shulman's belief that the knowledge base for teaching is characterised by the teacher's ability to renovate their content knowledge into practices that are pedagogically influential. Shulman (1986) specifies, the exhibition of ideas within the classroom necessitates the implementation of examples, diagrams, demonstrations and explanations. This notion refers to teacher's conduct concentrated to an individual child or group of children following background knowledge and understanding of the individual. The trainee's election and application of examples exhibited to the children to support their theory development, specific subject language acquisition and procedural presentations is of particular importance to the transformation aspect.

The connection category of the framework connects particular elections that are constructed for the acquisition of isolated elements of mathematical content. The coherence of the teaching and planning for a lesson or sequence of lessons is encompassed within the connection category. The notion of coherence embraces the successions of topics not solitary within lessons but also amid lessons, comprising of the organisation of tasks which reflect negotiations and preferences necessitating comprehension of organisational relations within mathematics and the cognitive mandates of varying mathematical topics and concepts. The final aspect of the knowledge quartet is that of contingency. This contingency aspect relates to unplanned occurrences within the classroom which are almost unattainable to prepare for and require the teacher to think on their feet. It requires the innate ability to act on children's notions which diverge from your planning for that particular lesson. Teachers who are anxious about their subject matter knowledge ability to

listen and support children's diverse ideas and concepts can sometimes lead to disengagement and the competence to listen reduces through anxiety (Brown and Wragg 1993).

The knowledge quartet has in recent years been used as a measure to assist concentrated reflection on the application of teacher mathematical subject knowledge. In addition the quartet has been used in collaboration with newly qualified teachers, trainee teachers, school mentors and university mathematical lecturers to develop mathematical teaching.

Although there is minimal evidence into the effect teacher subject knowledge has on pupil attainment, universities are working to improve trainee teachers' subject knowledge. The National Centre for Excellence in the Teaching of Mathematics has developed a Mathematics audit for PGCE students to support the identification of areas of weakness in students' mathematical subject knowledge. The audit is separated into eight sections and on completion provides the student with feedback on areas of both weaknesses and strengths. A study conducted by the University of East London into the mathematical subject knowledge of trainee teachers in 2009 found trainee's results from the audits corresponded with their GCSE Maths grade. The study found that trainees with a grade A at GCSE failed the fewest areas of the audit compared to those with a grade C who failed six times as many areas in the September audit and thirteen as many in the April audit. The study outlined four weakest areas of subject knowledge for all trainees across the GCSE grades. The areas that presented the greatest difficulties for the trainees were shape and space; equations, functions and graphs; reasoning and proof and algebra.

In my initial Professional Teaching Experience (PTE) I was placed within Key Stage 2 in a predominantly Year 4 class with only 2 Year 3 children. Over the past few years I have worked as a teaching assistant and higher level teaching assistant predominantly in the Foundation Phase working primarily in the Reception and Year 1 class. Although I covered the PPA (Planning, Preparation and Assessment) in Year 4 for a period of an afternoon once a week I only taught Guided reading and Religious Education. Owing to my previous experience I only had very basic subject knowledge for the Year 3 and Year 4 curriculum. Through extensive experience working in a primary school although there were weaknesses within my subject knowledge I had secure pedagogical strategies that supported my teaching.

My mathematics subject knowledge was a noticeable strength during PTE owing to my theoretical foundation consumed in relation to the Knowledge Quartet which supported my pedagogical content knowledge. I was confident in the planning and delivery of the mathematics lessons using the medium term planning, Programme of Study for Mathematics and the National Literacy and Numeracy Framework (LNF). For the daily Mathematics lessons to be of greatest advantage to the children's development it is indispensable for teachers to be copiously knowledgeable and confident about their own subject knowledge, understanding and skills of Mathematics. Limitations and weaknesses have direct association with the quality and efficiency of Mathematical teaching (Ofsted, 2000). I was particularly competent in the implementation of 'Big Maths' through a strong foundation knowledge owing to comprehensive training and continued application within my previous role. Consuming a strong subject knowledge facilitated effective planning and

delivery of the lessons. When pupils required support I had sufficient knowledge of the appropriate methodology in accordance with the programme, previous teaching and curriculum requirements. I was effective in my ability to introduce and explain methodologies including providing sufficient responses to pupils questions both within Big Maths lessons and daily mathematics lessons. In accordance with the Knowledge Quartet I was confident in implementing contingency when a pupil questioned why they couldn't answer a question using a different method. I used my knowledge to explain to the pupil that although their method worked correctly for that sum it would not work for all sums and provided an example. Expending my subject knowledge I was specifically able to support Child C who was a More Able and Talented (MAT) pupil. Child C had completed the Big Maths test promptly so I provided Child C with mathematical equations equivalent to Year 6 level. As Child C had a strong subject knowledge I was able to use my curriculum and subject knowledge to further develop his mathematical development.

I was able to share some of my Big Maths knowledge and training with the class teacher and teaching assistant on supporting the lower ability pupils during their Big Maths activities. During PTE I implemented the identification of the easier sums by simply highlighting those sums which was going to be continued to be implemented on my departure. This enabled those pupils to attempt to answer the sums within their capabilities and increase their confidence which for a few pupils had been severely knocked due to achieving the same or lower score on previous attempts. The subject knowledge of the Big Maths age related expectations also supported my mathematics lessons as it permitted the appropriate selection of sums for the daily warm up. These sums were specifically targeted to

weaknesses identified during previous Big Maths tests and if appropriate to the maths topics covered in the previous and current week.

Donaldson's review (2015) proposes ICT should have parallel status within the curriculum to that of literacy and numeracy and should be a cross-curriculum responsibility of all teachers'. Within PTE I incorporated the inclusion of the DCF due to the drive to increase technology within the classroom during mathematics lessons. During a lesson where pupils were creating a graph for the results they had collected, the lower ability pupils with the support of the teaching assistant used Just2Easy (J2e) on Hwb to create their bar graph. The use of ICT had a positive impact on this group of pupils as they very evidently more engaged with the activity once they knew they would be creating a digital graph. Certain individuals within the group struggle with number formation but by using J2e this enabled them to create the graph without losing confidence. During week 3 of my placement the warm up was the four times tables in which I employed a four times tables song off the Internet and daily as a class sang the song. The following week I played four times tables loop cards and the majority of the class were able to accurately answer four times tables questions. It was evident from this that the class had found the song engaging and had actively participated furthering their knowledge and understanding of the times table. Michael Gove (2011) recognised the use of Information Communication Technology (ICT) can be employed to improve motivation and engagement, interactivity and develop an innovative domain of fun.

I personally found my scientific subject knowledge the weakest as I had very limited understanding of the skills and expectations for Year 3 and Year 4. Additionally the school had very clear and concise presentation and layout rules for their investigations which I had to maintain within my lessons. Owing to the numerous different parts to science investigations and my lack of subject knowledge I found it best to have an example for each differentiated group on hand. Each example included notes detailing the complexity of the work expected and key words that they should be encouraged to use, particularly in their conclusion. After initially consulting the Key Stage 2 Science Framework to ascertain the expectations for the relevant age groups I looked at the aspects which were relevant to the medium term planning. I sought advice from the school's Science co-ordinator with expert scientific subject knowledge. The co-ordinator showed me science books from the previous year where we looked at the level of detail within an investigation, the differentiation and the layout.

Expending the science co-ordinators support I enhanced my planning before delivering the investigation into how far the rocket travels. Within my lesson plan (Appendix A) I ensured I included comprehensive detail of each aspect of the lesson owing to the lack of confidence within the subject area. Included within the lesson plan is the key questioning to be implemented within the lesson to support the development of pupils learning. Grossman et al (1989) expresses the lack of crucial subject matter knowledge, teachers are not capable to deliver valuable teaching as it is explicit for teachers to have the proficiency to explain and rationalise scientific theories distinctly. Weak subject knowledge will reduce the effectiveness of questioning within the classroom. Questioning increases pupil engagement,

supports active learning and affords instant assessment of learning. The constructivist teacher endeavours to explore learners understanding through discussion and questioning which promotes the formation of new understanding and learning (Brooks and Brooks, 1993). An issue I came across during the lesson was when I was using the division 'bus stop' method to work out the average on the Whiteboard with the class. The method has altered slightly since I was in school and I referred to that method by mistake which caused some confusion. This error was predominantly made due to a flaw in this area of mathematics. To alleviate this issue in the future I will create a prompt card to ensure I implement the appropriate methodology.

The preparation, planning and delivery of the lesson developed my science subject knowledge for future practice from the initial research during the planning and preparation through to the evaluation of the lesson. The enhancement of my scientific subject knowledge will support the planning and delivery of future science lessons as I have an increased subject knowledge of the relevant skills for the age group. However, although my scientific subject knowledge was enhanced through preparation and delivery of the science investigation lessons continuing professional development (CPD) will need to be partaken to maximise my pedagogical content knowledge. I am not in isolation in experiencing deficits in science subject knowledge, the lack of subject knowledge has been a concern for teachers for years (Holroyd and Helen, 1996, 1997 and Appleton and Kindt, 1999). The acquisition of subject knowledge will support the planning of future Science lessons not only for Year 4 but other age groups as I will have an increased awareness of the expectations.

My subject knowledge for literacy although moderately secure was found to have weaknesses during PTE. I found the principal fault within my subject knowledge was the terminology exhausted during certain lessons. Although I had previously studied the terminology required, owing to the lack of application and time lapsed, the terminology had become elapsed. After identifying these areas of weakness I revised these specific areas to ensure I had the appropriate subject knowledge to effectively teach and support the learning of the terminology during not only Literacy but across the curriculum. The class comprised of a small group of lower ability children who were working at reception to Year 2 level and were receiving daily Read Write Inc. (RWI) intervention from the teaching assistant. I was able to use my recent RWI training and experience to support these individuals thoroughly within their phonics development and specifically during Literacy lessons. During PTE when completing a basic writing activity I was able to use my RWI knowledge to support individual's spelling of words using the sound rhymes, Fred fingers and blending. Additionally this knowledge facilitated the support of letter formation as I was able to prompt children using the letter formation rhymes from the RWI programme across the curriculum. Although areas of weakness were identified it was noted in lesson feedback I articulate a fairly high standard of language and grammar during teaching which supports children's language development. All teachers have to be teachers of English because every subject across the curriculum is taught primarily in English whether it be through speaking, writing and reading within the lesson. A third of businesses reported they were dissatisfied with the literacy skills of young people on entry of employment (Literacy Trust, 2018).

In the course of PTE I was aware of a major lack of subject knowledge in relation to Star Wars. Star Wars was the class' topic for the term and was central within a number of lessons across the curriculum, specifically Humanities. Owing to limited foundation subject knowledge on commencement of PTE, initial research of Star Wars was conducted to facilitate preliminary consultation of planning. Drawing on a specific lesson where limited subject knowledge caused an issue was during a literacy lesson where they were writing a description of a Star Wars character. The first encountered issue was when supporting a lower ability pupil to choose a character as I was unfamiliar with all the characters names. Although the entire class were able to construct a basic description of a character I was in a weak position to maximise learning due to the limitations in subject knowledge of Star Wars. Although I lacked the subject knowledge to maximise this learning experience I had planned for pupils on completion of the task to work with a peer of higher ability to develop their description. Using Vygotsky's theory of learning through the Zone of Proximal Development (ZPD), through the interaction with a more knowledge other (MKO) pupils were able to use the guidance of the MKO to improve their description and therefore develop their understanding. Although I could support pupils in improving their description I lacked the specific Star Wars characters themselves which the MKO could.

The importance of strong subject knowledge is crucial for high quality teaching to ensure children make the maximum progress they are capable of. Strong subject knowledge is ultimately the most significant factor of quality education. A teacher with secure subject knowledge will have the aptitude to identify and resolve pupils' misconceptions, provide meaningful explanations that scaffold learning and further development those with strong

subject knowledge. Over recent years there has been an extensive drive to increase pupil's attainment which necessitates an improvement in the quality of teaching within schools across Wales. The Welsh Government's reform of the curriculum integrates the latest rational for education which will require all teachers to modify their teaching approach. An effective teacher will have a powerful and lifelong influence on an individual's education and life which supports the four main purposes of the curriculum as outlined in Successful Futures (Donaldson, 2015).

As discussed above there are areas of development within my subject knowledge that necessitate further development to maximise effectiveness within the classroom. I have identified that continual professional development through reading, seeking expert support and attending courses is essential to develop and support subject knowledge. Throughout the PGCE I am continually working towards achieving standard 2.1 of the Qualified Teacher Standards (QTS) that states "They have a secure knowledge and understanding of the subject(s) they are trained to teach". Additionally I will need to develop through my planning and teaching the incorporation of the new curriculums philosophy which necessitates the development of a 'Foundation' approach into Key Stage 2.

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Appendix

Appendix A

Canolfan Addysg Athrawon De-Orllewin Cymru  The South West Wales Centre of Teacher Education			1B	
Session Plan – Science				
Name of trainee: Nicola Davies		Session ref: 271118(3&4)Science 2		
Personal target(s) in relation to QTS:		They differentiate their teaching to meet the needs of learners, including the more able and talented, and those with special educational needs. They may have guidance from an experienced teacher where appropriate. (S3.3.4)		
Year group: 3/4	No. of learners: 29	ALN: Differentiation- Supported, Lower, Average and Higher ability		
Additional Adults: Teaching Assistant				
Learning objective(s): Science Investigation		Success criteria: • I can record my results in a table • I can draw a bar graph showing my results • I can explain what I found out		
Links to previous learning: Pupils have been studying forces and designed and created a rocket to use for the investigation. Pupils created their rockets in small groups.				
Curriculum coverage (range, skills) <u>Science</u> <u>Skills</u> Communicate clearly by speech, writing, drawings, diagrams, charts, tables, bar charts, line graphs, videos, and ICT packages, using relevant scientific vocabulary Use standard measures and S.I. units, e.g. kg, s, N, m <u>Range</u> When carrying out a fair test, the key variables that need to be controlled and how to change the independent variable whilst keeping other key variables the same The observations or measurements that need to be made Check observations and measurements by repeating them in order to collect reliable data Use some prior knowledge to explain links between cause and effect when concluding				
Literacy(LNF)		Numeracy (LNF) Select and use suitable instruments and units of measurement (KS2.5) Measure on a ruler to the nearest mm and record using a mix of units, e.g. 1cm 3mm (4.M1)		
DCF Results table displayed on the Interactive Whiteboard to collect the results from all the rockets for groups to copy into their table.	Thinking Pupils to think about why certain rockets may have travelled further and link to prior learning.	ESDGC	YCC	

Key vocabulary(English/Welsh): Light Investigate Heavy Measure Weight Distance travelled Friction Bar graph Speed Results Prediction Fair test		
Time	Session activities, organisation and management	Key questions & Assessment for Learning opportunities
10 mins	Introduction Remind pupils of the rockets they made last week. Ask pupils what they are going to be investigating. Review the planning board, section at a time- What we are going to investigate? What we will change? What we will keep the same? What we will measure? Pupils to complete and finish the planning board. Explain to the pupils how the investigation will work in the hall- One member of each group will need to blow up a balloon and attach it to the back of their rocket without letting the air out of the balloon. Another member will need to hold the rocket and stand behind the start line. Instruct pupils to let their rocket and the balloon go. Each group to work together to measure how far the rocket has travelled.	What are you investigating with your rockets? What are you going to measure? What are you going to change? What are you going to keep the same?
40 mins	Main activities Each group to choose one pupil to hold the rocket while other(s) blow up the balloon and attach the balloon to the rocket. Pupils' line up behind the line and on instruction let their rocket go to see how far their rocket travels. Each group work together to measure how far their rocket travelled using metre sticks and tape measures. Pupils to record their results in their results table for their groups rocket. Each group to repeat the flying of their rocket three times and record the results. Collect the results for each groups rocket and display on the Interactive Whiteboard (IWB) for pupils to copy down other groups results. Introduce pupils to 'average'. Ask pupils if they know what average is and how they would work out the average. On the Whiteboard model how you would work out the average writing the sum. Work out the average for each rocket asking pupils what step comes next when working out the average. Pupils to study their results looking at the average. Ask pupils which rocket travelled the furthest and why they think it travelled the furthest. Which rocket travelled the least furthest and why they think it travelled the least.	
20 mins		What does average mean? How do we work out the average? Which rocket travelled the furthest? Why do you think rocket (number) travelled the furthest? Which rocket travelled the least distance?

20 mins	Pupils to put their results into a bar graph. <u>Supported (PR)</u> PR to ask pupils what the average distance travelled for rocket 1 was and draw the bar on the graph. PR to model counting up the scale and emphasising where the bar stops. PR with the support of the group complete the bars for rockets 1-4. PR to photocopy the graph for each pupil and then they are to complete the graph for rockets 5-8. PR to support pupils reading the scale and drawing the bar in the correct place. <u>Lower Ability</u> Pupils provided with differentiated graph (2). Pupils to write a title for their graph and complete the axis. Pupils to complete the graph and may require support to complete the graph. <u>Average Ability</u> Pupils provided with differentiated graph (2). Pupils to write a title for the graph and complete the axis. Pupils to complete the graph mostly independently. <u>Higher Ability</u> Pupils to complete differentiated graph (3). Pupils' to label the axis, complete the scale and axis and create a title. Pupils to independently complete their bar graph. Pupils may choose to go up in 2's or 5's depending how far the rockets travel. <i>Miss a square between each bar on the graph.</i> Pupils to write up their results- What I found out? <u>Supported</u> Pupils to record what they found out in the investigation and give reasons why (because). Encourage pupils to refer back to their prediction and consider if they were correct. PR to support pupils looking at which rocket travelled the furthest and consider reasons why. <u>Lower and Average Ability</u> Pupils to record what they found out in the investigation and give reasons why (because). Encourage pupils to refer back to their prediction and consider if they were correct. <u>Higher Ability</u> Pupils to record what they found out in the investigation and give reasons why (because). Pupils to consider if their prediction was correct. Pupils encouraged to work out the difference between how far the rockets travelled. Pupils to use words such as light weight, heavy weight, affects speed, friction in their write up of the results.	Why do you think rocket (number) travelled the least distance? Observe pupils during the activity to assess how each individual pupil are doing and if more support is required. <u>Welsh</u> Edrychwch arna bwrdd gwyn Dwylo I fyny Dwylo I lawr Bendigedig Barod?
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10 mins	Plenary Ask for pupils to share their write up of what they found out during the investigation. Ask pupils to feel the weight of each rocket and see if the lightest rocket travelled the furthest and/or any patterns. Ask for reasons why they think certain rockets travelled further than others. Pupils to complete their Self-Assessment	What did you find out? Which is the heaviest rocket? Which is the lightest? Do you notice a pattern? Self-Assessment