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BA Primary Education with QTS

Module: ITDM 6002-C

Title:

**How can creativity support learning in
Science?**

18th April 2016

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Personal target(s) in relation to previous assessment (maximum of three targets):*

- To be more critical in my reflections
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Broad criteria related to learning outcomes	Poor / weak F	Satisfactory 3 rd	Good 2:2	Very good 2:1	Excellent 1 st	Mark
Subject Knowledge and Understanding, including evidence of Reading: LO1: demonstrate a critical understanding and practical application of how the processes of enquiry and reflection improve professional practice; LO2: demonstrate a thorough and comprehensive understanding of how research and theory can be applied to the teaching and learning of science and mathematics;	0-11	12-14	15-17	18-20	21-30	/30
Intellectual skills: LO3: critically analyse a comprehensive range of relevant literature and research materials relating to the teaching of science and mathematics; LO4: organise their knowledge and learning independently, demonstrating critical evaluation of appropriate research methodologies;	0-11	12-14	15-17	18-20	21-30	/30
Pedagogic and Professional applications, including ethical conduct (where appropriate): LO1: demonstrate a critical understanding and practical application of how the processes of enquiry and reflection improve professional practice; LO5: produce a well presented research project, with consideration to both literacy content and visual style, which is relevant, contextual and embedded in theory and reflective practice;	0-11	12-14	15-17	18-20	21-30	/30
Key/Transferable Skills (including Presentation, Organisation and Referencing techniques): LO5: produce a well presented research project, with consideration to both literacy content and visual style, which is relevant, contextual and embedded in theory and reflective practice.	0-3	4	5	6	7-10	/10



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Marker Comments

Targets for Improvement (maximum of three targets, these should include language and literacy targets and/or professional application targets)

-
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-

Tutor:

Date:

Second Marked

Yes

No

A sample of assignments will be second marked

Final Mark:

Frontispiece

This is to certify that the contents of this extended essay is the result of research carried out by the author, except where specific reference is made of work from others. The sole purpose of this essay is for assessment of the authors understanding of the subject matter which contributes towards the overall degree classification of BA (Hons) in Primary Education with QTS at the University of Wales Trinity St David, Carmarthen and has not been presented as part of any award or publically published.

Abstract

This essay aims to identify how creativity can be used to support learning in Science by using the pedagogy of puppets to engage learning

Secondary research was conducted in order to gather evidence, opinions and findings of other professionals in the field of Creativity and Science. The research highlights the creativity agenda in the National Curriculum for Wales; the support for greater acknowledgment for creativity in the curriculum, how creativity will play an emerging role in Donaldson's Successful Futures recommendations and how the arts are being incorporated into the STEM agenda. The differences of teaching creatively and teaching for creativity will be explained, as will the pedagogy of using puppets to creatively engage children's learning in science with reference to the research on the Puppets Project. Findings from secondary research suggest there is currently a shift in acknowledging the importance of creativity in both the National Curriculum and the Science agenda and how by teaching and nurturing creativity in pupils it can enhance learning and develop transferrable skills that employers suggest are the necessary qualities for a future productive workforce.

From primary research carried out qualitative data was collected through observations and interviews with pupils and staff. The findings of which suggest that the use of puppets as a creative pedagogy stimulated talk, promoted collaborative working, motivation and engagement with the subject.

The research carried out has provided the writer with a greater depth of knowledge and understanding in how creativity can support learning in science. With this understanding strategies could be transferred to other subjects such as Maths and in particular the use of puppets to be explored in PSHE.

Acknowledgements

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Chapter 1 – Introduction

Chapter 1 -Provides an introduction to the scope of the research including the context of why the question for the research was chosen and how in the current climate Creativity and Science are married together. The aims of the research are outlined as are research sources, limitations to the research and a hypothesis.

Chapter 2 consists of a literature review which discusses a variety of opinions and findings from secondary research in the field of Learning, Creativity and Science. Different schools of learning theory will be discussed before examining the meaning behind the pillars of the constructivist approach through the CASE Project (Adey, 1999). Theory in relation to the characteristics of creativity will be discussed as will how it dovetails with current thinking in education. Further discussion will take place with regards to creativity in the classroom and the different elements incorporated into its successful integration with science in particular the STEM to STEAM agenda.

Chapter 3 outlines the methodology used in order to gather primary research evidence some of which are included in the appendices.

Chapter 4 discusses the findings of the research and although this is a very small scale research project it shares clear commonalities with the findings from the Puppets Project research.

Chapter 5 draws the research findings to a conclusion discussing the professional development gained by completing this research and ideas for further inquiry.

1.1 Scope of the research

This research project was inspired after the author of this essay attended a conference on Creativity in Science at the National Museum of Wales in Cardiff Museum which was facilitated by Association of Science Education. It presented ideas about creativity in science by the author of the book 'Teaching Science Creatively' Dan Davies (Davies and Milne, 2010) with which a number of workshops were provided to illustrate how this can be done.

The author of the essay has a personal interest in creativity and shares many of the same views as Sir Ken Robinson, a leading figure in the field of Creativity. Whilst the author gravitates to creative activities such as art, design and technology it is acknowledged that they have a knowledge deficit in the area of Science. Therefore in order to rectify this in preparation for showing evidence of personal development in relation to the QTS standards this research was conducted.

Whilst Creativity is currently high on the education agenda and in particular in Wales in response to the recommendations from the Donaldson report (2015), it is worth therefore acknowledging its importance to the future of the education system and especially in relation to the current science agenda. The benefits the Arts bring to the table have been acknowledged as valuable transferrable skills that the Science Technology Engineering and Maths field (STEM) express that they so badly need. Therefore not only is there change imminent in the National Curriculum for Wales but the movement from STEM to incorporate the Arts into STEAM subjects. Therefore this research comes at a pertinent time for future practitioners in the field of education.

1.2 Research Aims

This research aims to:

- Provide a brief overview of how learning takes place especially when adopting a constructivist approach to learning.
- Identify the theory behind creativity and examine how this relates to learning.

- Identify the elements of Teaching Creatively and Teaching for Creativity and how this supports learning.
- Focus of the use of Puppets as a pedagogic tool to engage learning in science.
- Identify the significance of incorporating the Arts into STEM subjects to create STEAM.

1.4 Research Sources

Research carried out for this paper includes

- Literature review – Secondary research which provides a critical response to using creativity to support learning in science using research from books, journals, reports from a variety of organisations including newspapers and websites.
- Observations from lessons – Primary observations of three pupils were carried out using the Leuvan Scale to measure involvement in the lessons.
- Interviews with staff – Primary Research interviewing HLTA who participated in the lessons and supported with observing the pupils. A series of questions were also presented to the science coordinator of School A.
- Interviews with pupils – Primary research interviews were carried out with three target pupils of varying abilities.

1.5 Limitations

This research would have benefitted from a greater amount of time with which to observe knowledge and understanding of science over a longer period of time. Especially as creativity is difficult to assess. Therefore observations that were made can only be regarded as a snapshot of how creativity supports learning in Science. In the short term however there were opportunities to gain evidence with regards to engagement in the learning of science through a creative approach.

The class with whom the research was conducted was a Special Needs class with a number of pupils having learning difficulties such as limited literacy skills in reading and writing, other difficulties included Dyspraxia therefore focus was placed on

teaching creatively in order to present the information in an accessible format for the pupils. For a number of pupils their oracy and individual problem solving skills are excellent and they were able to utilise these during the creativity process and during the series of lessons. For others however their limited skills in particular those having a limited ability to think imaginatively consequently proved more of a challenge.

Ideally this research would form the foundations of an Action Research Project through a Professional Learning Community where a greater number of students teachers/ teachers and pupils with SEN could carry out wider reaching research which would provide more reliable, robust qualitative and quantitative data.

1.7 Hypothesis

Science has traditionally been viewed as a subject that is dry, boring and one where teachers pass on scientific concepts for pupils to learn. Emphasis is placed upon the pupils to accommodate new facts and concepts rather than having the opportunity to explore and freely create their own concepts.

Therefore, how is it possible to incorporate creativity into a traditionally taught subject? What does creativity mean? And what pedagogies can support learning in science?

How does this benefit children? Given the importance of gaining firm subject knowledge in primary school on which to build for secondary school formal summative assessments of GCSE.

For pupils with Special Education Needs Science in its traditional form poses difficulty for pupils with a range of difficulties from Literacy and Numeracy difficulties to more complex needs to access the curriculum. What pedagogies engage these children in learning science?

Chapter 2 – Literature review

2.1 Scope of the chapter

This chapter consists of a literature review that provides the background research upon which Chapter 3, the primary research, was based upon. This chapter highlights relevant research with regards to the current thinking in Creativity and in particular Creativity in Science and the creative use of a proven pedagogy.

2.2 How does learning occur in relation to Science.

In order to begin to understand how creativity supports learning in science it is important to first put into context how learning takes place.

There are many theories with regards to how learning takes place (Pritchard, 2009) these can be broken into three different approaches:

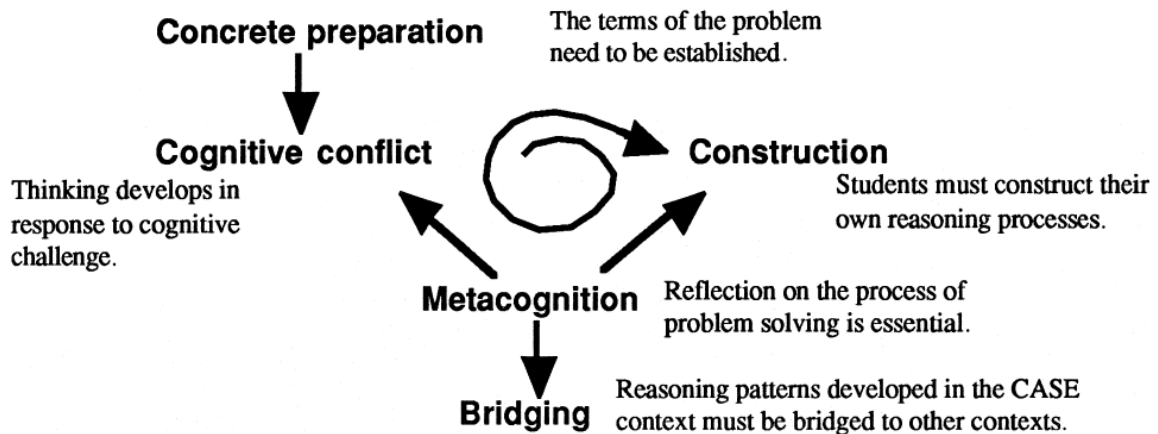
- The Behaviourist Approach - Can be linked with the work of Skinner who believed that learning takes place when learners are motivated by reward and deterred by consequences. (Pritchard, 2009)
- The Humanist Approach – Linked with theorists such as Holt who believed that students should be able to take responsibility of their own learning. This ensures they have greater responsibility and engagement with their learning. (Pritchard, 2009)
- The Constructivist Approach – Where knowledge and understanding are built on previous experiences in particular the work of Piaget and Vygotsky (Doherty and Hughes 2009).

In relation to a constructivist approach in Science, The SPACE project conducted research into how children construct knowledge, using teaching approaches that challenge children's existing concepts and facilitates opportunities to reconstruct new knowledge themselves (Sharp et al, 2014). However a more appropriate form of a constructivist approach in relation to this research project is that of CASE Cognitive Acceleration in Science Education.

The CASE project (Adey et al 2001) originally designed for pupils in secondary schools but now expanded through the 'Let's Think' programme (Adey, 2008) for younger pupils and for other subjects, was soon identified as model that could be used to develop cognitive processes to move pupils through different stages of

thinking, from concrete to abstract. CASE has strong routes in Piagetian theories linking to Assimilation, Accommodation and Equilibrium (Doherty and Hughes, 2009). The principle of the CASE approach is supported by five pillars as can be seen from Figure 1.

Figure 1 Adey (1999)



The first of the five pillars, 'cognitive conflict' (Adey, 1999:5) occurs when a pupil encounters a problem that they are not able to solve themselves. A possible solution to this comes from the second pillar 'Construction' (Adey, 1999:6) and draws on Vygotsky's theory of the Zone of Proximal Development (Pritchard, 2009). Moving on with the learning proves difficult; however when provided with the scaffolding of a more knowledgeable other for instance a teacher, a peer or equipment/materials to learn from, new learning is achieved and moved forward.

The third pillar involves 'metacognition' (Adey, 1999:6), thinking about thinking a higher order thinking skill where pupils are encouraged to identify how they may have solved a problem. This develops the skill of becoming aware of their own thinking.

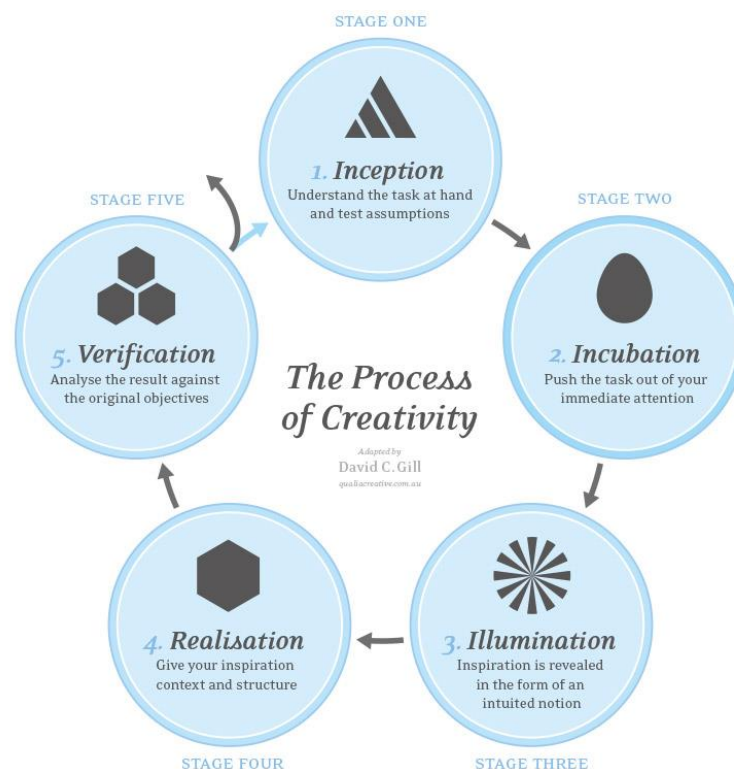
The final two pillars 'concrete preparation' (Adey, 1999: 6) and 'bridging' (Adey, 1999:6) are explained respectively. Pupils must be exposed to the language and/or materials of the problem before they begin; they need to have gained some familiarity of the expectations, materials and circumstances around which to solve the problem. This often occurs with an introduction to a lesson or a follow on from a previous lesson. Finally 'bridging' (Adey, 1999:6) is the ability to take what has been

learnt and transfer those skills and knowledge to other contexts such as other subjects such as Maths or into real life situations.

2.3 What is creativity?

Creativity is difficult to define with many definitions, Edward de Bono (1990) suggests that creativity involves looking at things in a different way, Best and Thomas (2007:27) defines creativity as ‘the intentional and purposeful search for innovation in problem solving’ and Craft (2000) suggests that creativity should also include ‘possibility thinking’; adopting a what may happen if.....? approach. However others (Robinson, 2009 and Gill, 2013) portray creativity as a process for which there is a purpose and an outcome. Figure 2 illustrates the different stages Gill suggests there are to creativity

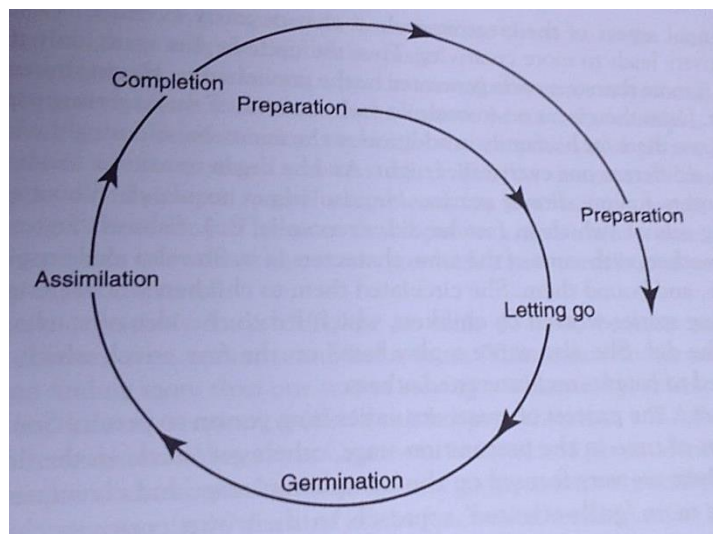
Figure 2 Gill (2013)



Craft (2000) similarly suggests as can be seen in figure 3 that there are also five stages to the creativity process and whilst they have different title headings the definitions have many commonalities. For example in Stage 2 of Gill's model (2013)

Incubation he suggests that once the concept has been identified then we must forget about it for a while, Gill suggests that in doing frees up the unconscious mind to be able to cognitively construct new ideas in relation to the original one. Similarly Craft suggests that there should be a stage of 'letting go' (Craft, 2013:33) where focus is momentarily diverted from the main focus giving space to regroup and draw on the unconscious mind for further direction.

Figure 3 Gill (2000:33)



Both Gill's model (2013) and Craft's model (2000) identify with the more formalised definition of creativity that 'imaginative activity fashioned so as to produce outcomes that are original and of value' (NACCCE, 1999). Although there is no evidence that this has been taken as an official definition the four characteristics of creativity: imaginative thinking, purposeful activity, originality and value were incorporated by QCA into their resource for teachers which provides guidance on identifying, developing and supporting creativity for Primary school pupils (QCA, 2004).

If we further examine each of these elements firstly taking Imaginative Thinking. Desailly (2015) suggests that imaginative thinking is not necessarily thinking about something completely new but potentially different approaches to something familiar, Craft (2000) further introduces possibility thinking which she suggests is the type of thinking that generates questions to explore new ideas. De Bonno (2009) suggests that creativity is connected to lateral thinking whereby Lateral thinking concerns itself

with the thinking of new ideas, furthermore Education Scotland (no date) support the idea that in order to be creative lateral thinking must be applied.

Secondly in their definition (QCA, 2004) suggest that creativity must have a purpose, imaginative idea need to be supported by a purpose, Ken Robinson (2009) shares this view and also advocates that creativity is not just about a happening but involves a practical process of doing things. The final two elements: originality and value, are drawn together through the development of new ideas that are of use and are worthwhile not only to themselves but to others.

2.4 Where does creativity come into education?

Recent reports (Donaldson, 2015 and Smith, 2013) highlight the importance of incorporating Creativity in schools through a number of avenues. Smith (2013) emphasises the importance of creativity from an Arts perspective suggesting that it should be given as equal an importance across the curriculum as literacy and numeracy.

The Scottish Government in comparison to the Welsh Government have already incorporated Creativity into their curriculum (The Scottish Government, 2013) and endeavour to ensure that all children and young people in Scotland have a variety of opportunities with which to develop creativity. Creative skills are defined as curiosity, open mindedness, imagination and problem solving (Education Scotland, 2015) which are incorporated across the curriculum

Although a little behind but with a change in education on the horizon, the Welsh Government welcomes the recommendations from the Donaldson report (2015) which suggests at the core of the curriculum should be learners who:

➤ **enterprising, creative contributors who:**

- connect and apply their knowledge and skills to create ideas and products
- think creatively to reframe and solve problems
- identify and grasp opportunities
- take measured risks
- lead and play different roles in teams effectively and responsibly
- express ideas and emotions through different media
- give of their energy and skills so that other people will benefit

and **are ready to play a full part in life and work**

(Donaldson, 2015:29)

A challenge that will place great emphasis with regards to incorporating creativity in the classrooms of Wales.

2.5 Creativity in the context of incorporating the Arts into STEM to make STEAM

Bringing Creativity into the national picture of science we must look at the change in thinking in this field. Currently in a world where we face global challenges such as the greatest population the world has ever seen, testing natural resources and technology moving at an unprecedented pace the challenges the world face need as much help as it can get both now and in the future (Robinson, 2009). The focus for global economies therefore is how to find solutions to future challenges such as 'economic growth, better health, sustainable development, and enhanced safety and security' in the 21st Century (The OECD Committee for Scientific and Technological Policy at Ministerial Level , 2004) Traditionally responsibility has been placed on the Science, Technology and Engineering industries for solutions however currently within the UK there is a great shortage of skilled workers in these areas (UKCES, 2015). A challenge therefore for the UK competing in global economies is ensuring there is the growth of an appropriately skilled workforce to take the country into the 21st Century and beyond.

In identifying the skills deficit it is important to understand what skills are being sought after. EU Skills Panorama (2014) suggest that not only a depth of subject knowledge in the area of Science, Maths, Engineering and Technology is needed but more transferable skills of critical analysis, problem solving and logical reasoning the CBI (2015) further suggest that analysis and a sense of curiosity are valuable attributes in the STEM field.

Serious consideration must also be given to the figures published by the OECD (2014) which suggest that PISA results show that pupils performance in Wales with regards to science have repeatedly fallen since 2006. A stark reality for professionals in the science community but one that could CBI (2014) and Donaldson (2015) suggest could be tackled through addressing misconceptions of STEM based subjects early in Primary schools, by developing a curriculum that supports creativity and the promotion of STEM subjects through areas of learning. There is great support for incorporating creativity and the arts into STEM subjects. Rt. Hon Maria Miller Culture Secretary for the Coalition Government (2014) suggested that we should embrace the Arts in STEM subjects, a belief that is supported by The Cultural

Learning Alliance (2014) who also advises that STEAM can solve the problems of STEM as the arts breakdown barriers between subjects and foster creativity and innovation. Furthermore findings from the CASE Programme (2010, cited in The Cultural Alliance, 2014) show that children's cognitive skills can increase when participating in structured Art activities.

In acknowledging this it is important to note therefore that schools, in particular Primary schools play a vital role in promoting the incorporation of creativity through Arts in STEM subjects at the earliest opportunity. Further examination therefore needs to be made of how this is done in the classroom.

2.6 Incorporating Creativity and science in the classroom

So what does creativity look like in particular teaching science. Davies and Milne (2010) suggest there are two elements of creativity in the classroom:

- Teacher creativity
- Teaching for creativity

Teacher creativity or creative teachers could be best described as effective teachers (OFSTED, 2010), teachers who may move away from a traditional cognitive approach in science to a Socio - Cultural one where cultural identity and needs are taken into account (Traianou, 2006). Each child brings with them their own set of cultural values, Harlen (2011) suggests that creative teaching takes into account the feelings of the pupils which is more likely to get pupils to 'think, to reason, to argue, and to be creative in their own thinking' (Harlen, 2011: 104). A creative teacher of science will: link and make the learning significant in relation to everyday life, have a flexible approach that listens to pupil's ideas and alters and adapts their teaching and assessment methods in order to incorporate these.

Creative teacher pedagogies in science may include the use of Thinkers Keys (Ryan, 2009) and the Let's Think series (Adey 2008) to promote creative thinking skills, or the use of Concept Cartoons (Naylor and Keogh, 2010) for promoting creative communications between pupils. The Puppets Project (Naylor et al, 2005) also a creative strategy for teaching science is documented to have positive effects on children's motivation to engage in science lessons. The case study presented by

Keogh et al (2008) illustrates just this. Teachers observed interactions between a teacher, puppet and pupils during a series of demonstration lessons. These lessons consisted of a teacher modelling the use of the puppets during a science lesson, the teacher modelling had never met the pupils before and therefore had no prior classroom relationship with them.

Teachers who were observing identified that when a problem was presented by a puppet, pupils' motivation and engagement to solve the problem was high. Pupils freely expressed their scientific opinions and ideas to the puppet which teachers observed was important in the problem solving process. They identified the need to ensure that more time should be given in order for pupils to develop talk for learning with others. Where talk plays an important role by having the opportunity to share, explore and construct new ideas through interactions with others. This is supported through research conducted by Mercer et al (1999) which suggest that talk between pupils in the classroom promotes thinking skills and in doing so through social interaction as advocated by Vygotsky's work (1978) helps pupils develop language, knowledge and understanding.

Given the evidence presented by Keogh et al (2008) that a social constructivist approach to learning through dialogue created with puppets can support learning in science, this pedagogy can also support the creativity in the subject too through promoting the development of the 'little 'c'' (Davies and Milne, 2010). The little 'c' according to Davies and Milne (2010) refers to pupils having the opportunity to create their own original ideas which are different or unusual from the current thinking. Teaching for creativity in which to promote the little 'c' involves opportunities for pupils to be able to question and challenge scientific concepts by making connections and identifying how they relate to other things for example in everyday situations. The little 'c' can be developed when pupils adopt a what if attitude similar to that advocated by Craft (2000) by maintaining an open mind and assessing appropriateness of ideas through evaluating, reflecting and amending where appropriate.

2.7 Conclusion and Summary of Chapter

To conclude this chapter has examined the literature in relation to creativity and creativity in education and has critically evaluated the notion of incorporating the Arts into STEM based subjects in particular the benefits in relation to the skill gained and how they can be transferred to other areas.

Whilst many agree that creativity is something to be embraced unlike Scottish Education, Wales has no current guidance on how to support education practitioners in this process. Therefore the responsibility for incorporating creativity into lessons relies on the skills knowledge and understanding of teachers in adopting creative pedagogies; such as the use of puppets to teach creatively and teach for creativity.

Chapter 3 – Methodology and research design

3.1 Scope of the chapter

This chapter outlines the methods used in the primary research that was carried out by the author of this research project. It explains the reasoning behind choosing this particular type of research and the methodologies used.

3.2 Methodology

This research if used in conjunction with other professionals in particular with other student teacher could have formed a Professional Learning Community (PLC) research project (Welsh Government, 2013) which uses action research to inform and improve teaching and learning. However due to the time and word count constraints this was not possible.

This primary research was carried out to investigate how the creative use of pedagogies, in this case puppets, had an impact on learning in science and whether findings the finding from this research complemented or contradicted the findings from the Puppets Research Project (Keogh et al 2008). It was therefore appropriate to carry out a small scale case study in order to gain the qualitative data necessary to make a judgement on how creativity supports learning in science.

This case study provides an example of real pedagogies with a real class. Cohen et al (2011) suggests that case studies are best used when there is little control over behaviours or events. With this definition in mind it was therefore appropriate to choose this method of research to record findings. Using Yin's description of a case study (1984) this is an Explanatory Case Study which aims to test the theory and research of using creativity to support learning in Science in particular that of using puppets and is of a 'multiple-case design' (Yin, 2009).

Observations were taken by the author of three pupils, a higher ability, a middle ability and a lower ability child in order to gain a balanced overview of the impacts the pedagogy had. Recordings were also made using the Leuven Scale (Plymouth City Council, 2011) to measure and record engagement with the lesson as was observations from the author and additional adults supporting the children.

A series of science enquiry lessons were developed blending together a number of theories and methodologies: Constructivist theory, Creativity and The Enquiring Minds model (2007).

The table 1 below illustrates how different theories were incorporated into the lessons.

Table 1

Lessons	Constructivist Theory	Creativity	Enquiring minds model
1. To create a plan on how to solve the problem and identify what the piece of equipment should be used for (Zoomy Egg)	Using prior knowledge and understanding to create a plan	Problem solving and thinking skills by posing questions. Using questioning and planning with the puppets.	Stage 1 – Initiating and Eliciting Posing questions Stage 2 – Defining and Responding
2. Follow plan – Using the equipment (Zoomy egg) and bones.	Addressing misconceptions as the pupils work through their plan.	Using ICT to compare bones. Explaining to the puppets	Stage 3 – Doing and making
3. Final stage of plan – Solving the problem. Evaluating how they executed the plan.	Completed their task and evaluated how they did it. How misconceptions were addressed in the process	Recording how they have done it, using an iPad Using the puppets to feedback to. Creating the dinosaur skeleton	Stage 3- Doing and making. Stage 4 – Communicating and evaluating

Puppets were used in the introduction of the lessons, in Lesson 1 they were used to introduce the problem to the class and the puppets were used in subsequent introductions and plenaries to recap the previous lesson and present the current lesson.

In order for the puppets to communicate with the adults and pupils the handler of the puppet would pretend that the puppet was whispering into their ear then would relay what the puppet had said to the rest of the group or class.

During small group work one pupil from each group was responsible for the puppet.

Using Social Constructivist theory and the promotion of the middle 'c' using the sociocultural approach (Traianou, 2006) to the science lesson to support the development of creativity in pupils. Pupils worked in 3 ability groups, each with a supporting adult, the expected outcomes for each group were differentiated according to their ability. Each adult within the group had a session plan on which to record pupil's interactions in greater detail within the lesson. (See Appendices 10,11 and 12).

3.2 Pupils views

Interviews were conducted with the targeted pupils one from each group: higher, lower and middle ability groups (See appendices 2, 4,6) . It was explained prior to the interview that all pupils were able to withdraw their participation at any point. The interviews were conducted in a relatively informal manner due to the nature and previous experiences that some of the children may have had. Therefore they may not have identified them as interviews just as chats about their lessons. Reassurance that information would be kept confidential was also made

3.3 Practitioners Views

The views from one HLTA were gained through an interview where they were asked a number of questions about their views on how the lessons had supported the pupil's learning in science and their own personal opinions with regards to the use of puppets in science (see appendix 7).

In order to gain an overview of the school's perspective of the science curriculum and how they incorporate creative pedagogies an interview was held with the Science Coordinator (see appendix 8).

3.4 ***Ethics***

Throughout this research the BERA Guidelines (2011) have been followed and the ethics form completed for this research project which is located in the opening pager of this paper presents the guidelines to which the research has been adhered to.

The author of this paper had a dual role in the research whereby they were not only presenting the lessons but were observing pupils within it. In order to combat bias, interviews were conducted with both the pupils and a HLTA who was also involved in the lessons.

All participants provided voluntary informed consent and were given the opportunity to withdraw from the research at any point. Where pupils have been observed or interviewed their identity has been protected, reference has been made to them by using Child A, B and C, other children have been referred to as numbers. The identity of the adults who participated in the research has been protected and only their job title used as a reference. At no point is there reference to the school either.

Chapter 4 – Analysis of findings

4.1 Scope of this chapter

This chapter examines the findings of the primary research and its relation with regards to theory. The evidence presented from the primary research will make comparisons with the secondary research by identifying evidence that supports, contradicts or shows an indifference to secondary research theories or findings. This small scale primary research attempts to illustrate how teacher creativity can support learning in science whilst using the proven pedagogy of a secondary research project.

4.2 Evidence from the primary research linking to secondary research

Throughout this next section explanations of the activities carried out in the primary research will be given which will either look to support, contest or present a case of indifference based on the evidence.

Below was the problem presented to the pupils:

Problem:

Nanna, Ricky and Ruby went to the Science museum; unfortunately Ricky and Ruby were messing around and knocked three dinosaur exhibits over causing all the bones to be completely muddled up.

The curator of the museum was particularly angry with them. He gave them the bones and a microscope and told them they needed to go away, sort the bones out and reassemble them just the way they were.

As suggested by Robinson (2009) in order for creativity to take place there must be a purpose, this problem fulfils this caveat and although different replicates the Too Many Teeth problem presented in the Spellbound Science Book 1 (Keogh et al, 2007).

The first lesson in the series of three consisted of the planning stage to sorting the problem out.

Nanna, Ricky and Ruby's problem was presented to the class and their help was sought. From the moment the puppets were taken out the pupils were engaged, sitting still and listening attentively to the introduction to the lesson. This can be seen in Appendix 10, Child A has already been given Nanna to look after and Child B has Ruby on their lap. Other pupils were focussed on the author who was holding and talking with Ricky.

Pupils were grouped by ability with an adult allocated to them in order to provide support by scribing pupil's ideas. Red group completed three steps of their four step plan by sharing their ideas on how to solve the problem. In examining Pupil 1's ideas (appendix 10) he was obviously drawing on previous scientific knowledge and understanding. He suggests in step 1 (appendix 10) that they use the microscope to find out the DNA. This highlights a misconception of the process of identifying DNA. There are many forms of DNA testing which he alludes to in his suggestion. This calls into question the depth of his knowledge in this area. This misconception was not addressed by the additional adult and therefore remains unchallenged.

Both Child C and Pupil 2 suggest sorting out the bones and putting them back together for the puppets. These suggestions show evidence of problem solving thinking one of the characteristics of creativity (Craft, 2000). Furthermore JE shows signs of empathy towards Nanna by suggesting that if the bones are put back together then Nanna will feel better, as Harlen notes (2011:14) that teaching creatively incorporates the feelings of learners. There are obviously feelings being expressed by the pupil and therefore the supporting adult provided them with the opportunity to have a go at sorting the bones out.

In the middle ability group Child B (Appendix 3) who regularly presents challenging behaviour was fully engaged in the lesson and was given responsibility for Ruby the puppet. As can be seen from observations of the lesson (Appendix 12), other pupils were asking the puppet Ruby questions and Child B was answering the questions on her behalf. Usually Child B would refuse to answer questions if they were unsure as they are often the the least knowledgeable within the class or group and often give wrong answers. In this instance the use of the puppet provided Child B with confidence to be able to ask and answer questions. This alleviated the pressure from Child B providing him with the message that he was a valued member of the group

thus having a positive impact on the Child B's confidence and self-esteem. This supports the evidence presented by the Puppets project (Keogh et al, 2008) which also suggests that for those who are less confident and low attaining the impact is the most evident.

The lower ability group found the task particularly difficult as they did not have an understanding of how to create a plan. The steps were too large for them and therefore needed scaffolding using Vygotsky's ZPD theory (Pritchard, 2009) to be able to access and move forward with the learning. This is evident from the comments made on the session evaluation in Appendix 13.

Lesson 2 saw the use of the Zoomy Egg microscope. The groupings were kept the same to ensure there was consistency of collaborative group work which would ensure this variable in the research was consistent. All groups drew on previous knowledge from other areas; that in order to use the Zoomy Egg they needed to use the USB plug to connect to a computer. Initially they were unsure how it worked and began a series of testing, evaluating and retesting in order to identify how the Zoomy Egg worked. Under normal circumstances in other subjects with a teacher led lesson many of the pupils would have given up after the first attempt, however most pupils showed signs of adopting determination and motivation for example see appendix....) to get it to work or perhaps it could be suggested they showed elements of adopting a what if approach (Craft, 200). As they were trying to sort the problem out for the puppets links to the theory from the CASE model (Adey, 1999) could be made, where cognitive conflict was presented in the form of their lack of understanding how the Zoomy Egg worked. They tested different ways of getting it to work by adopting suggestions from their peers; they retested using the construction of reasoning and bridging.

The development of scientific language was evident when using the Zoomy Egg pupils were identifying textures as rough, smooth, spotty, stripy, zoom in/out, makes it bigger. They were also using classification to identify differences in texture between the bones.

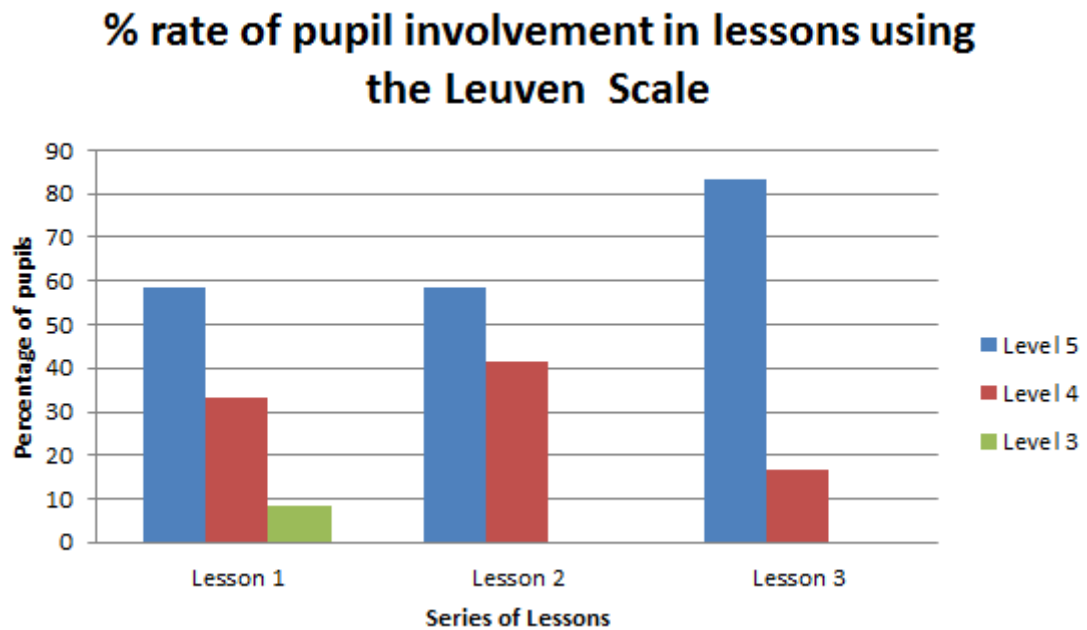
All this activity was central to feeding back to the puppets. It was recorded that the pupils regularly reported back to the puppets, keeping them informed of the process.

Throughout **Lesson 3** the lesson all pupils were engaged in meaningful discussions with regards to sorting the bones out according to their property. Child A was especially engaged in the creative process as can be seen from the observation note in appendix 14. After viewing a song on a video of how to put the dinosaur bones back together according to the observation from the HLTA they were able to confidently reassemble the bones. Furthermore Child A took this activity a step further and using creative thinking he suggested they introduce a challenge whereby the pupils were set a challenge to put them together whilst using a timer. This illustrates once again how the CASE model theory is linked to cognitive development in science, this pupil began to use the bridging pillar by further extending the activity to begin to explore other concepts, in this case creating another problem to solve: reassembling the bones within a timeframe. With regards to the creative process he was at the completion stage of Craft's model (2000), Child A had identified that the initial problem had been solved by completion of reassembling the bones. He had created the dinosaur skeleton and wanted to test to see if it was possible to correctly recreate it using the timer as a means of monitoring how quickly he could achieve this aim again.

The findings from the interviews with the three children (appendices, 2, 4, 6) illustrate their enthusiasm and motivation whilst working with puppets in Science lessons. When asked about the science lessons all pupils were able to recount how they went about the process of sorting the problem out for the puppets. They all expressed how they enjoyed holding; looking after and talking to the puppet and saw the puppet as helping them sort the problem out too.

In analysing the results from observations using the criteria of Leuven Scale of involvement (Appendix 14) it can be seen that the majority of pupils were operating a level 4/5 for the series of lessons.

Figure 4



Lesson 1 shows the majority of the pupils were operating at levels 4 and 5, Plymouth City Council (2011) in relation to the Leuven scale of involvement suggests that if pupils are operating at level 4 or 5 then a deeper level of learning can be achieved. For Lessons 2 and 3 pupils increasingly move from level 4 to level 5.

With regards to the target pupils as can be seen from figure 5, both Child A and Child C were continuously engaged at level 5 for all lessons, however Child B dropped to level 4 in lesson 2 (as can be seen from figure 5). Although small decrease this is quite significant in the research findings. For lesson 1 Child B was responsible for looking after the puppet Ruby, however in Lesson 2 another child in their group was responsible for the Ruby. Child B therefore appeared not to be as focussed on the activity, having short moments where concentration lapsed, inappropriate behaviour set in which had to be managed in order to redirect and get back on track.

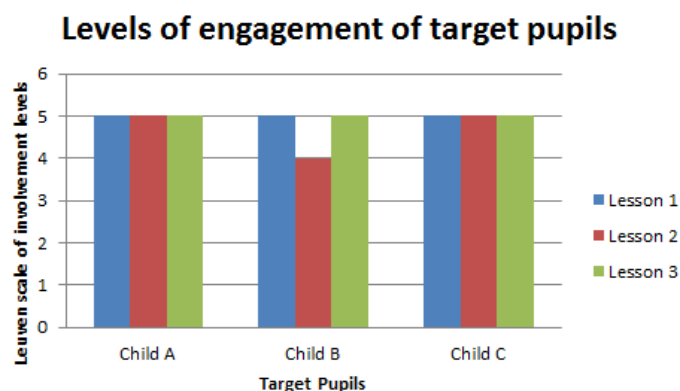


Figure 5

Conclusion of the findings

Having examined the findings from both the primary and secondary research there is strong evidence to suggest that the creative pedagogy of puppets can engage and motivate pupils' learning in science lessons.

In the authors interpretation of the findings of the primary research it is clear that when a teacher applies their creative skills, in this case making aesthetically tactile resources (dinosaur bones) to support the learning activity, coupled with the creative manner in which the puppets were used to facilitate the small 'c' of creativity, that where children are able to express their own creative thoughts and act upon them, pupils are more motivated and engaged in the learning process. Elements of creativity such as the use of imagination to create new ideas and apply these to a problem solving scenario, collaboration was evident through the sharing of creative talk and critically analysing and reasoning whilst trying to figure out how to put the dinosaur bones back together.

However in order to answer the question of this research 'How does creativity support learning in Science' fully, the use of other pedagogies should be explored as should how creativity develop knowledge and understanding in the subject.

Chapter 5 – Conclusion

5.1 Essay Aim

The aims of this research have been met through both the primary and secondary research analysing and critically reflecting upon the findings

5.2 Conclusion

Using creativity in particular the pedagogy of puppets to support learning in science is an effective tool all teachers should have in their classroom toolkit. However in order for them to use puppets effectively in the classroom there is a need to train teachers through the Continuous Professional Development pathway. In completing this small scale research the author thought it important to acknowledge the work of the Puppets project and therefore emailed Stuart Naylor. The response can be seen in Appendix 16.

5.3 Professional Learning

It would be appropriate to transfer the positive experience of using puppets in science to explore other areas of the curriculum such as Maths or PSHE.

5.4 Recommendations

Schools should invest in training and the use of puppets for all staff, in particular with the focus on creativity in the recommendations from the Donaldson report (2015) and the focus on STEM to STEAM.

5.5 Further research

The author would like to carry out further research with regards to the use of puppets in other subjects for instance Maths or PSHE. In particular how creativity can support learning in these subjects.

Word Count: 6587

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Appendix 1

General Information - Child A

Child A is male has general learning difficulties with some speech and language difficulties coupled with Dyspraxia.

They are 10 years old and are currently educated in a Learning Recourse Centre (Special Educational Needs class) within a mainstream school. The class consists of 14 children aged 7- 11 years old.

Child A has been within the Learning Resource Centre since he was 5 years old and is placed in the lower ability group within the class. They are assessed to be at P Level 5 for English and 5 for Maths. Their skills in these areas are limited, counting and writing to the number 5 whilst they are almost able to phonetically sound out the first and last sound of CVC words.

However they excel in their oracy skills. They are quite verbally articulate and very often have creative solutions when problems are presented. Their behaviour can sometimes be quite excitable causing them not to listen to instructions given by adults and therefore needing a five minute egg timer to use as thinking time to calm down.

Appendix 2

Interview with Child A

Interviewer: *This week in class we have sorted a science problem out for Nanna, Ricky and Ruby. Tell me what the lessons this week have been like for you.*

Child A: *I've enjoyed it.*

Interviewer: *What have you enjoyed the most?*

Child A: *Sorting the problem out and looking after Ricky*

Interviewer: *Why did you enjoy sorting the problem out and looking after Ricky?*

Child A: *Well, Ricky needed to be looked after didn't he? I showed him how we sorted the bones out. We made a plan first, then we sorted the bones out. We used that egg thingy that you plugged into the computer, oh, what was it called, erm.*

Interviewer: *It began with 'm', mi, mic, micr....*

Child A: *That's it microscope, microscope*

Interviewer: *What did you do with the microscope?*

Child A: *It was plugged into the computer and we put it on a bone and could see what it looked like.*

Interviewer: *What did it look like?*

Child A: *It looked like the beach, like the sand on the beach you know.*

Interviewer: *Were the bones the same or different under the microscope?*

Child A: *Some were the same and some different. The ones with the same pattern on were the same with the microscope.*

Interviewer: *How did this help sort the bones?*

Child A: *We were able to sort them into piles then we swapped them with the other groups so we got a pile of bones the same.*

Interviewer: *What did you do then?*

Child A: *We looked at the shape of the bones and talked about where to put them. There were some small bones and some big bones we tried to do it ourselves then used a picture to help us.*

Interviewer: *How did you find putting the bones back together?*

Child A: *It was hard at first but when we used the picture it helped us a lot.*

Interviewer: *What about the Ricky, where was he when you were doing this?*

Child A: *He was with us, I kept telling him what we were doing*

Interviewer: *What did you think about sorting the problem out for Nanna, Ricky and Ruby?*

Child A: *It was good.*

Interviewer: *Does it help with your learning of science?*

Child A: *Mmmmmmm not sure, I liked trying to sort the problem out for them and I liked holding Ricky and I liked talking to him.*

Interviewer: *Well thank you for talking to me about your science lessons*

Child A: *Ok thanks*

Appendix 3

General Information – Child B

Child B is a boy who has recently re-joined the Learning Recourse Centre after a period in a mainstream school. After having spent periods of time in a mainstream school and in a Nurture group the current placement has strict conditions with regards to attendance.

Child B shows Social, Emotional and Behavioural difficulties and needs constant and consistent boundaries set and re-enforced. He is 10 years old and is of large stature and exhibits some signs of Dyspraxic tendencies however has not been formally diagnosed with the condition. His self –esteem and confidence are very fragile and often can be seen disrupting lessons or opting out of tasks choosing not to do the work if it presents a small amount of challenge. He can become verbally abusive and aggressive.

Being new to the Learning Resource Centre his academic levels have not yet been set however from observations, Child A is able to count reliably to 20 and write numbers relatively securely to 10. There are however occasionally number reversals within this that are not consistently the same numbers. With regards to English, his handwriting is pre-cursive with some letter reversal; he is relatively secure with spelling CVC words and most high frequency words. His reading age is 7 years.

Appendix 4

Interview with Child B

Interviewer: *This week in class we have sorted a science problem out for Nanna, Ricky and Ruby. Tell me what the lessons this week have been like for you.*

Child B: *Good*

Interviewer: *What have you enjoyed the most?*

Child B: *Holding Ruby and putting the bones back together*

Interviewer: *Why did you enjoy putting the bones back together and looking after Ruby?*

Child B: *I really liked holding Ruby, she was soft and nice to hold and I looked after her.*

Interviewer: *What about putting the bones back together. You said you enjoyed that.*

Child B: *Yes, we sorted them out and put them back together*

Interviewer: *How did you do that?*

Child B: *We'll firstly we took the bones out of the bag and put them on the floor. We looked at them and tried to put them into a dinosaur shape.*

Interviewer: *Did you manage to do it?*

Child B: *No we found out that we didn't have all the right kinds of bones. The next lesson we used an egg microscope thing to look at the bones. It was amazing, when you held the egg on the bones you could see on the screen what it looked like. Mine looked like it had loads of holes in it. When you looked at the bones without the egg they had patterns, some were rough, some had stripes and mine had circles on it. When I put the egg on it you could see the circles were really big. The stripy bones were different though.*

Interviewer: *Where was Ruby when all this was happening?*

Child B: *Oh, she was with us. I held her for the first lesson then I chose DR to hold her. It was difficult to choose who could hold her next because I didn't want to upset anyone. So I asked Ruby and she said she wanted DR to hold her.*

Interviewer: *That was a good idea asking Ruby for help. Did it help you?*

Child B: *Yeah*

Interviewer: *How did it help you?*

Child B: *Because it did she told me who to pick*

Interviewer: *So after you looked at the bones under the microscope what did you do?*

Child B: *We took them back to the carpet and sorted them into different piles. The rough pile, the*

stripy pile and the circles pile. We kept the rough bones and then I took the bones to the other groups, they had our other bones. I brought them back and we looked at the shape of the bones to see if we knew what they were.

Interviewer: *Did you know any bones?*

Child B: *Yes, I knew the leg bone and the head bone because that had teeth, there was a foot bone because I could see the toes and the hand bone.*

Interviewer: *Sounds like you know a lot of bones. What did you do in the last lesson*

Child B: *We listened to a song about putting the bones back together.*

Interviewer: *Who had Ruby in your group?*

Child B: *BT had her, I wanted to look after Ruby, I don't think BT looked after her as well as me.*

Interviewer: *Oh, why was that?*

Child B: *Because I was holding her nicely and talking to her, BT wasn't holding her nicely and wasn't talking to her.*

Interviewer: *Oh dear that's a shame perhaps if Ruby visits again you could spend a little more time with her, would that be ok?*

Child B: *Yep*

Interviewer: *What did you think about sorting the problem out for Nanna, Ricky and Ruby?*

Child B: *I enjoyed it at least they can go back home now and we've sorted the problem out for them.*

Interviewer: *That's true, I'm sure they'll be really happy about that. What about Science, did Ruby help you to learn more about science?*

Child B: *Yes she helped us put the bones back together for her.*

Interviewer: *Thank you for talking to me about you lessons.*

Child B: *It's OK.*

Appendix 5

General Information-Child C

Child C is 8 years old and a girl. She has been in both the Infant and Junior Learning Resource Centre of the school since she was 4. She has some speech and language difficulties coupled with Dyspraxia.

She is currently placed in the higher ability group within the class and functions at P Level 6 for English and 6 for Maths.

Child C understands of concepts needs to be regularly checked through AfL strategies as her emotional reactions or body language clues are difficult to read as often she lacks outward expression of emotion.

Child C's social interaction with others is good, she is able to make and maintain friendships and although generally quiet in class she often make valuable contributions to lessons. Sometimes the contributions may be random and lack imagination.

Appendix 6

Interview with Child C

Interviewer: *This week in class we have sorted a science problem out for Nanna, Ricky and Ruby. Tell me what the lessons this week have been like for you.*

Child C: *Good*

Interviewer: *What have you enjoyed the most?*

Child C: *Helping Nanna sort the problem out.*

Interviewer: *Why did you enjoy sorting the problem out for Nanna?*

Child C: *Because it was fun.*

Interviewer: *What was it about the lessons that were fun?*

Child C: *We got to sort out the bones.*

Interviewer: *How did you manage to do that?*

Child C: *We'll first we looked at them, then we decided that we needed to sort the bones out.*

Interviewer: *How did you decide to sort the bones out?*

Child C: *We looked at them, we felt them to see what they felt like.*

Interviewer: *What about Nanna, where was she when you were deciding what to do?*

Child C: *JE was holding her for the first lesson and I held her for the next lesson*

Interviewer: *What was I like looking after Nanna?*

Child C: *It was good*

Interviewer: *When you were holding her what did you do?*

Child C: *She sat next to me and I talked to her about what we were doing. I asked her if that was ok and she said yes.*

Interviewer: *Ok, so in the first lesson you came up with a plan of how to sort the bones out. In the second lesson you used that plan. What did you do?*

Child C: *We looked at the bones again, we counted them, we sorted them into sizes, we talked about them and how some of them were rough and smooth. We could see patterns so we sorted them into piles.*

As well we looked at them in the microscope. It was amazing! JE said it looked like the moon

Interviewer: *Have you used a microscope before?*

Child C: *No but we took it in turns to put the microscope on one of our bones to look at. It was a bit difficult at first because we didn't know we had to hold it on the bone.*

Interviewer: *What did you do then?*

Child C: *We gave the other piles of bones to the other groups*

Interviewer: *When you got your pile of bones what did you do?*

Child C: *We looked at them again and tried to see if we could see what the bones were. I could see a head bone because it had teeth.*

Interviewer: *In your final lesson what did you do with the bones?*

Child C: *We listened to a song first about dinosaur bones called Dig it up, it went like this. Dig it up, dig it up, dig it up, dinosaur bones erm, erm, I forgot now. But it did sing about head bone and all the other bones an all. I liked that song.*

Interviewer: *What did you do after that?*

Child C: *We made a dinosaur skeleton from our bones.
We wrote the names of the bones on the labels and put them by them.*

Interviewer: *What about Nanna? Where was she? Who was looking after her?*

Child C: *We both looked after her, we talked to her and telled her what we were doing. I think she liked it.*

Interviewer: *What did you think about sorting the problem out for Nanna, Ricky and Ruby?*

Child C: *It was good.*

Interviewer: *Did having Nanna help you with your learning of science?*

Child C: *She helped because we had to sort the problem out for her.*

Interviewer: *Well thank you for talking to me about your science lessons.*

Child A: *Ok*

Appendix 7

Interview with HLTA

Interviewer: *You had the lower ability group for the week. How do you feel the pupils engaged with the lessons?*

HLTA: *They loved the puppets; the puppets really grabbed their attention and held it there. You could see they were all eager to please and talk to the puppets; explaining what they were doing every step of the way.*

Interviewer: *And the planning and sorting elements of the series of lessons. How do you think the pupils participated in them?*

HLTA: *The bones were a real challenge for the group because at first they hadn't grasped the concept that they had a sample of three different types of bones. They also found it difficult to understand the different steps that were needed in the planning process. They needed the steps breaking down further which I did.*

Interviewer: *Once you'd broken the steps down did they understand the concept of following their plan through?*

HLTA: *Yes, in fact they were so eager to please the puppet that they wanted to do everything there and then. So we tried making a dinosaur from the bones we had and the group found out that they didn't have all the bones they needed.*

Interviewer: *What interaction took place between the pupils and the puppet?*

HLTA: *Well, one pupil from the group was looking after it, holding it and having it either sat next to them or on their lap. For the three lessons pupils took it in turns to look after it. There were four pupils in my group so unfortunately one pupil didn't get chance to look after it during the lesson. They did after the lesson and they were happy with that. The pupils talked to the puppet explaining what they were doing during the activity, at times they were so engrossed in the discussion of the bones that the puppet didn't factor into it. They regularly checked to see if the puppet was ok by asking it questions and providing responses which was quite comical at times. Obviously it was their own thinking and words but they were passing it off as if that's what the puppet had said.*

Interviewer: *What impact do you think the puppets had on their learning in Science?*

HLTA: *Mmmm, I'm not sure. I suppose their eagerness to please the puppet motivated them to solve the problem of the mixed up bones. They used a lot of experimenting in terms of trial and error but trying to fix them back together, realising they didn't have enough then having to re-evaluate their next steps. I don't think it had much impact on their scientific language as the language within the activities wasn't too scientifically complex for them, a couple*

*struggled to remember the word 'Microscope'.
They were just very motivated to please the puppets*

Interviewer: *Were there any negative points to using the puppets?*

HLTA: *On the odd occasion the puppets were more of a distraction because the pupils would focus their attention on them rather than participating in the actual work of the lesson. Where this did occur it was explained to pupils that the puppet would need to be taken away from them in order for them to refocus and concentrate on the task.*

Interviewer: *Have you ever used puppets in your work before?*

HLTA: *I have but not like this. I'm amazed how positive the pupils have been to the puppets, especially how they have motivated the children to remain on task to sort the problem out for Nanna, Ricky and Ruby.*

Interviewer: *Thank you for taking part in this interview.*

HLTA: *It's a pleasure thank you*

Appendix 8

Interview with Science Coordinator with a focus on KS2

Interviewer: How is the teaching of Maths/science organised across the school?

Science Coordinator: Science is taught on a Friday across KS2 and at Fenton we follow an investigative approach in which one investigation may take 2, 3 or 4 weeks to complete. Children are encouraged to discover things for themselves and plan investigations as well.

Interviewer: How is it differentiated for Foundation Phase/KS2

Science Coordinator: I'm sorry but I know very little about Foundation Phase only that Science is covered in the 'Knowledge and Understanding' area of learning. It is differentiated accordingly in KS2. Science lessons, like all lessons are differentiated when appropriate where MAT children are challenged and the less able are supported/given work on the same subject but at a suitable level.

Interviewer: What input do you have on the teaching of Science in the LRC and nurture?

Science Coordinator: Very little but the Science Schemes are there to follow should they wish to use them.

Interviewer: What pedagogies does the school use to teach science?

Science Coordinator: A wide variety – I don't know what else to say here really. All teachers will adopt different approaches towards the same lessons. I'm sure myself and other teachers teach identical lesson plans in completely different ways.

Interviewer: Are these consistent across the school?

Science Coordinator: I don't know sorry

Interviewer: How do you ensure they are and how is it monitored/ assessed?

Science Coordinator: Science lessons have been observed in year 6 by Mr Harries and Incerts is used to monitor the subjects throughout the school. The GL assessment that we started this year will also give a score for science.

Interviewer: Are you aware of anyone in the school that has used puppets to inspire learning in science and maths?

Science Coordinator: Not that I'm aware of – more of an infant/LRC thing I'd imagine.

Interviewer: What is your opinion on using puppets to create talk for learning in Science?

Science Coordinator: If it works – go for it.

Interviewer: How does the school promote creativity in science?

Science Coordinator: I think the investigative approach to science promotes creativity.

Interviewer: Do you work with outside agencies with regards to science, for example the Darwin Centre?

*Science Coordinator: We work with the Darwin Experience they are good and offer one free session for the school per year and invite us to shows at Pembrokeshire College etc. We work with the National Park sometimes, depending on our topic for the year. Tasker Milward Science department are also great too and have offered much help in our Science work as well as loaning us equipment.
I'm sure there are loads of agencies/organisations we could use as well to help us but they all cost lots of money.*

Appendix 9

Nanna has already been given to Child A

Ruby is sitting on the lap of Child B



Appendix 10

Ideas dictated to LSA who scribed for them.

Red Group's 4 Step Plan

First	Second
Pupil 1 Build the use the microscope to find out the d.n.a. we can use the camera to scan the bones.	Pupil 2 Sort the bones out small med. Large. If we put the together. T. Rex to see how big the T. Rex is. If we put the bones to gether nanna with feel better.
Third	Finally
Child C. we need to sort the hands and feet. we can help them to build it back up. we can use camera to take pictures. If we put the bones to gether nan na with Ruby + Ricki.	

Appendix 11

Observations of pupils against the learning objective and success criteria completed by the author of this research paper.

Feedback from Learning Support Assistant: _____

Activity: Green group 3 step problem solving plan Date: 8/3/16

Pupils and group	Achieved Learning objective by achieving success criteria (Please tick S= Self-Assessment - Fans, A = Adult)						Comments
	Red		Amber		Green		
	S	A	S	A	S	A	
			✓				_____ was engaged with the task. She made a contribution to the group and at times was a little over enthusiastic and had to be moved as she was annoying another pupil.
			✓				Used good thinking skills to solve the problem. She identified that there weren't enough bones. She participated when asked but needed encouragement.
	✓						Needed prompting to take part he participated well when he did, provided ideas and suggestions.
Child B			✓				Took charge of the puppet, he contributed to the discussion with the puppet and answered questions on behalf of the puppet. This was particularly engaging. → Need to put this in research project.

What went well?

Discussion with regards to the Dinosaur bones identified that they were all different.

How could the activity have been improved?

More turn taking.

I needed to be a little stricter with my behaviour management.

Verbally decided on a 3 Step plan but would have been better recording it with the iPad.

Appendix 12

Observations of pupils against the learning objective and success criteria completed by the HLTA.

Feedback from Learning Support Assistant: [REDACTED]

Activity: Blue group 3 step problem solving plan Date: 8/3/16

Pupils and group	Achieved Learning objective by achieving success criteria (Please tick S= Self-Assessment - Fans, A = Adult)						Comments
	Red		Amber		Green		
	S	A	S	A	S	A	
[REDACTED]			✓	✓			The group didn't understand the 3 stage problem solving. I broke down to brief instruction / explanation which with little steps could follow.
[REDACTED]			✓	✓			A big positive was their eagerness to please the puppet and reconstruct the dinosaur. The group were able to turn take and negotiate different places for the bones after a brief chat.
[REDACTED]			✓	✓			
[REDACTED]			✓	✓			

What went well?

- The use of a puppet focused the children
- The practical activity of building a dinosaur with the bones and realising they did not have enough bones to make a complete dinosaur.

How could the activity have been improved?

- Shorter steps
- Use i-pad for evidence take picture

Appendix 13

Copy of lesson observation showing Child A's creative suggestion.

Feedback from Learning Support Assistant: [redacted]

Activity: make dinosaur + label Date: 11.2.16

Pupils and group	Achieved Learning objective by achieving success criteria (Please tick S= Self-Assessment - Fans, A= Adult)						Comments
	Red		Amber		Green		
	S	A	S	A	S	A	
[redacted]					✓	✓	Group responded v. positively to 'Dig it up' Confidently rebuilt dinosaur shape, looked more closely at neck bone / leg bone and reassembled. Child A suggested use 5 min timer to 'make a challenge'. Group all able to write 1st / last sound for labels, Able to place in correct place on dinosaur I-pad used to record.
Child A			✓			✓	
[redacted]					✓	✓	
[redacted]				✓	✓		
[redacted]							
[redacted]							[redacted] again went to toilet during part of small group

What went well?

'Dig it up' song, dvd practical activity rebuild activity

How could the activity have been improved? 😊

'Timer Challenge'

For blue group: labels to match to body part [optional]

* Creativity put into ITDM research assignment

Appendix 14

Leuven Scale of involvement**The Leuven Scale for Involvement**

level	Well being	Signals
1	Extremely low	Activity is simple, repetitive and passive. The child seems absent and displays no energy. They may stare into space or look around to see what others are doing.
2	Low	Frequently interrupted activity. The child will be engaged in the activity for some of the time they are observed, but there will be moments of non-activity when they will stare into space, or be distracted by what is going on around.
3	Moderate	Mainly continuous activity. The child is busy with the activity but at a fairly routine level and there are few signs of real involvement. They make some progress with what they are doing but don't show much energy and concentration and can be easily distracted.
4	High	Continuous activity with intense moments. The child's activity has intense moments and at all times they seem involved. They are not easily distracted.
5	Extremely high	The child shows continuous and intense activity revealing the greatest involvement. They are concentrated, creative, energetic and persistent throughout nearly all the observed period.

(Plymouth City Council, 2011)

Each pupil was observed by the same person for two minutes at the same point in each lesson. The above table was used to measure their involvement in the lesson then a score allocated.

The results are as follows:

Pupils	Lesson 1	Lesson 2	Lesson 3
1	5	5	5
Child C	5	5	5
2	5	4	5
3	4	5	5
Child B	5	4	5
4	5	5	5
5	4	4	4
6	5	5	5
7	4	5	4
8	3	4	5
9	4	4	5
Child A	5	5	5

Appendix 15

Email reply from Stuart Naylor one of the authors of the Puppets Project with regards to an email by the author of this research project.

Re: Puppets Research



Stuart Naylor <stuartnaylor@millgatehouse.co.uk>

Mon 4/4
1302049

  Reply all | 

Dear Teresa

Thanks for your email. It's always very encouraging to know that other people have found our work useful. I like the way you have taken the Too Many Teeth story from Spellbound Science, reworked it in a dinosaur context and used this for a science enquiry lesson. Presumably you have access to some of our writing on the use of puppets for your dissertation?

I don't deal with sales but one of my colleagues will contact you about getting hold of a puppet to use in your teaching. We always give student teachers a discount on all of our resources anyway, so I know we can do a discount on one or more puppets for you.

Best wishes for your dissertation
Stuart

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