

Overview

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Assignment Title: Prepare a portfolio (as though you were sharing with a mentor) which illustrates a critical reflection of progress made on the planning and implementation of three pedagogical principles.

Pathway: Secondary PGCE Chemistry with Science.

Targets from previous assignment:

- 1) Extend the range of reading.
- 2) Develop critical reflection that is informed by a good literature review.

Link to OneNote: https://uowtsd-my.sharepoint.com/:o/g/personal/1901603_student_uwtsd_ac_uk/EpyGVzdCI3ZAgTLxY06wLuEB00z2qjkB1IAPYuxCZykQFA?e=Je5da2

Illustrative example 1: I have developed a learning wall approach as a form of AfL with a Year 7 class. I decided to implement this approach in Physics at the start of the new topic forces. The learning wall has been used as an ongoing formative assessment that is currently being employed as a starter or plenary (Figures 1.1-1.2). Pupils write something that they have learnt and can remember from the lesson during the plenary or a previous lesson if during the starter on a post-it note. The post-it note is then glued next to the pupils' name on a display board (Figures 1.3-1.4). This approach has been particularly beneficial as a visual representation of the pupils learning and as a tool to recognise any misconceptions that may have been developed. This has allowed me to take the level of pupils' understanding into consideration when planning subsequent lessons. As a result of developing this deeper understanding of the pupils' progress, my decisions have been more informed when planning the content of the subsequent lessons, for example, what to cover during the opening phase of the lesson has been adapted to ensure misconceptions are immediately addressed.

Illustrative example 2: During a Year 8 Chemistry lesson which mainly focused on introducing the topic of compounds, a range of AfL strategies were used. The example which has been provided within this portfolio was a real-time whole class assessment in the form of a 'Show Me' task (Figure 2.1). This global assessment was used as a mini plenary during the lesson to identify whether the pupils understood the difference between an element and a compound. This helped me to determine whether the class was ready to move forward with the learning or if further explanation was needed. This task was delivered in the form of a competition to the pupils. A chemical formula was displayed on the board (Figure 2.2) and the pupils were required to identify whether the formula was for an element or a compound and as a result show the corresponding card (Figure 2.3). The challenge was to be the first pupil to show me the correct answer. During this task almost all of the pupils were consistently showing the correct answer apart from one who was acting disruptively. Using this form of AfL allowed me to identify that the pupil was acting this way because they couldn't access the content. This allowed me to reflect in action and adjust the lesson plan to include an extra level to the task where individual pupils were asked to explain why they had chosen element or compound. This helped to involve the pupil in the lesson and to improve their understanding (Figure 2.4).

Illustrative example 3: I have developed a mark sheet (Figure 3.1) for a Year 8 class for which I teach Biology, Chemistry and Physics. This mark sheet consists of levels that have been assigned to each pupil according to the National Curriculum levels which act as a type of assessment. This assessment involved marking and levelling investigative projects for both Physics and Biology and providing written feedback (Figure 3.2). The mark sheet has been used to compare the pupils' progress within each subject and across the AOLE and to identify where any weaknesses may occur for each individual pupil. The mark sheet also states whether the pupil is FSM or has ALN and which type of provision the pupil requires which has been useful to include. Moving forward, the mark sheet will be updated and added to throughout PTE to monitor progress and the attainment of the pupils.

AfL illustrative example 1

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Opening phase (with links to prior learning)	1. Write one thing you learnt last lesson on a post-it note. 2. Give an example of a push or pull force.	1. Pupils to recall the last lesson and write one thing they learnt on a post-it note for the learning wall. 2. Pupils to give examples where they would use force to push or pull something in their every day lives.
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Figure 1.1: A screenshot from the relevant part (highlighted in red) of the APLP lesson plan showing preparation for the learning wall.



Figure 1.2: The slide used during the lesson to initiate the task.

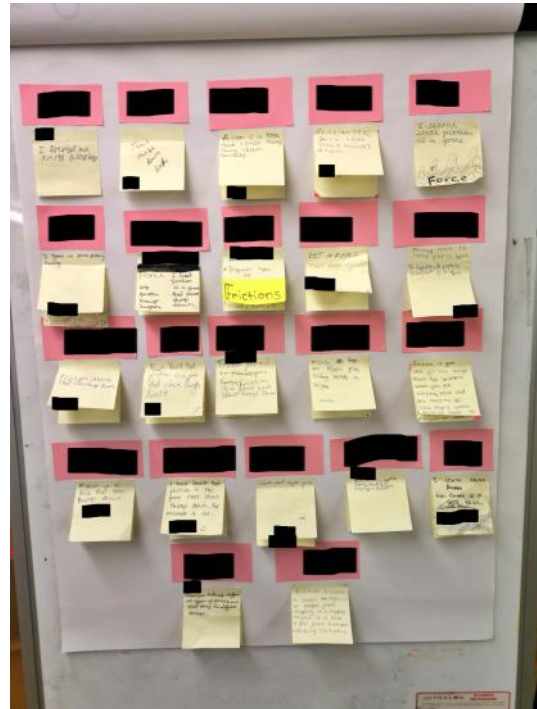


Figure 1.3: The learning wall showing all pupils' responses.

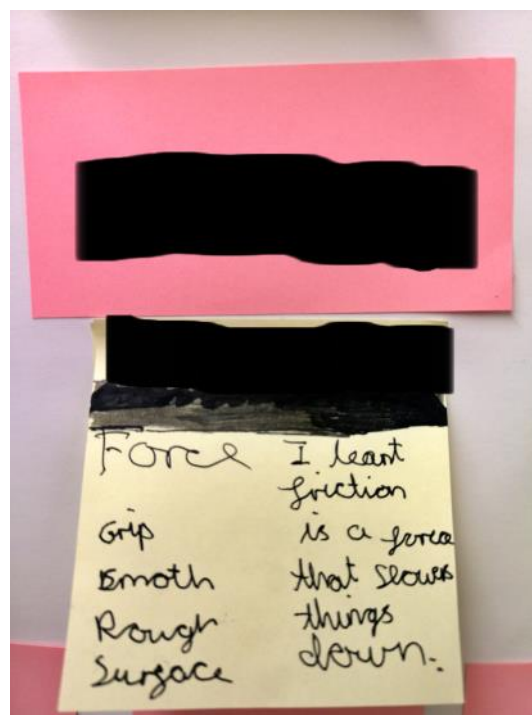
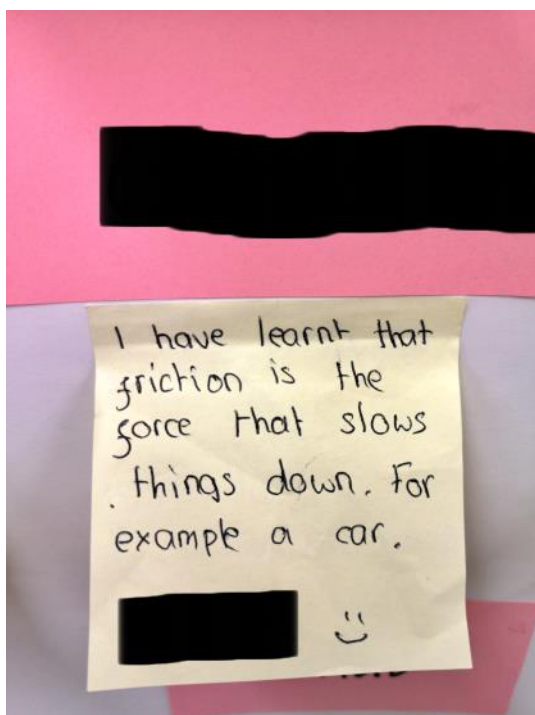


Figure 1.4: Selected pupil responses from the class learning wall.

AfL illustrative example 2

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Teaching & Core Learning	1. Key Question – How are compounds different from the elements they are made from?	1. Pupils to recall that elements have different properties. For example, sodium is a metal and chlorine a poisonous gas but together they are salt.	1. Compounds continuation ppt.
	2. Mini-plenary (AFL): 'Show me'		2. 'Show me' cards.
	3. Recap of rules for naming compounds with one metal and one non-metal – ides.	2. Pupils have different coloured cards with compound or element. When shown substances on the board, pupils to hold up what they think is right.	3. Compounds continuation ppt.
	4. Introduce compounds with one metal		4. Compounds continuation ppt and printed sheets for STF.

Figure 2.1: A screenshot from the relevant part (highlighted in red) of the APLP lesson plan showing preparation for the 'Show Me' task.

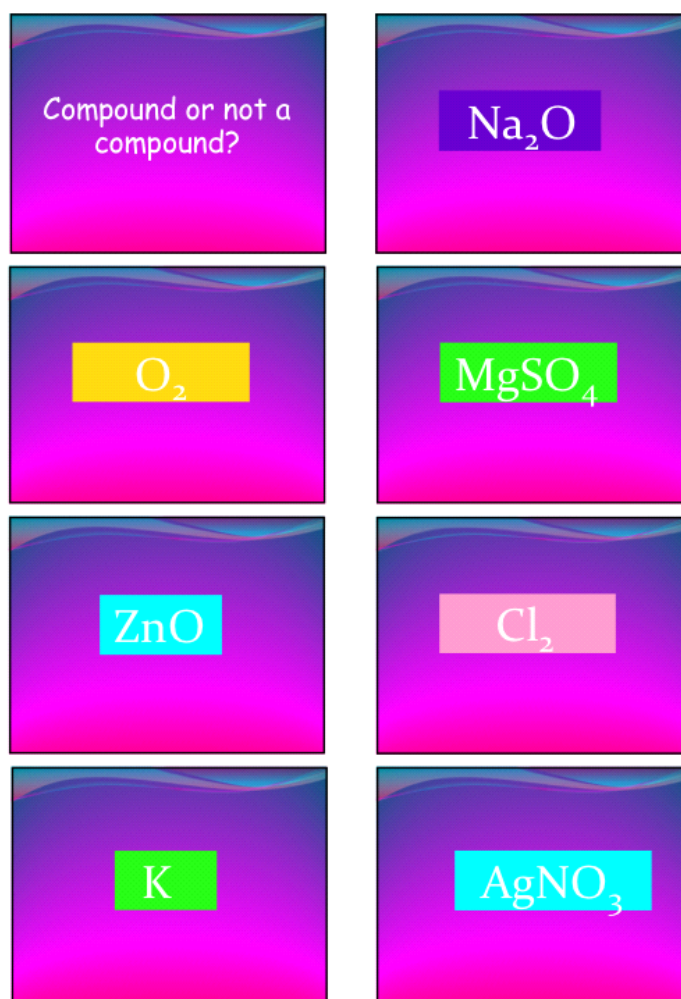


Figure 2.2: Slides containing the chemical formulas used for the 'Show Me' task.

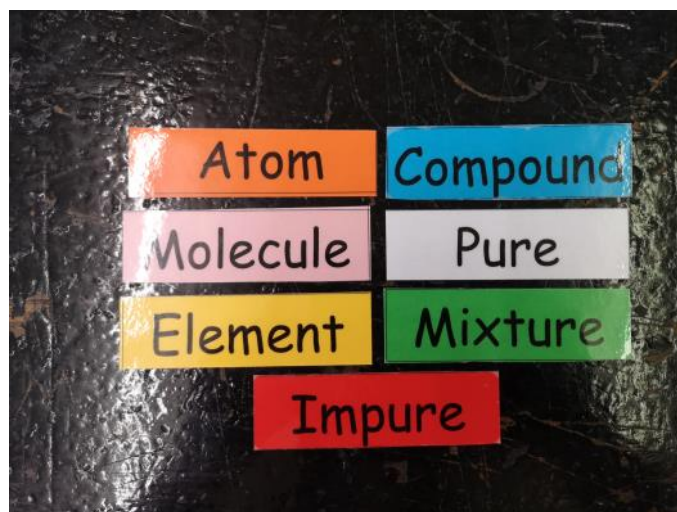


Figure 2.3: The coloured cards used for the 'Show Me' task. The pupils were only required to use the element and compound cards.

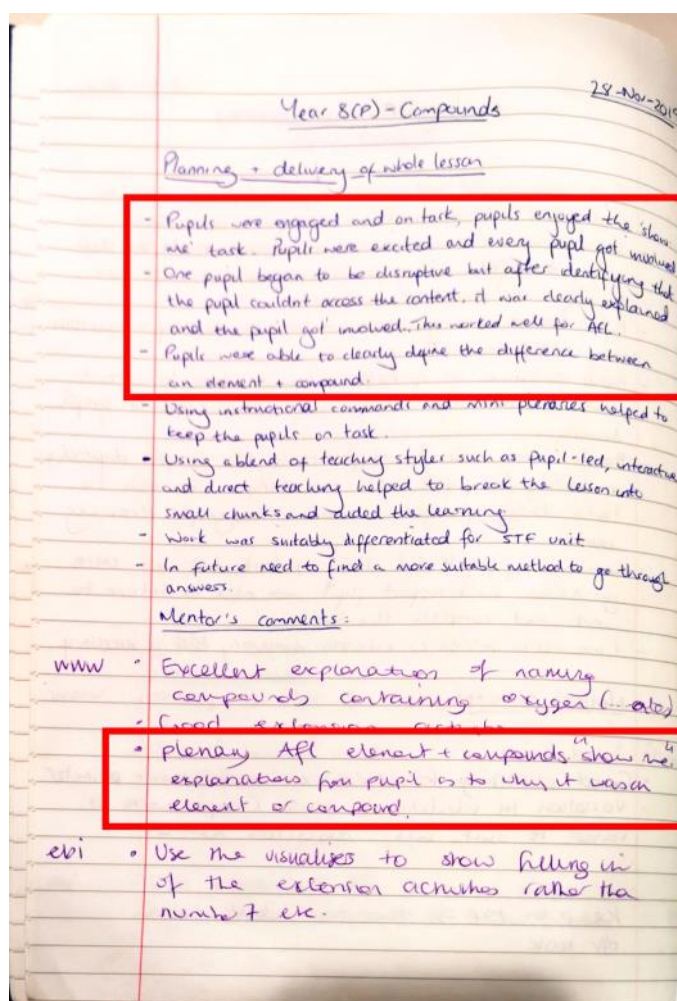


Figure 2.4: An extract from the learning journal showing my reflections and my mentor's comments regarding the 'Show Me' AFL task.

AfL illustrative example 3

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Name	FSM	SEN	STF Unit	Physics		Biology		
				PDR	Method	P	D	R
		S	Y	3	3	3+	3	ND
	Y			4	ND	ND	ND	ND
	Y			4+	4			
				4 (Graph missing)	4	5	6+	4
				5 (Graph missing)	6	ND	5+	4
		S	Y	3	3	3+	3	
	Y	A		3 (no conclusion or evaluation)	Only two lines written	ND	ND	ND
				5	4+			
				4+ (Evaluation missing)	ND	5	6+	5
				4	4	4+	5+	4
	Y			4+	5	4+	5+	4
	Y			5	5			
		A		3+	3	3	2+	ND
		S	Y	3	ND	4	3	
				4+	4			
				4	ND			
				ND	ND	5	6	ND
	Y	S	Y	3	3	4	3	
				3+	5			
	Y	A		3+	4	4	3	4
				4+	5			
				5	6	5	6+	5
						5	6	ND
						4+	6	ND
	Y	S	Y	3	3	4	3	ND
				ND	3+			
	Y			5	5	5	6+	5

Figure 3.1: A mark sheet for my Year 8 class containing each pupils marks for levelled pieces of work in both Biology and Physics.

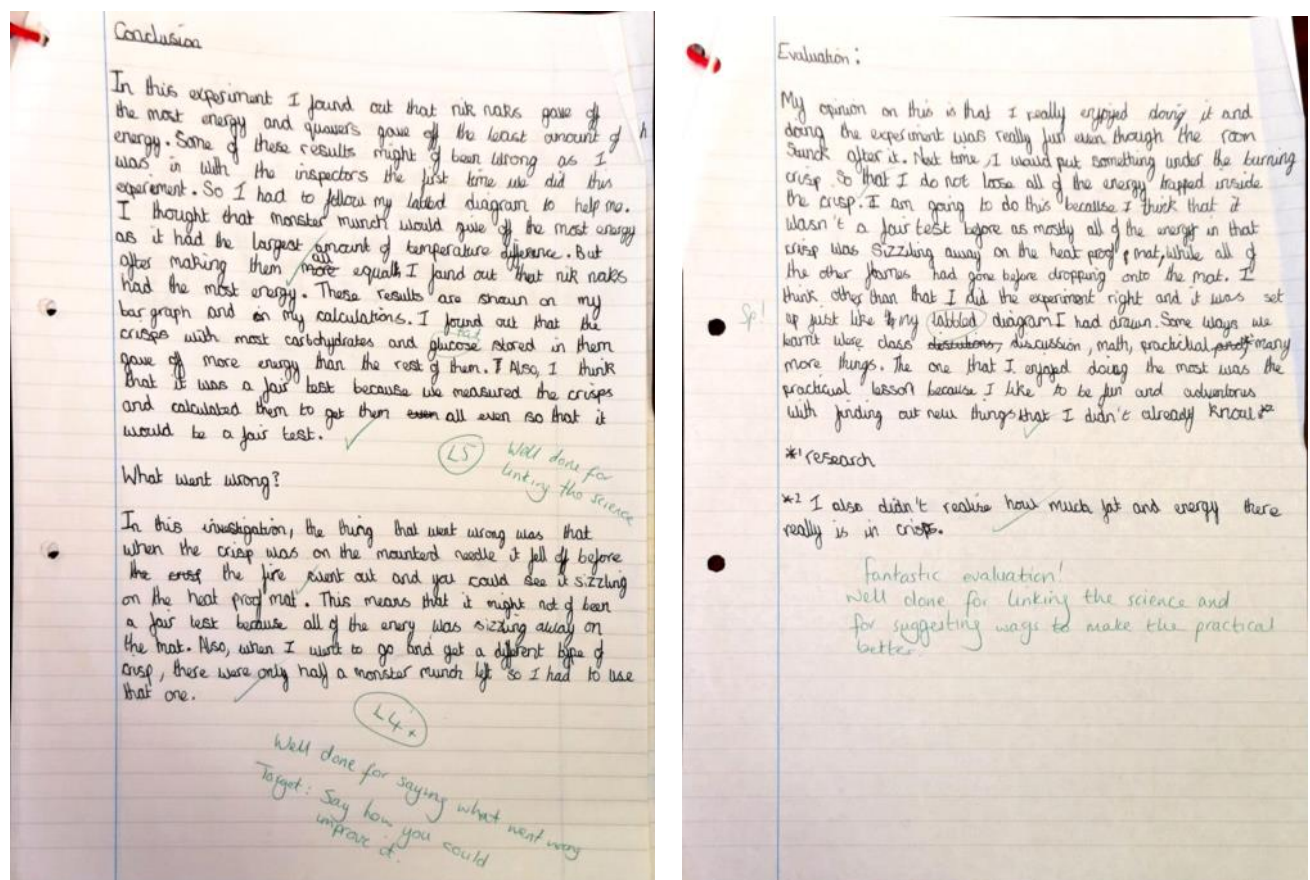


Figure 3.2: An example of a levelled Biology piece of work from the above mark sheet.

Illustrative example 1 (Literacy): During a Year 9 Chemistry lesson the pupils were required to write a method describing each step of their practical work (Figure 4.1). A special emphasis was put on the importance of using imperative verbs, adverbs and the use of a sequential structure. The pupils were provided with the Science specific literacy during the lesson (Figure 4.2) so that the pupils could purely focus on writing their methods to a high standard. The methods were then marked and levelled and each pupil was given individual feedback and targets that were specific to their work (Figure 4.3) with the aim of improving the pupils' quality of writing. During the next lesson the pupils were asked to look at their feedback and adjust their methods according to the feedback and targets that were given (Figures 4.4-4.6). Moving forward into the next lesson the pupils were required to write another method for a different practical. The pupils were asked to take into consideration the feedback that they had received from the previous two lessons. The methods that were produced during this lesson (Figure 4.7) were in most cases of a higher standard in contrast and imperative verbs were almost always used by the pupils.

Illustrative example 2 (Numeracy): This evidence was taken from a Year 9 Skills lesson which focused on using graph drawing to portray information (Figure 5.1). The pupils were introduced to the topic of dinosaurs and they were provided with a spreadsheet of data about a selection of dinosaurs. The topic of dinosaurs was simply chosen to add an authentic context to the lesson. The data (Figure 5.2) that the pupils were provided with consisted of a range of lengths and masses, how long ago the dinosaurs lived, whether they were a Carnivore or Herbivore, two-footed or four-footed and the period that they lived in. The pupils were asked to think of a question that they could ask and answer by producing a graph from the data that was given to them. This task was differentiated to suit the different levels of ability since the KS3 classes are not set in School X (Figures 5.3-5.6). The higher ability pupils were able to draw a graph showing which dinosaurs had the most mass (Figure 5.3), whilst the lower ability pupils were able to draw a graph showing how many dinosaurs lived in each period (Figure 5.5). This lesson was useful to discuss graph drawing with the class as graph drawing is a common challenge for pupils within the AoLE of Science and Technology.

Illustrative example 3 (DCF): A Year 8 Physics lesson on Insulation was taken in the computer room where pupils were asked to research different types of insulation in the modern home and to make an individual resource in the form of a poster, PowerPoint or mind-map (Figures 6.1-6.2). Pupils were introduced to the topic of insulation in the previous lesson and were required to develop their knowledge further during this research lesson and apply their learning to the modern home. A resource (Figure 6.3) was added to the student drive to sign-post all the aspects that were to be researched. The pupils were then required to make their own individual resource using a format of their choice or the pre-made mind-map (Figure 6.4) if required. This lesson encouraged pupils to take ownership for their own learning and to develop their computer and research skills. Some pupils used the pre-made mind-map (Figure 6.5) whilst others produced posters using Word (Figure 6.6) or PowerPoints (Figure 6.7). The pupils then used their resources in the following lesson to design a practical to test different materials found in the South Pole to assess their suitability as insulators for the different areas of the house.

Cross Curricular Responsibilities illustrative example 1 - Literacy

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Lesson 1: Initial method writing

Teaching & Core Learning	1. Discuss what key words mean, introduce meaning of new key word 'base' 2. Recap last practical i.e. acid and alkali, hydrochloric acid and sodium hydroxide to make NaCl. i.e. Acid and Alkali = Salt + Water 3. Introduce Acid + Base = Salt + Water 4. Practical demo 5. Complete the practical in groups 6. Method write-up (or differentiated cut and stick)	1. Students to formulate a definition for each key word after questioning 2. Students to recall previous weeks experiment 3. Listen to explanation and write two equations down with explanation 4. Pupils to observe a demo and answer questions regarding health and safety and practical implementation 5. Carry out practical 6. Write-up method using words on the board	Acid and bases powerpoint Salt made previous week CuSO ₄ practical supplies Print out methods in wrong order for differentiation
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Figure 4.1: A screenshot from the relevant part (highlighted in red) of the APLP lesson plan showing preparation for the literacy method writing task.



Figure 4.2: The slide used during the lesson to provide the key words to be included in the method and to visually remind the pupils of the importance of using imperative verbs and adverbs.

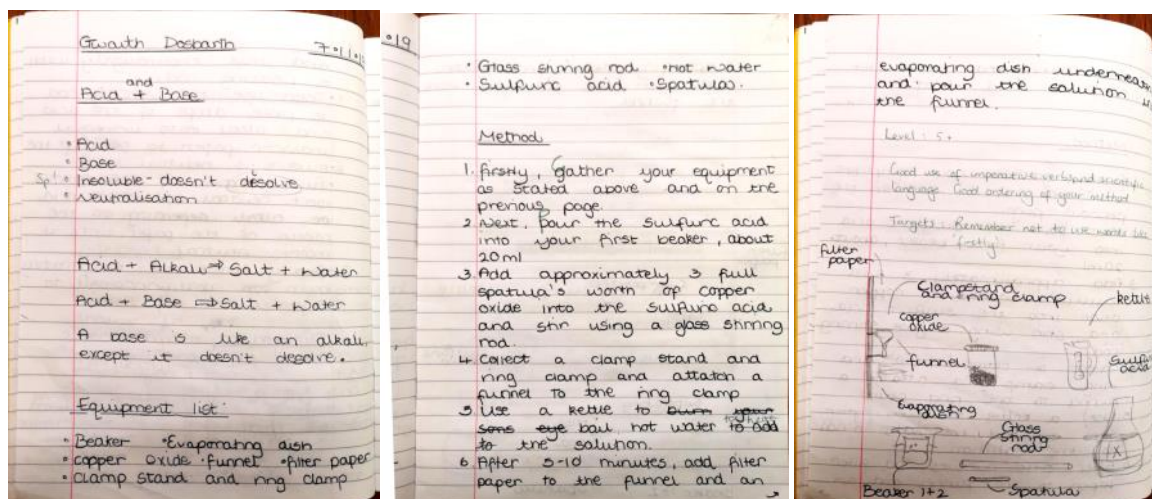


Figure 4.3: An example of a pupil's written work from this lesson.

Lesson 2: Re-write your method according to the feedback

Teaching & Core Learning	1. Finish method write-up or make corrections according to feedback (resource for those who missed the practical). 2. Draw a labelled diagram of each stage of the experiment. 3. Complete a quiz 4. Complete a reverse crossword 5. Complete extension quiz	1. Pupils to address the feedback in their books and make corrections / finish writing method 2. Pupils to draw a clear and labelled diagram of the experiment. 3. Pupils to complete a quiz 4. Pupils to design clues for scientific key words 5. Pupils to complete a further extension task to the quiz	1. Acid and base continuation lesson powerpoint (CuSO₄ resource) 2. N/A 3. Acid and Base Quiz 4. Reverse Crossword 5. pH Quiz extension
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Figure 4.4: A screenshot from the relevant part (highlighted in red) of the APLP lesson plan showing preparation for the correct your method writing task.

Go through your books and correct your method according to the feedback

REMEMBER:

Always use imperative verbs
Avoid using words such as 'firstly' and 'next'
Include scientific language

Apparatus list - Method

Remember to use IMPERATIVE VERBS and ADVERBS

- Beaker
- Copper oxide
- Clamp stand and ring clamp
- Evaporating dish
- Funnel
- Filter paper
- Glass stirring rod
- Hot water
- Sulfuric acid
- Spatula

Figure 4.5: The slides used during the lesson to provide the key words to be included in the method and to visually remind the level of literacy required for method writing.

Personal reflection:

- Use of marking to inform lesson objectives for the lesson.
- Marking informed individual targets for the lesson.
- Multiple extension tasks were provided for pupils that were finished.
- Highly literacy focused, use of imperative verbs and adverbs.
- Seating plan was effective for some however may have to rearrange some as some were still not on task.
- One pupil particularly troublesome. Breaktime catch up session was given to catch up after multiple warnings.
- Behaviour management still an issue.

Mentors comments:

www - Marking linked to levels + targets set.

- work suitable for learner

Personal reflection:

- Use of AEC (marking) to develop the learning objectives for this lesson.
- Use of specific targets for the individual.
- Use of differentiation to provide extension tasks.
- Incorporation of literacy by focusing on the use of imperative verbs and adverbs.
- Classroom management, keep trailing different methods.
- Loudness + children's names will help.

Mentors comments:

www - feedback was suitable for each learner - well done

- clear marking

Figure 4.6: Two extracts from the learning journal showing my reflections and the mentor's comments regarding the literacy task and feedback.

Lesson 3: Write a new method

Acid + Metal carbonate

- Metal carbonate
- Lim Acid
- Limewater
- Carbon dioxide
- Milky
- Reacts

Metal carbonate + Water $\xrightarrow{\text{acid}}$ Salt + Carbon dioxide

Metal Carbonate	Observation
Sodium carbonate	Bubble + milky
Calcium carbonate	Bubble + milky
Copper carbonate	Milky + Bubble

carbonates

All metals + react with acids to make water, salt and carbon dioxide.

Method

1. Gather the equipment
2. Assemble the clamp stand.
3. Add 2 squirts of hydrochloric acid using a test pipette into the test tube
4. Using another test pipette, put 3 squirts of limewater into a separate test tube.
5. Put 3 spatulas of sodium carbonate into the hydrochloric acid, followed by a delivery tube, quickly put the other end of the tube into the limewater to catch the carbon dioxide until it's a milky white.

Figure 4.7: An example of the same pupil's work from Figure 4.3 showing an improvement in literacy.

Cross Curricular Responsibilities illustrative example 2 - Numeracy

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Teaching & Core Learning	1. Recap over how to draw graphs. Continuous/discontinuous data i.e. line/bar graph. 2. What questions can you think of according to the data? Whole class discussion. 3. Individual question development. 4. Draw a graph. 5. Extension – calculate the perimeter.	1. Pupils to discuss the difference between continuous and discontinuous data. Pupils to identify what graphs are used to represent each type of data. Pupils to identify the success criteria for drawing a graph well. Axis in pencil, scale, labels, units and correctly drawn curve. 2. Pupils to contribute towards a discussion surrounding the possible questions they could ask and how to address the questions. 3. Pupils to identify and write down their own individual question. 4. Pupils to produce a graph to address this question. 5. Pupils to calculate the perimeter for each dinosaur.	Dinosaur data sheet, Graph paper, lined paper, rulers and pencils.
Plenary	1. Link to graph drawing to science.	1. Pupils to identify where they may use a line graph or bar graph in science.	No resources required.

Figure 5.1: A screenshot from the relevant part of the APLP lesson plan showing preparation for the numeracy skills lesson.

	Name	Lined (m)	Length (m)	Mass (kg)	Continous/Discontinous?	Four sided? Two sided?	Period		
1	Albertosaurus (Alberta lizard)	80	9.1	2722	C	2	Cretaceous	X	
2	Allosaurus (other lizard)	190	12.2	1814	C	2	Jurassic	X	
3	Anchisaurus	220	4.0	200	H	4	Triassic	X	
4	Ankylosaurus (armored lizard)	170	10.6	4536	H	4	Jurassic	X	
5	Apatosaurus (deceptive lizard)	180	22.9	29937	H	4	Jurassic	X	
6	Brachiosaurus (arm lizard)	135	30.5	45369	H	4	Cretaceous	X	
7	Ceratopsaurus (horned lizard)	145	6.1	1361	C	2	Jurassic	X	
8	Coleophytis	210	2.0	40	C	2	Triassic	X	
9	Deinonychus (terrible claw)	115	2.7	80	C	2	Cretaceous	X	
10	Diplodocus (double beam)	145	27.1	22699	H	4	Jurassic	X	
11	Eraptor	225	1.0	40	C	2	Triassic	X	
12	Hadrosaurus (bulky lizard)	75	9.1	2722	H	4	Cretaceous	X	
13	Iguanodon (iguana tooth)	125	9.1	4536	H	4	Cretaceous	X	
14	Megalosaurus (big lizard)	175	7.9	907	C	2	Jurassic	X	
15	Plateosaurus	215	9.9	4090	H	4	Triassic	X	
16	Staurikosaurus	230	2.0	90	C	2	Triassic	X	
17	Stegosaurus (plated lizard)	190	9.1	2722	H	4	Jurassic	X	
18	Triceratops (three-horned face)	70	7.9	6359	H	4	Cretaceous	X	
19	Tyrannosaurus (tyrant lizard)	87	15.2	6359	C	2	Cretaceous	X	
20	Velociraptor (swift robber)	90	1.8	113	C	2	Cretaceous	X	

Figure 5.2: The table used by each pupil to formulate their questions and produce a graph.

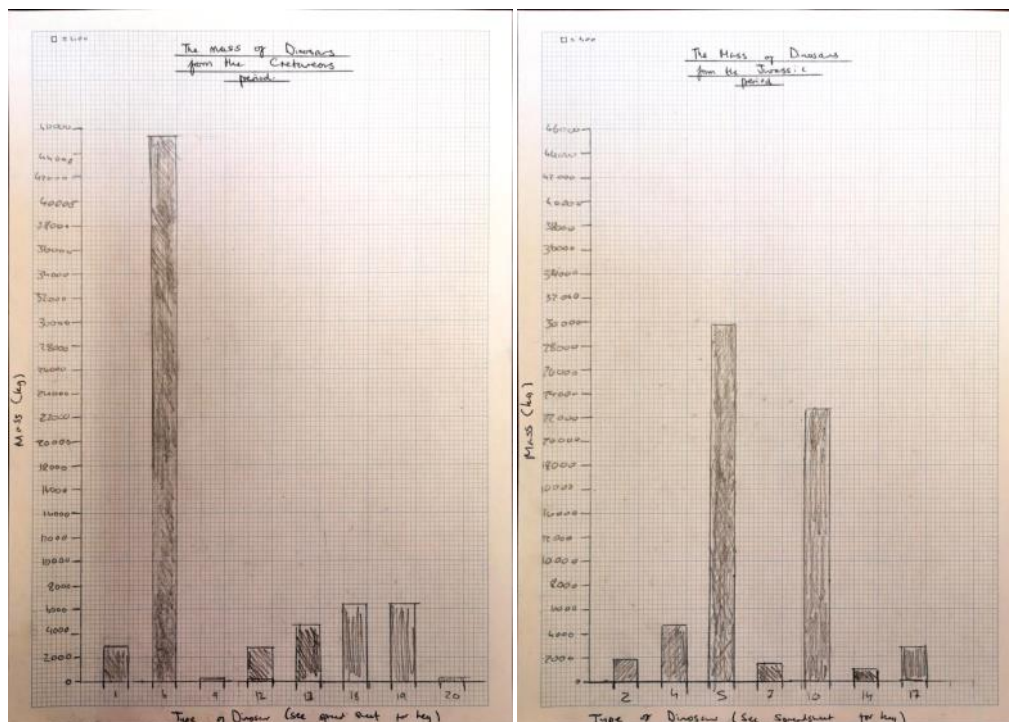


Figure 5.3: An example of two graphs drawn by a pupil to answer their question; Which period have the heaviest dinosaurs?

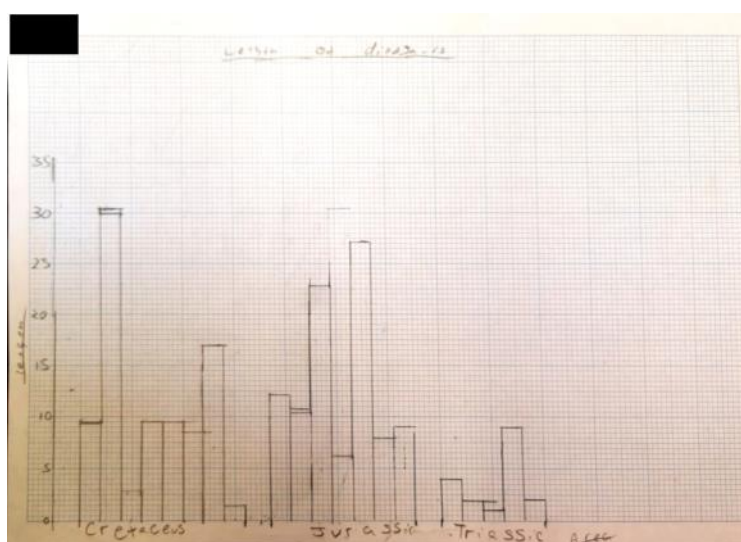


Figure 5.4: An example of a graph drawn by a pupil to answer their question; Which period have the longest dinosaurs?

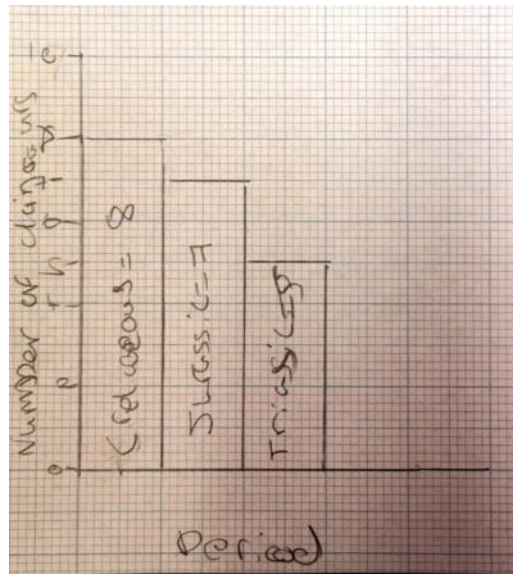


Figure 5.5: An example of a differentiated graph drawn by a pupil to answer their question; Which period had the most dinosaurs?

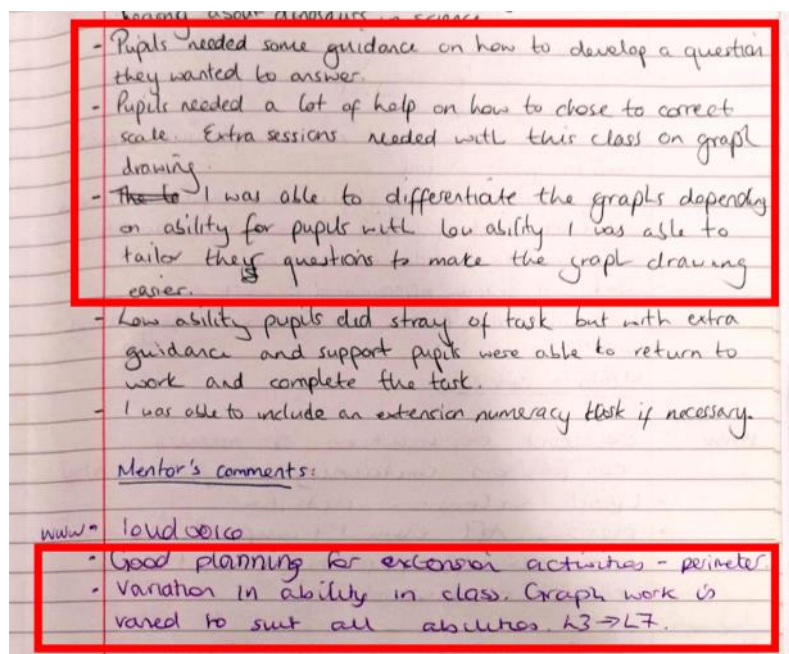


Figure 5.6: An extract from the learning journal showing my reflections and the mentor's comments regarding the numeracy task.

Cross Curricular Responsibilities illustrative example 3 - DCF

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Teaching & Core Learning	1. Introduction of Scott's Hut. 2. Introduction of payback time. 3. Research types of insulation in houses today and make a powerpoint/presentation/mind-map. Use resource and mind-map if required.	1. Pupils to identify areas in Scott's hut where heat can escape. 2. Pupils to identify how to calculate payback time of types of insulation using a provided table and as a class calculate the payback time for the first insulation. 3. Pupils to develop a resource of the different types of insulation within a house.	1. LP Scott's Hut. 2. LP Scott's Hut. 3. Computer room, types of insulation resource on the pupil server and example mind-map on the pupil server.
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Figure 6.1: A screenshot from the relevant part (highlighted in red) of the APLP lesson plan showing preparation for the DCF lesson.

Part 1: Research Mind Map or Poster

Research how buildings are insulated, including which parts of buildings are insulated and what materials are used.

Get your information from the Types of Insulation PowerPoint, you can also use the internet.

MAKE A MINDMAP OR A POSTER TO COMMUNICATE YOUR FINDINGS INCLUDE THE PAYBACK TIME

Figure 6.2: The slide used during the lesson to provide the pupils with the information relevant to the task.

Key Question

Where do you think heat is lost from this house?



Where does the heat go?



Windows

- Double glazing - two pieces of glass are used.
- There is a gap between the two pieces which is filled with air.
- Air is a bad conductor so the heat can't easily travel through the glass to the outside.
- Thick curtains also help to insulate a house.



Draughts

- Draught excluders put at the bottom of doors where heat can be lost.
- Stops the breeze coming in under the door.
- Remember heat always moves from a warm place to a cool place.



Roofs

- Attics are warm because heat rises.
- Attic insulation stops heat energy travelling to the attic and keeps it in the house instead.
- Fibre glass and silver foil lining is often used.



Walls

- Cavity wall insulation - a gap between two walls is filled with fibre glass to stop convection.
- Solid wall insulation - a wall is insulated to stop conduction through the wall to the outside.



Floors

- Insulation to provide a protective layer between the house and the cold ground.
- Carpets or Rugs can also help to insulate a house.



Payback time

Calculate the payback time for each type of insulation.

Energy Efficiency Option	Installation Cost	Cost saving (per annum, per year)	Payback time
Double Glazing	£3,000	£500	
Attic Insulation	£400	£200	
Draft Proofing	£50	£12	
Cavity Wall Insulation	£500	£450	
Floor Insulation	£500	£70	

Payback time = Installation cost ÷ Cost saving

Figure 6.3: The resource prepared to help pupils with their research task.

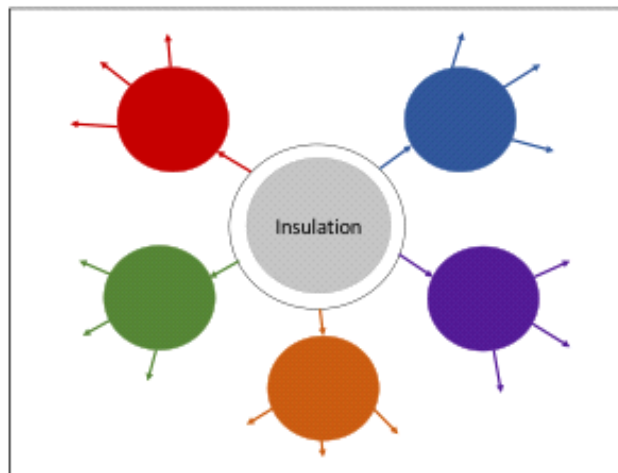


Figure 6.4: An example mind-map prepared for pupils to use, particularly for the lower ability.

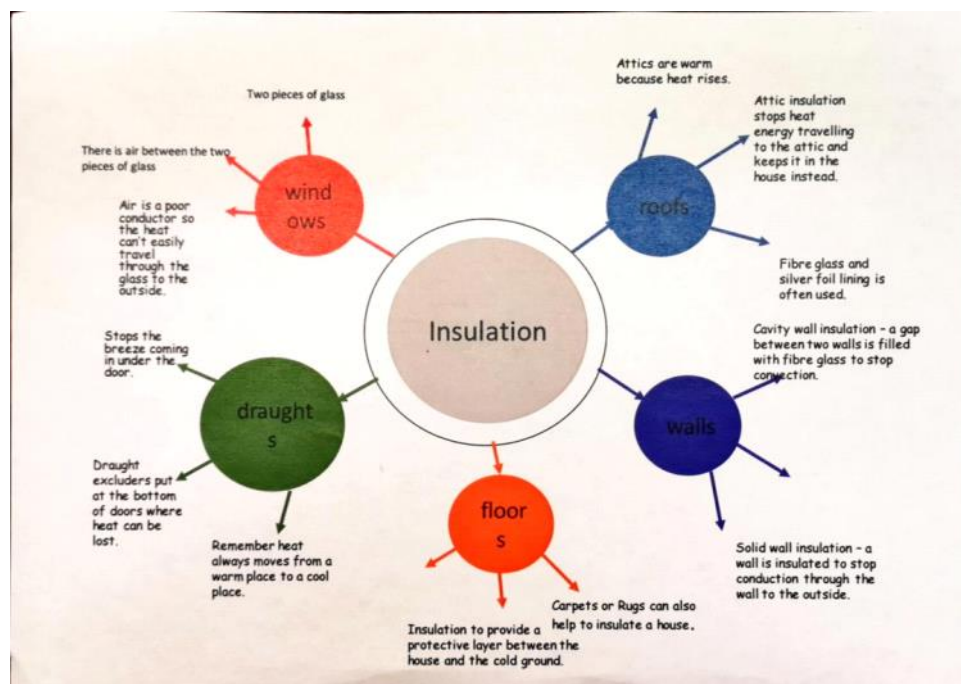


Figure 6.5: An example of a mind-map produced by a pupil using the example mind-map provided.



Figure 6.6: An example of a poster produced by a pupil using word.



Figure 6.7: An example of a PowerPoint resource produced by a pupil.

Employing a blend of approaches including direct teaching

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Illustrative example 1: This evidence is taken from a series of Year 7 lessons where the investigative approach to scientific inquiry was introduced via the thinking actively in a social context (TASC) method (Wallace et al. 2012, p. 61). Pupils had to gather and organise information before planning a practical and reflecting on the results (Figure 7.1). This is called the *PLAN, DEVELOP, REFLECT* (PDR) method within School X. This TASC wheel method approach (Figure 7.2) was used to investigate which factors had an impact on friction force, namely mass (Figure 7.3). This PDR project was taught over two lessons. During the first attempt at the lesson it was clear that the pupils needed a lot of extra guidance to complete the tasks and this method was difficult to teach effectively. These issues were somewhat due to the fact that I, as their teacher was lacking in confidence when delivering this approach (Figure 7.4). However, during the second attempt at the lesson, I was able to adapt my planning to couple the TASC wheel approach with the authentic context of Formula 1 (Figures 7.5-7.6) and direct instruction which resulted in a better delivery of the lesson and enabled pupils to work more independently (Figure 7.7).

Illustrative example 2: The evidence for this example shows the comparison of a lesson taught through a pupil-led forces circus and a second lesson taught through teacher-led demonstration and collaborative learning (Figure 8.1). During an 'Introduction to Forces' lesson with a Year 7 class, a forces circus task was used. To complete this task pupils were to rotate in groups around the room to 6 different stations (Figure 8.2) and perform a quick practical task to visually and physically see and in some cases feel the effect of the force. The pupils were then required to use the text books provided at the stations to complete their tables for all the forces (Figure 8.3). Even though the physical part of the forces circus was initially considered to be beneficial, it actually quickly became a distraction and the pupils failed to complete their tables and learn the names or the effects of the forces which were linked to the practical task. This was because the pupils spent too much time on the practical aspect and not enough on the comprehension task (Figure 8.4). The 'Introduction to Forces' lesson was therefore attempted a second time after adjusting the planning to become a more teacher-led lesson (Figure 8.5). During this lesson I was able to demonstrate each practical to the class twice before completing the table collaboratively using the visualiser. Pupils were able to contribute their answers as a class to complete the table and they were able to provide their own authentic context for each force. This was a more efficient and beneficial approach to teaching this lesson (Figure 8.6).

Illustrative example 3: During the course of the PTE I have been able to use many practicals, both demonstrations and practicals completed by the pupils. The evidence provided for this section is taken from a range of different lessons with Year 8, 9 and 10. The Year 8 practical shown here was used build on prior knowledge and to investigate which materials are the better insulators (Figures 9.1-9.3). This was a full investigative project that was subsequently levelled according to the National Curriculum levels. The Year 9 practical shown was used to visually show the pupils the salt that is produced during an acid reaction with a base (Figures 9.4-9.5). This was a single lesson practical which involved the pupils building on their previous practical experiences. The Year 10 practical example that has been shown was performed as a team teach by myself and my mentor in School X where we each took charge of separate groups to show them how to correctly dissect a heart and to simultaneously discuss each part of the heart as they were exposed. Seeing a real heart (Figure 9.6) and its components was beneficial for the Year 10 pupils who were learning about the circulatory system. This transferred their knowledge from being conceptual to reality. Practical have been particularly beneficial in giving the pupils a real-life hands on experience with parts of the curriculum that are perhaps hard to visualise. They have also provided opportunity to incorporate literacy and numeracy into most practical-centred lessons.

Employing a blend of approaches including direct teaching illustrative example 1

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Lesson 1: First attempt at teaching scientific inquiry

Teaching & Core Learning	1. Introduce Newtons and the force meter. 2. Gather around TASC wheel, go through prediction and write the variables. 3. Experiment – Results table.	1. Pupils to fill in the blanks surrounding friction and newtons. 2. Pupils to recall gather and organise and implement stage. 3. Pupils to complete practical and fill in a results table.	1. Friction PDR 1 ppt. 2. TASC wheel. 3. 100 g masses, 1 and 10 newton meters, cardboard and string. Friction PDR 1 ppt.
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Figure 7.1: A screenshot from the relevant part (highlighted in red) of the APLP lesson plan showing preparation for the 'Plan develop and reflect (PDR)' task.

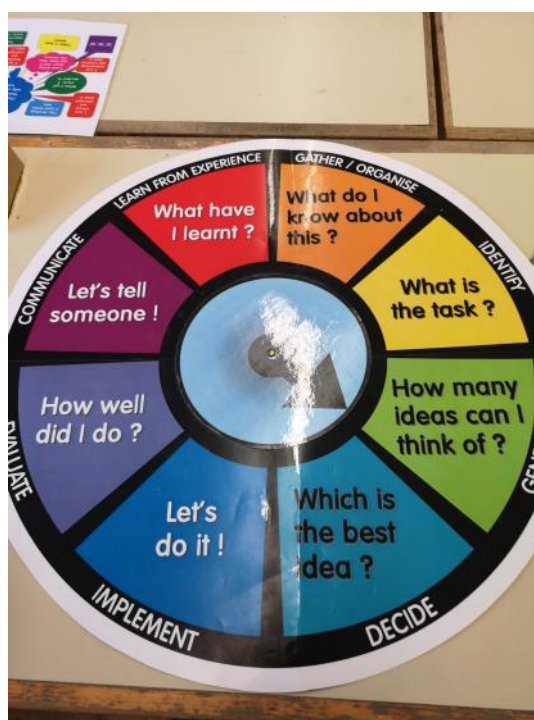


Figure 7.2: The TASC wheel used to teach pupils the investigative approach to scientific inquiry.

Number of 100g masses	Force / N
1	
2	
3	
4	
5	

Figure 7.3: The table provided for the pupils to carry out their investigation.

Evaluation of Pupil Learning	
Evidence of Learning (including attitude to learning over time))	Pupils were able to identify that friction is affected by mass and surface area. Pupils were engaged with the lesson and gave good and extensive answers to the questioning at the start of the lesson and were able to apply their prior learning to real life situations. During the practical pupils needed a lot of extra guidance on how to complete a prediction and the practical task. Even though the lesson felt confusing the pupils remained engaged and on task. There was some misconceptions within the class surrounding the difference between weight and mass. PDR/investigative work is a completely new concept for the pupils therefore the pupils were unable to work completely individually and needed a lot of extra guidance.
Next Steps for Progress	Address the misconception surrounding mass and weight. Repeat the PDR lesson where students are to complete the method, practical and conclusion. Linking this investigative approach to a real life situation will help the students to form links with the learning.

Reflective Analysis of Teaching and Strategies For Development – including justification/rationale for pedagogical choices	
Evidence of my Effective Practice	I was able to increase the complexity of the questions during the opening phase of the lesson to allow pupils to elaborate on each others responses and develop links to prior learning. I was able to effectively introduce a new concept of measuring force with Newton meters. Here I used pupils to describe the story of Isaac Newton to explain why we measure forces in newtons. By doing this pupils were able to recall prior learning from primary school. I gathered pupils around the board in order to allow for a more collaborative learning environment to develop ideas and answers surrounding the approach to scientific enquiry. Mentor's comments in the learning journal: Good preparation of ideas and concepts. A well planned lesson.
Areas for my Development Personal Targets for Progress	PDR/Investigative work is hard to teach effectively, pupils needed extra guidance. Developing a bank of more instructional commands with this type of work will be useful towards the delivery of the lesson. More planning and clarity was needed for an investigative task like this. Planning clearly laid out sections for each task where and explanation, task and mini plenaries are used will help to break this concept up into smaller chunks to deliver the lesson effectively. Dealing with misconceptions on the spot and not letting it affect the lesson. Even if this means stopping the whole class to deal with the misconception collectively. Mentor's comments in the learning journal: You need to be more confident and clear on the route through scientific enquiry. Having a clear idea will help to improve pace.

Figure 7.4: A screenshot from the relevant part (highlighted in red) of the APLP lesson plan showing the reflections and mentor's comments from this lesson.

Lesson 2: Second attempt at teaching scientific inquiry after some moderations

Teaching & Core Learning	1. Key Question – A formula 1 driver wants to know what things affect friction force. What will you tell them? 2. Gather around TASC wheel, go through prediction and write the variables. 3. Write a method. 4. Draw a graph. 5. Write a conclusion.	1. Pupils to discuss where the friction is acting on the car, what they could test relating to the practical, mass of car and surface area of tyres. 2. Pupils to recall gather and organise and implement stage. 3. Pupils to write a method using the key words. 4. Draw a graph of results. 5. Pupils to write a conclusion based on their practical.	1. Friction PDR ppt. 2. TASC wheel. 3. 100 g masses, 1 and 10 newton meters, cardboard and string. 4. Friction PDR ppt. 5. Friction PDR ppt.
Plenary	1. Discussion	1. Pupils to discuss their conclusions and apply their learning to the Formula 1 scenario.	1. Friction PDR ppt.

Figure 7.5: A screenshot from the relevant part (highlighted in red) of the APLP lesson plan showing the adapted preparation for the 'Plan develop and reflect (PDR)' task.

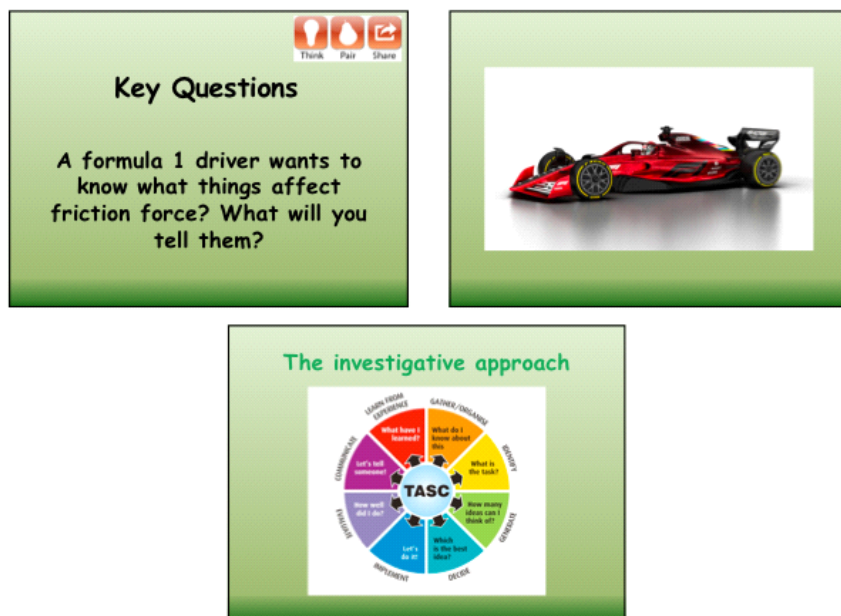


Figure 7.6: The PowerPoint slides used to develop an authentic context for this investigative approach to scientific inquiry.

Evaluation of Pupil Learning	
Evidence of Learning (including attitude to learning over time))	The pupils were encouraged to see the learning wall with their previous work present, this will be continued throughout the topic of forces. The pupils were able to recall what friction is and its effect on an object. Pupils responded well to the formula 1 context. Pupils were responding well to questioning with a high standard of answers. Some reminder of the importance of being respectful and listening to each other answers was needed. The pupils were on task with some chatter but they were all able to complete a method in the time limit given, some to a very high standard. Pupils were able to draw a graph showing the effect of mass on friction. Some extra guidance was needed individually for this task. The pupils responded well to the use of a timer for the method writing.
Next Steps for Progress	Repeat the practical testing different surface areas, write another method and graph.

Reflective Analysis of Teaching and Strategies For Development – including justification/rationale for pedagogical choices	
Evidence of my Effective Practice	The learning wall has been effective as a form of AFL. Each lesson I am able to assess pupils understanding of the topic. This has also been implemented in an effective and engaging manner. Using a timer has improved my pacing for the lessons and has helped to set clear expectations of the class during certain tasks. I felt far more comfortable to teach the process of scientific enquiry to the pupils after performing individual research into the TASC wheel approach. This opened up opportunities to use questioning to drive the lesson towards the learning objectives. I was able to change the lesson plan during the lesson in order to ensure effective learning. Mentor's comments in the learning journal: Very confident approach, well planned, good use of the timer to speed up the pace of the lesson, excellent questioning techniques, confident change of lesson plan when needed.
Areas for my Development	Stopping the lesson to deal with a class wide misconception rather than feeling stretched to explain to each individual that was confused. Ensure there are plenty of resources i.e. rulers before starting the lesson.
Personal Targets for Progress	Mentor's comments in the learning journal: You could have checked understanding for the graph.

Figure 7.7: A screenshot from the relevant part (highlighted in red) of the APLP lesson plan showing the reflections and mentor's comments from this lesson.

Employing a blend of approaches including direct teaching illustrative example 2

Saturday, 14 December 2019 14:19

Lesson 1: First attempt at teaching forces through a forces circus

Teaching & Core Learning	1. Direct teaching, teacher describes what a force is i.e. it is unseen but you can see how it affects an object. 2. Forces definition. 3. Type of forces circus.	1. Pupils to listen to direct teaching (teacher led). 2. Pupils to copy down definition of a force. 3. Pupils to rotate around the room, to complete a forces circus. Perform a short practical at each. Pupils to fill out a table for name of force, context and effect of the force.	1. Introduction to Forces powerpoint. 2. Introduction to Forces powerpoint. 3. See Science book and table of results. Sandbox with marble, sandpaper and brick, magnets and paperclips, water in a bucket with floating splints, glass slides, teat pipette and water, cloth, plastic rod and paper.
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Figure 8.1: A screenshot from the relevant part (highlighted in red) of the APLP lesson plan showing preparation for the pupil-led forces circus.



Figure 8.2: The different stations of the forces circus, each representing a different force.

Station	The Effect of the Force	Context	Name of the Force
Pulling a weight over sandpaper and then plastic.			
Dropping an object into a tray of sand.			
Floating a wooden raft on water.			
Picking up paperclips with a magnet.			
Droplets of water on glass			
Paper and a plastic rod.			

Figure 8.3: The table used by the pupils to complete the forces circus.

Evaluation of Pupil Learning	
Evidence of Learning (including attitude to learning over time))	Pupils were immediately engaged by the starter and were able to discuss as a class and develop a collective idea of what a force is through the starter. Pupils were able to recall what a force is during the plenary. Pupils were able to identify that they could not see a force but they could see how a force effects an object instead. Pupils were able to link their learning to real life situations such as pushing and pulling a door etc. Not all pupils were completely on task during the circus as they were distracted by the practical aspect e.g. pupils were playing with the sand rather than identifying the force and filling in their tables.
Next Steps for Progress	Pupils need to finish the forces circus. The plenary was used to question the students to identify why they didnt finish it in the lesson. Pupils could identify that they spent too much time playing and not enough time working. Pupils then to learn about specific forces in more detail.

Reflective Analysis of Teaching and Strategies For Development – including justification/rationale for pedagogical choices	
Evidence of my Effective Practice	A blend of approaches were used within the lesson to teach the subjects of forces. Pupils were directly taught, questioned to develop an idea and were given a practical way of learning. Pupils were encouraged to take initiative and responsibility for their own learning through the forces circus. An authentic context was created by asking pupils to describe where they see forces such as push or pull in their day to day lives. This also built on the pupils previous knowledge. Pupils were encouraged to collaborate by working in groups. Mentor's comments in the learning journal: Good key questions and engaging at the start. Good effective plenary.

Figure 8.4: A screenshot from the relevant part (highlighted in red) of the APLP lesson plan showing the reflections and mentor's comments from this lesson and in particular the use of a forces circus.

Lesson 2: Second attempt at teaching forces this time through teacher demonstration and collaborative learning

Teaching & Core Learning	1. Direct teaching using the visualiser, teacher demonstrates each section of the forces circus and complete the table as a class. 2. Recount the text literacy task	1. Pupils to discuss and contribute the answers to complete the forces table. Pupils to name the force, describe its effect on an object and put the force into context. 2. Pupils to examine some text and complete questions by applying their knowledge.	1. Introduction to Forces powerpoint. 2. See Science text books.
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Figure 8.5: A screenshot from the relevant part (highlighted in red) of the APLP lesson plan showing preparation for the teacher-led demonstration and collaborative completion of the forces circus.

Evaluation of Pupil Learning	
Evidence of Learning (including attitude to learning over time))	Pupils were immediately engaged by the starter and were able to recall the key learning points of the previous lessons. Pupils were excited over the concept of developing a learning wall for the class. Pupils were on task for the majority of the main section of the lesson and were contributing ideas to the complete the table. Most pupils were able to apply their learning to a different real life situation. Pupils started to stray off task and were fidgety when we got near to the end of completing the table. Pupils needed extra guidance with the literacy task. They had difficulty knowing how to form their sentences to answer the questions, perhaps further literacy tasks are needed to help with this. When discussing the answers most pupils were in agreeance that they had the correct answer. Most pupils were able to answer the key questions in full detail during the plenary. A few pupils needed extra prompting.
Next Steps for Progress	Pupils to begin looking into more detail at specific forces and to plan, develop and reflect on how they can measure and experiment forces. Extra literacy work to aid students with further tasks of this kind.

Reflective Analysis of Teaching and Strategies For Development – including justification/rationale for pedagogical choices	
Evidence of my Effective Practice	A blend of approaches were used within the lesson to teach the subjects of forces. Pupils were directly taught, questioned to develop an idea and an authentic context was developed for the learning by linking the topic to the pupils every day lives. Literacy was focused on during this lesson and the pupils ability was assessed in a real-time manner. Higher order questioning was used in order to complete the forces table task. After reflecting and adjusting the lesson plan following the previous lesson, the forces circus it was decided that completion of the task as a whole class following a demonstration was the better delivery method. Mentor's comments in the learning journal: Good confident delivery of this lesson. It worked well to go through the task as a whole class with demo.
Areas for my Development	Pupils started to become distracted nearing the end of the main task. Pacing of the task could have been better to avoid this from happening. Many pupils needed extra guidance for the literacy task, perhaps I should have stopped the class and modelled how to answer the questions in full sentences.
Personal Targets for Progress	Mentor's comments in learning journal: Be aware when pupils start to become distracted and think of ways to move on.

Figure 8.6: A screenshot from the relevant part (highlighted in red) of the APLP lesson plan showing the reflections and mentor's comments from this lesson and in particular the use teacher-led instruction and questioning.

Employing a blend of approaches including direct teaching illustrative example 3

Saturday, 14 December 2019 14:19

Practical example 1: Year 8 - Insulation practical

Teaching & Core Learning	1. Direct teaching – What is insulation? 2. Introduction of fur as an insulator. Pupils asked what material hasn't been said in the starter, likely to be fur. Direct teaching – how is fur an insulator? 3. Prediction writing: what material out of 4 do you think will be the better insulator? 4. Insulation practical demonstration. 5. Draw a table of results. 6. Complete practical.	1. Pupils to copy down definition into their books. 2. Pupils to come up with ideas of how fur may be an insulator. Why do we have hair on our bodies? How does it work? Pupils to then listen to the explanation. 3. Pupils to write a coherent prediction of what material will be a better insulator and why. 4. Pupils to observe a practical demonstration pupils to answer questions regarding safety points and how to do the practical. 5. Pupils to draw a table of results – copy from the board. 6. Pupils to test four materials to decide which is the best insulator.	1. Insulation ppt. 2. Insulation ppt. 3. Insulation ppt. 4. Glass jars, thermometers, kettle, elastic bands, timers, fur, foil, bubble wrap and newspaper. 5. Insulation ppt and printed tables for differentiation. 6. See point 4.
Plenary	Which material was the best?	Pupils to look at their results can calculate the temperature change for each material. Pupils to feedback which material is the best.	No resources required.

Figure 9.1: A screenshot from the relevant part (highlighted in red) of the APLP lesson plan showing preparation for teaching a Year 8 class the topic of insulation through the use of a blend of approaches.

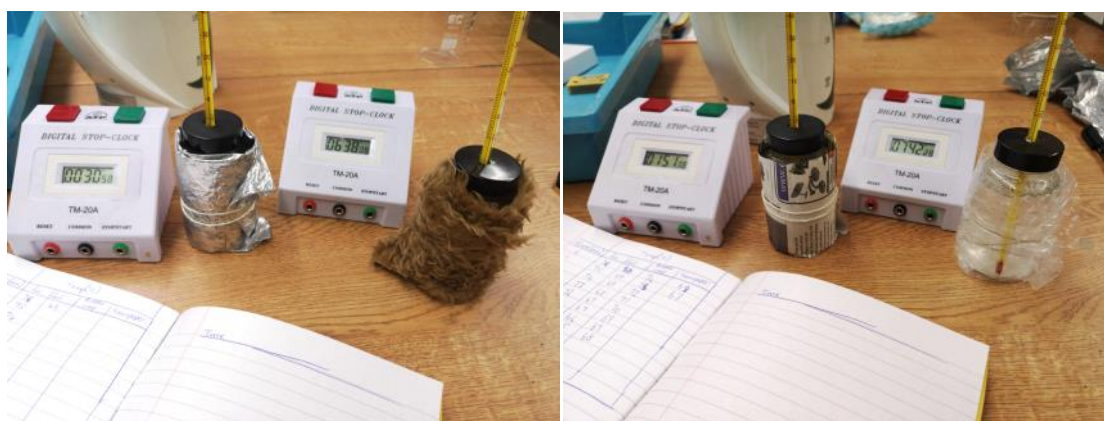


Figure 9.2: An example of the practical performed by a Year 8 class to test which material is the better insulator.

Evaluation of Pupil Learning	
Evidence of Learning (including attitude to learning over time))	Pupils were immediately engaged and asking / answering questions. Pupils identifying areas of life where they have come across insulation. Pupils identified risks and safety upon questioning and were able to feedback the steps of the practical which indicated understanding. Pupils were able to successfully complete a practical and were able to identify the better insulator. Pupils were on task from the start and continued to be on task. However when trying to explain the next steps students were not always completely quiet and listening.
Next Steps for Progress	Pupils to analyse their results, write a full method and conclusion with their other class teacher. Pupils to carry out a PDR piece of work to summarise all their learning on heat transfer and insulation.

Reflective Analysis of Teaching and Strategies For Development – including justification/rationale for pedagogical choices	
Evidence of my Effective Practice	I was able to use a blend of approaches such as direct teaching, questioning, practical demonstrations and a practical task to effectively teach and engage the pupils. I was able to encourage pupils to develop an authentic context to the learning by asking the students to think about where they have used the word insulation before. I was able to encourage pupils collaborate and to be responsible for their learning by allowing pupils to engage in group practical work where they had to work as a team each with a different job to get the work done. I used effective questioning and APK throughout the lesson to ensure pupils understanding. Mentor's comments in the learning journal: Very good questioning and APK. Good description of practical, good safety check and circulation during practical.

Figure 9.3: A screenshot from the relevant part (highlighted in red) of the APLP lesson plan showing the reflections and mentor's comments from this lesson and in particular the use of a blend of approaches.

Practical example 2: Year 9 - Acid reactions practical

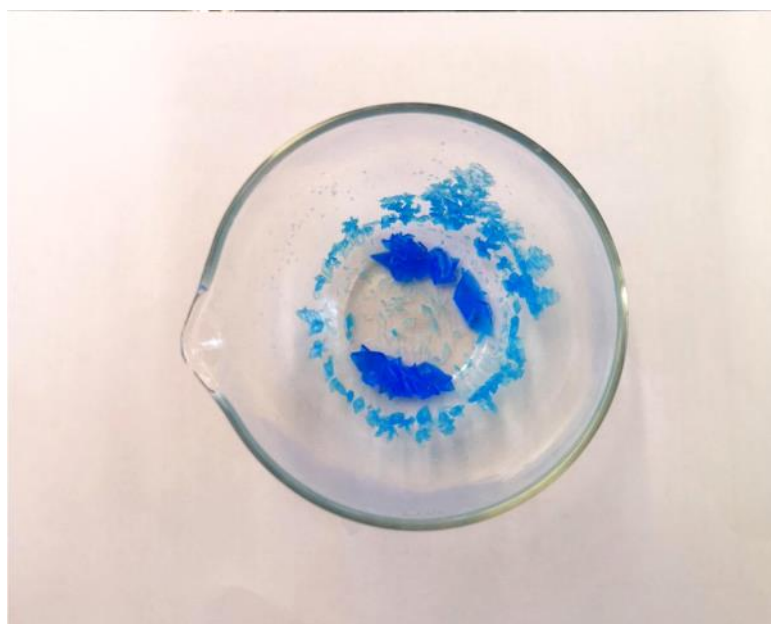


Figure 9.4: The products made by one of the Year 9 groups clearing showing that a salt has been made.

Evaluation of Pupil Learning	
Evidence of Learning (including attitude to learning over time))	Pupils were able to explain how an base is different to an alkali using some of the scientific key words discussed i.e. a base does not dissolve or a base is insoluble. Pupils were able to recall the previous practical and link the practical performed within this lesson. Pupils observed that both an acid and alkali and an acid and base produce a salt. Pupils were able to successfully perform the practical after an initial demonstration with limited extra guidane, when questioned the pupils were also able to recall what they had done and furthermore why they had done this. The pupils were also able to write a method, most also included imperative verbs and scientific literacy as requested. Some even included adverbs as requested. Marking and leveling the pupils methods write up allowed for an evaluation of the pupils understanding. The majority of the pupils completed the method to a high standard.
Next Steps for Progress	Pupils are to complete targets given as feedback for their method write up. Pupils to finish their write-up. An overall summary of acid, alkalis and bases and the universal indicator to be performed to gain an even further understanding of the pupils understanding. Pupils are to apply the knowledge of acids to reactions with metals.

Reflective Analysis of Teaching and Strategies For Development – including justification/rationale for pedagogical choices	
Evidence of my Effective Practice	I was able to incorporate a blend of approaches to my teaching. I was able to use questioning, direct teaching when explaining the reacions for both acid and base and an acid and alkali. I was able to model a practical for the students to perform and include within that questioning to determine the pupils understanding before they did the practical. I was able to use questioning as a form of AFL to ensure the pupils understanding of the subject before moving on. I also used marking as a form of AFL and a method of giving feedback to the pupils. I was able to encorporate literacy within my lesson by addressing the need of imperative verbs and adverbs within method writing. Feedback from mentor – Fantastic first lesson.

Figure 9.5: A screenshot from the relevant part (highlighted in red) of the APLP lesson plan showing the reflections and mentor's comments from this lesson and in particular the use of a blend of approaches.

Practical example 3: Year 10 Triple - Team teaching for a heart dissection



Figure 9.6: An example of a good dissection performed by one of the Year 10 groups.

Critical reflection

Saturday, December 14, 2019

1:27 PM

The aim of Curriculum for Wales 2022 is to develop ambitious capable learners, enterprising and creative contributors, ethical, informed citizens and healthy, confident individuals. (Donaldson, 2015). Iversen argues that this means that learners should be capable of searching for, selecting and analysing information and applying the learning to their own lives (Iversen, 2015, p. 1). Donaldson's 12 Pedagogical Principles for good and effective teaching aims to develop learners with these traits, however, Donaldson stresses that they are recommendations and that some decisions are best made by the teachers (Donaldson, 2015). As a result, teachers should ensure that reflection is integral to their teaching practice, linking research to action, informing and improving their teaching practice (Ragland, 2016, p. 198). This critical reflection will focus on the implementation of 3 of the 12 principles during a professional teaching experience (PTE) and will highlight points for future development. The examples given are mostly from mixed ability KS3 classes from School X (BERA, 2018), some which included pupils from the special teaching facility (STF).

The first of Donaldson's 12 Pedagogical Principles to be discussed emphasises the use of assessment for learning (AfL) principles (Donaldson, 2015). AfL has been shown to substantially increase learning gains, even doubling the rate at which pupils learn (Black and Wiliam, 2005; Wiliam, 2017). Wiliam describes AfL as "the bridge between teaching and learning" allowing teachers to reflect and adjust their teaching to best meet the pupils' needs (Wiliam, 2013, p. 15). Harlen (2006, p. 176) describes AfL as integral to teaching, however, in order to be effective, the pupils should feel comfortable to contribute their ideas (Hodgson and Pyle, 2010).

AfL is essentially formed by three questions: what does the learner know, what does the learner need to know and how to get there (Wiliam, 2017). Effective teachers integrate AfL into their teaching by sharing the success criteria, checking for evidence of learning, providing feedback and assessment (Leahy et al. 2005, p.20; Wiliam, 2017). Hattie focuses particularly on the feedback element, stating that feedback is vital for improving learner outcomes (Hattie, 2012).

The Assessment Reform Group (2002) summarises effective AfL in these 10 principles:

- Part of effective planning.
- Focused on how pupils learn.
- Central classroom practice.
- Key professional skill.
- Consisting of sensitive and constructive feedback.
- Motivating feedback.
- Developing an understanding of the success criteria.
- Providing guidance on how to improve.
- Developing independent learners capable of self-assessment and reflection.
- Is not identical for all learners but rather recognises a range of achievement.

In Successful Futures, Donaldson acknowledges that AfL requires careful planning, stating that a wide range of assessment techniques should be used given that they are 'fit-for-purpose' (Donaldson, 2015). Wiliam suggests that the development of professional practice to include minute-by-minute assessment will likely have the largest impact on student achievement, mirroring principles 3 and 4 listed above (Wiliam, 2017).

Further to improving learner outcomes, increasing learner confidence, independence and improving the classroom culture are also considered benefits of AfL (Cambridge International Education Teaching and Learning Team, n.d.). However, implementing AfL is not without its challenges. Broadfoot et al. (1999) identified some of these challenges, one of which is that teachers frequently assess the quantity of work rather than learning and give more attention to marking. The teacher's feedback also tends to not serve its purpose in developing the learning (Broadfoot et al. 1999) but rather leads to superficial learning

(Black, Harrison and Lee, 2003). Black suggests that for AfL to be successful and lead to positive outcomes, it must be used to adjust teaching and learning through improved feedback and the engagement of learners (Black, Harrison and Lee, 2003). Good feedback and discussion between the learner and the teacher can also contribute to implementing the second of Donaldson's 12 pedagogical principles to be discussed.

This principle focuses on the importance of cross-curricular responsibilities and providing opportunities to practice them (Donaldson, 2015), specifically literacy, numeracy and digital competence. Both Donaldson (2015) and the Welsh Government (2019a) believe that these skills are essential to developing confident individuals who are lifelong learners able to contribute to the modern world and that they should be incorporated into all areas of learning and experience (AoLEs) (Donaldson, 2015; Welsh Government, 2019a). Donaldson (2015) has even suggested that primary schools can almost be reduced to only teach these skills.

The Literacy and Numeracy framework (LNF) became a statutory requirement in 2013, intending to raise the standards of literacy and numeracy (Dauncey, 2013, p. 14). Markwick (2013, p. 13) suggests that for a learner to develop good literacy skills they must be given opportunity to practice them and so every teacher should provide these opportunities (Markwick, 2013, p. 14). Improving literacy skills is important in education since poor literacy skills have been associated with low self-esteem and low achievement, especially at key stages 3 and 4. Literacy can be broken down into oracy, reading and writing, with each area being as important as the next (Welsh Government 2019d; Welsh Government 2019e; Welsh Government, 2019f). Developing a competence in these areas enables the learner to develop and present ideas, locate and use information and organise ideas, therefore enabling the learner to access the curriculum more easily (Dauncey, 2013, p. 17). Numeracy was also highlighted as a vital skill (Welsh Government, 2019c) used in everyday situations such as managing money, time and interpreting data. It is a common misconception that numeracy should only be taught in maths, however numeracy can easily be distinguished from maths in that it is the reasoning and application of numerical skills and procedures to enable an individual to solve everyday problems (Dauncey, 2013, p. 10). It is for these reasons that literacy and numeracy have been recognised as essential foundations to be developed in education (Donaldson, 2015).

The Successful Futures document also communicates a need for a digital competence framework (DCF) in response to the high demands of the current and future workforce (Donaldson, 2015). The Welsh Government supported this recommendation making DCF central to the national mission for education. Within this mission, the Welsh Government have highlighted their commitment to developing learners who have high-level digital skills (Welsh Government, 2017; Estyn, 2018). However, according to Estyn (2018) there is a lack of a clear vision on how to prepare for and embed the DCF within the curriculum resulting in vague timeframes and unclear arrangements. In order to move forward Estyn suggests that there must be a clear focus on improving not only the learners' digital skills but also the teachers' (Estyn, 2018).

Donaldson also suggests that "Good teaching and learning means employing a blend of approaches including direct teaching" (Donaldson, 2015). Teaching and learning can be separated into two main categories, these are teacher-led and pupil-led. Traditional approaches such as direct instruction often fall into the teacher-led category (Gurses, Dogar and Gunes, 2015, p. 2385). The direct instruction approach tends to be teacher-centred and is reliant on knowledge being passed from the teacher directly to the learner in a top-down approach. Here, pupils learn through instruction followed by repeated exercises within a highly structured classroom environment (Ku et al. 2014, p. 253). However, this approach to teaching has been associated with causing the learner to lose interest as a result of the lack of interaction of the learners with the subject content (Shamsudin et al. 2013, p. 584). Even so, Kirschner (2006, p. 83) argues that direct instruction is critical for ensuring that learning has taken place. Kirschner continues that teaching through experience may lead to unguided practical work and argues that direct instruction is more compatible with how learners' minds retain information (Ku et al. 2014, p. 254). Direct instruction is also considered to be the most suitable approach to teaching new content and skills (Shamsudin et al. 2013, p. 585).

On the other hand, in the learner-led approach the learners are encouraged to build upon their own understanding to form links to new concepts and to develop new ideas. Typically, learner-led approaches include collaborative learning such as pair or group work and research-based approaches such as problem-based learning or inquiry-based learning (Ku et al. 2014, p. 253). This approach is based on the teacher acting as a facilitator allowing the learners to take more of a hands-on approach and enabling them to practice what they are learning. Learner-led teaching has also been associated with improving learners' attitudes whilst also increasing interest and curiosity (Shamsudin et al. 2013, p. 584). However, in practice the learner-led approach can be difficult to implement. This is due to the limited control over what misconceptions the learners may develop during the inquiry process as well as the difficulty in maintaining learner motivation. As a result, direct instruction is required to provide structure and motivation and to impart adequate subject content knowledge before allowing the learners to explore the subject further (Shamsudin et al. 2013, p. 585). Consequently, employing a blend of approaches provides opportunities to encourage learners to take an active role in their learning whilst also providing learners with the tools needed to succeed.

A critical review of the implementation of 3 of the 12 principles

Throughout the entirety of the PTE I have attempted to ensure good practice by implementing Donaldson's 12 pedagogical principles (Donaldson, 2015) and by reflecting on my practice throughout. I attempted to make AfL central to my classroom practice (Assessment Reform Group, 2002). Firstly, through developing relationships with the pupils to ensure they felt comfortable to share. This knowledge of the pupils was used to inform my practice, striving to ensure that suitable AfL strategies were focused on within the lesson planning process (Burton, 2016). These were in the form of questioning, including higher order questioning, plenaries, classroom circulation where verbal feedback was given and marking pieces of work. For a Year 7 class a different approach to AfL was taken resulting in the development of a learning wall (Figures 1.3-1.4). This approach was successful in ensuring that the less confident pupils were able to contribute their ideas (Hodgson and Pyle, 2010) and that AfL could simultaneously take place. Having a visual representation of the pupils' learning increased their pride and confidence in their work (Dunne, 2000) whilst also enabling me to adapt the current or subsequent lesson to address misconceptions (Hargreaves, 2005, p. 215). Whilst this approach was beneficial, many pupils provided the same information often word-for-word. As a result, it was sometimes unclear what each individual had learned. In future, implementing this as a think-pair-share task would encourage each pupil to construct their own ideas (Bamiro, 2015, p. 2; Ingram and Elliott, 2016, p. 44) by providing think time and subsequently promoting purposeful talk within the classroom through partner or class discussion (Ingram and Elliott, 2016, p. 47).

Whilst the learning wall was useful as a starter or plenary activity, it was clear that continuous AfL was needed throughout the lessons. This led to the implementation of interactive mini plenaries (AfL illustrative example 2). Once again, the visual representation of the 'Show Me' task was beneficial for assessing where pupils were in their learning. However, similar to the learning wall approach, some pupils were awaiting other pupils' responses making it difficult to assess what pupils actually knew. This was addressed through coupling the task with probing and redirecting questions, asking the pupils to expand on their and others' answers (Oliveira, 2010, p. 423). Delivering this task as a competition was highly engaging for the majority of the pupils, however one pupil who struggled with the content quickly became disruptive due to the lack of differentiation. This was immediately tackled to some extent by using it as a teaching opportunity. However, perhaps allowing think time in the form of a countdown will allow each pupil to feel equally involved in the task (Bamiro, 2015, p. 2).

Hattie and the Assessment Reform Group state that feedback is an essential aspect of AfL (Hattie, 2012; Assessment Reform Group, 2002), therefore I attempted to provide feedback wherever possible, whether verbal or written feedback (AfL illustrative example 3). The feedback given was targeted to give the pupils instructions on how to improve and meet the success criteria (Figure 3.2) (Assessment Reform Group, 2002), however it is unclear whether the feedback has always been motivating or meaningful to the pupil.

Literacy and numeracy have also been central to my planning process and wherever possible opportunities for the pupils to practice these skills have been provided. Within the Science AoLE, these skills are highly important for success given that method writing (cross curricular responsibilities illustrative example 1) and interpreting data through graph drawing (cross curricular responsibilities illustrative example 2) are vital components of the scientific inquiry process and are often parts of levelled work (WJEC, 2019). It was for this reason that I included method writing and graph drawing within my planning. Prior to providing feedback and re-writing their methods (Figure 4.3), Year 9 pupils were consistently failing to use adverbs, scientific literacy and failing to start their sentences with imperative verbs. After providing this intervention pupils were asked to write a new method, where many used imperative verbs, adverbs and included more scientific literacy (Figure 4.7). However, further opportunities to practice method writing is needed to ensure the learning was meaningful and not simply surface learning. During the PTE a significant focus was given to scientific literacy, such as introducing scientific key words and method writing. However, moving forward a more holistic approach to improving pupils' literacy skills needs to be taken and the development of the pupils' oracy and reading skills will be considered equally important to the written literacy and will be included within my planning process (Dauncey, 2013, p. 17).

Similar to literacy, a specific aspect of numeracy was given focus, this was graph drawing. During the PTE it became clear that pupils found it difficult to draw graphs to present data, therefore a Year 9 skills lesson where interpreting data was the focus was planned. When planning this numeracy task careful thought was given to ensure the task could be differentiated to suit all abilities (Figures 5.3-5.5). This lesson was used to provide pupils with opportunity to practice this skill and receive verbal feedback on how to improve, a discussion as a class surrounding the success criteria was also promoted. Even though data interpretation is important for everyday life (Glazer, 2011, p. 183-184), future planning needs to be extended to include other aspects of numeracy. As the PTE continues, I will attempt to ensure my planning includes numeracy to promote the development of the pupils' reasoning skills and the knowledge of how to apply their reasoning in their everyday lives (Dauncey, 2013, p. 10).

Out of the three cross curricular responsibilities, DCF was by far the hardest to implement. The planning and implementation of the DCF during the PTE could have been improved as my misconception that DCF always required I.T. equipment hindered this process. When I was able to provide a computer lesson for a Year 8 class, pupils were able to develop their knowledge through a research-based lesson, producing individual resources as a result. However, this lesson could've been better implemented had I provided pupils with more direction, such as handouts stating the success criteria. Moving forward I can better implement the DCF by including tasks, such as classroom talk and using interactive tasks such as quizzes that involve the use of phones which can also be considered part of the DCF (Welsh Government, 2019b).

Employing a blend of approaches was originally thought to be the most natural principle to implement during the PTE. Especially since the Science AoLE provides many opportunities to use both teacher-led approaches and pupil-led approaches to teaching. However, in practice implementing this principle correctly and gauging what approach to use and when was sometimes challenging and occasionally required a second attempt to find the correct balance. An example of this was a Year 7 investigative project where the approach to scientific inquiry was introduced via the TASC wheel method (Figure 7.2) at School X's request (Wallace et al. 2012, p. 61). During this lesson a pupil-led approach was taken and minimal instruction was provided. However, it became clear that pupils were lacking in confidence and perhaps the tools needed to complete the task and therefore, a varying level of support was needed (Figure 7.4) (Wallace et al. 2012, p. 60). The balance between direct teaching and pupil-led learning was lacking and this affected the delivery of the lesson as highlighted by my mentor in Figure 7.4. As a result, I adapted my planning for the second attempt at this lesson to add an authentic context for the inquiry to enable the pupils to form links to the subject content (Ku et al. 2014, p. 253). I also planned to provide direct instruction and mini-plenaries at intervals throughout the lesson clarifying what the pupils should be doing and what to do next, therefore avoiding unguided practical work (Kirschner, 2006, p. 83)

by giving the pupils the tools to know what to do and how to succeed. This balanced approach appeared to be more effective and the pupils responded well (Figure 7.7). A similar issue occurred again with the same Year 7 class. Here I attempted to teach the concept of forces through an interactive circus task (Figure 8.2). However, as suggested by Shamsudin (2013, p. 585) it was difficult to maintain the pupils' motivation and the practical tasks at each station became distractions. As a result, I once again adapted my planning to involve more direct instruction and higher order questioning to ensure that the pupils understood how to attain the success criteria. This approach appeared to be more effective at engaging the pupils with the learning, however some pupils began to become distracted when too much direct instruction was used.

That said, I have mostly been successful in planning and using practical tasks during the PTE (Employing a blend of approaches illustrative example 3). Using practical tasks has been particularly beneficial in giving pupils a hands-on experience with parts of the curriculum that are often hard to visualise or explain by direct instruction alone. These tasks have also promoted meaningful discussion surrounding the relevance of the scientific content being learned and as a result has simultaneously provided opportunity for pupils to practice their oracy (Ofsted, 2013). However, on occasion the purpose of these practical tasks has not always been made clear to the pupils during the explanation and therefore may not reach their full potential in supporting pupils' knowledge and understanding (Ofsted, 2013).

Continual professional development is key to improving a teachers' practice and dependent on evidence-based reflection and reflection in action. I will continue to reflect in action but also ensure that I use evidence-based reflection to continually adapt and improve my implementation of the 12 pedagogical principles. There are two clear areas which need focus. Firstly, when planning AfL strategies I will ensure that they are 'fit-for-purpose' and differentiated to suit all pupils (Donaldson, 2015) and incorporate time for meaningful feedback (Assessment Reform Group, 2002). To ensure successful implementation of AfL, I will use a range of resources such as TES and Teacher Tool Kit to source the strategies that are most suitable. Secondly, I will continue to use a blend of approaches in the form of inquiry-based learning, practical tasks and direct instruction, however a balance will be developed to ensure the pupils are given the tools needed to succeed. I will do this by breaking up the pupil-led learning to include aspects of direct instruction and AfL. I will also ensure that I make the purpose of the activities and the link to the scientific context clear to all the pupils (Ofsted, 2013).

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