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APPENDIX GA36d

LEVEL 7 ASSESSMENT SPECIFICATION

Student name:	Hannah Macgregor	Student ID number:	1801080
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Submission method:	All written assessments, where practical and possible, must be submitted via Turnitin unless otherwise instructed by the Lecturer. (Please DO NOT put this assessment specification into Turnitin or it will match many similarities with other students' submissions.) Alternative submission method (if applicable): Late submission of the assessment will result in a late penalty mark. Penalties for late submission: Up to one week late, maximum mark of 50%. Over one week late, 0%. Only the Extenuating Circumstances Panel may approve a change to submission dates.		
Academic honesty / referencing:	Academic honesty is required. In the main body of your submission you must give credit to authors on whose research and ideas your work is based. Append to your submission a reference list that indicates the books, articles, etc. that you have used, cited or quoted in order to complete this assessment.		

To examine if intervention by the discussion of model answers and provision of success criteria will help with the ability to answer scientific literacy based questions

Introduction

The aim of this investigation was to explore the impact of the provision of specific support and guidance to pupils in a secondary science lesson. This support existed in the form of success criteria and the discussion of model answers, and was implemented to discover if this method of intervention could aid pupils to achieve more highly when answering scientific literacy based long written examination questions (Quality of Extended Response (QER) questions). This area of educational research may also examine the role of a specialist science teacher in maximising pupils' success within this area of their scientific education. By exploring this area of research, valuable insight into the efficiency of scaffolding support, and how it may impact on pupils academic performance during QER questions should be gained. This process will also further develop my practice as a training professional educator within the secondary sector, and equip my knowledge of the challenges potentially experienced by pupils when faced with QER questions.

My first teaching placement was in a mixed comprehensive secondary school in Swansea (School X), which has approximately 482 pupils of which 28 % are eligible for free school meals (FSM), which is significantly higher than the national average of 17.7 %. The school is placed in the "yellow" support category (Welsh Government, 2016). During this placement, I taught a low ability year 10 class consisting of 18 pupils on the subject of the structure and function of the heart. I used this opportunity to implement the scaffolding techniques discussed below, and I observed the difference in the pupils' performance before and after these interventions. Scaffolding, associated with the work of Vygotsky and Bruner, is a technique used in teaching which has been used to achieve successful pupil learning in a classroom of all abilities (Vygotsky, 1978). By providing structured and tailored support, scaffolding has the ability to help an individual student access a higher level of thinking and achievement. The two forms of scaffolding used in this study were success criteria and discussion of a model answer. Providing success criteria gives a structure to help the pupil form their own written answer (Hattie, 2012), and the discussion of a model answer with the class allows the students to see a worked example and understand what is required of them in answering such a question (Black, et al., 2003; Wiliam, 2011).

The main focus of this research project is ‘to examine if intervention by the discussion of model answers and provision of success criteria will help with the ability to answer scientific literacy based questions.’ The reason this area of study was chosen is due to the current focus on the development of pupils’ literacy skills across the United Kingdom in all subjects within the curriculum (Welsh Government, 2016) In every subject area it is compulsory that pupils have opportunities to develop their literacy skills and for teachers to assess and monitor their pupils’ development in this area. Furthermore, Donaldson’s new curriculum addresses the importance of pupils’ literacy skills (Donaldson, 2015) and the new Welsh Joint Education Committee (WJEC) GCSE key stage 4 (KS4) syllabus stresses the importance for students to enhance and improve their literacy skills and scientific knowledge and their ability to combine and apply these aspects to competently answer QER questions in examinations (WJEC, 2016a).

Literature Review

The National Literacy and Numeracy Framework (LNF)

The compulsory National Literacy and Numeracy Framework (LNF) puts into practice the necessary skills for pupils to develop and advance across all subject areas (Welsh Government, 2014). The framework includes the expectation that all pupils aged between 5-14 years will become competent in their oracy, reading, writing and numerical reasoning skills. These vital skills are required of pupils when attempting PISA style questions. PISA tests 15 year old pupils on their ability to apply knowledge and skills to real life challenges of adulthood (Bradshaw, et al., 2010). Analysis of recent PISA reading and science tests, demonstrates that approximately one in five pupils in Wales failed to gain Level 2, which is considered to be the baseline of proficiency at which students begin to show the ability to actively contribute to their lives (Wheater, 2013). Furthermore, Wales had the poorest results in the UK (Hume, 2016) highlighting the need to intervene and improve literacy and numeracy in schools in Wales. A low ability in numeracy and reading is a major disadvantage for pupils as they become adults (Welsh Government, 2014). It has been suggested that literacy and numeracy skills could be improved by the provision of regular opportunity to develop and refine these skills by embedding them into schemes of work across the

school curriculum. In doing so, this could increase overall pupil performance and equip each pupil to achieve and become successful in adulthood (Welsh Government, 2014).

The need to enhance literacy and numeracy skills in schools is also emphasized by Donaldson (2015). Donaldson has suggested that competency of higher order literacy and numeracy skills would enhance pupils learning experience and achievement in all subject areas in schools, and not solely within core subjects. The efficacy of a whole school approach in implementing the LNF within schools is supported across a variety of educational literature (Tanner, et al., 2002;).

Literacy skills within Science

Scientific specific literacy skills can be considered a vital component of a modern scientific education (Wellington & Osborne, 2001). This includes the ability to source information from scientific sources, as well as writing in a scientific style. Across the scientific literature, it is evident that most research papers will require competent literacy skills to access the relevant information. Readers of these papers must have the ability to effectively locate, select, and evaluate key information from large and often complex pieces of text, in order to synthesize a conclusion. Studies of secondary school pupils conducted by Brill et al (2004) and Heinström (2006) have suggested that pupils' reading of scientific information is conducted “superficially” in that students aim to seek a correct answer for convenience. This has the potential to disadvantage pupils when attempting scientific PISA style questions which examine pupils' ability to identify key information within a piece of text and use this to draw a conclusion. Potential explanations of this lack of literacy skills include: teachers having the perception that pupils simply develop and learn literacy skills throughout their schooling without specific instruction; or teachers may not possess sufficient literacy skills themselves to encourage and enhance these skills in their pupils (Brill, et al., 2004). Furthermore, some teachers may not take information seeking and literacy skills seriously enough, as they are not extensively tested during examinations (Heinström, 2008). However, the explanations drawn from these studies may be flawed in that they did not consider actual classroom practices or mindsets of teachers; they therefore may contain an element of bias.

At GCSE level, the literacy skills of pupils are measured during science WJEC examinations by quality of extended response (QER) questions (WJEC, 2017). These QER questions demand an accurate response to a scientific question using appropriate spelling, punctuation and grammar, presented in a quality written answer. As such, pupils require sufficient literacy skills to complete these questions to a high standard. Furthermore, these QER questions have a significant number of marks awarded to them (WJEC, 2017), highlighting the relevance of this study. In addition, literacy skills developed within science are transferable skills which will be of value to students across all their school subject areas.

The importance of improving pupils' literacy skills at all stages in education has also been highlighted by the Welsh Government. The Welsh Government have suggested that the enjoyment and achievement of pupils in all subject areas, is positively correlated with how pupils feel about their own ability to apply literacy skills. A focus on improving literacy skills in schools could therefore be expected to bring a beneficial effect to the overall wellbeing of pupils (Welsh Government, 2010).

The role of the teacher in facilitating learning – The Behaviourist theory

The main teaching method used to enable pupils to successfully answer a QER long answer question will make use of the pedagogical theory of Behaviourism, which is associated with the work of Watson, Skinner and Pavlov (Wellington, 2007). This theory refers to a teacher guided approach where the teacher provides the necessary knowledge and understanding to the pupils through a series of small, organised learning portions and the provision of consistent feedback (Pritchard, 2008). This approach will allow students to gain the necessary foundation of scientific knowledge, and to demonstrate the correct literacy skills required to attempt QER questions during examination. Teacher led interventions such as the provision of success criteria and the discussion of model answers, may complement the behaviourist theory of teaching. In this research project, the theory of behaviourism was evident in the implementation of these scaffolding techniques, and also in the post test data collection.

The positive use of behaviourism as a method to enhance learning and academic achievement has been widely recognized (McLoughlin & Oliver, 1998; Pritchard, 2008). For example, Hodgen and

William (2006) have suggested that once students have been taught how to achieve something and understand the logical steps needed to achieve it, they are better equipped and able to carry out these steps later in a different context. However, the effectiveness of the teacher is very important in achieving this goal, and could be a limiting factor (Hanushek & Rivkin, 2010b).

The pupil's role in their own learning – The Constructivist theory

Once the behaviourist theory has been implemented and the pupils have gained sufficient subject knowledge through the direction and guidance of a teacher, the natural progression of teaching would be to introduce a more constructivist teaching approach. This is because constructivism, a pedagogical teaching approach to learning associated with Piaget, Vygotsky and Bruner (Westwood, 2004) allows the pupils to build upon their prior subject knowledge to develop and construct their own understanding of the newly taught topic, with limited teacher instruction and guidance (Kirschner, et al., 2006).

It is natural for both constructivism and behaviorism to be integrated within a teacher's practice to develop and enhance pupil learning. Furthermore, it has been suggested that pupils' learning experience is enhanced when there is limited input and guidance from the teaching practitioner, and that a teacher-centric and quiet classroom may not necessarily imply that learning has taken place (Kirschner, et al., 2006). This argument is contrary to traditional attitudes towards behaviourism as the main method of successful teaching and learning. For this research project, the use of constructivism as an approach to learning was expressed during the pre-test data collection. The pre and post tests will be discussed further below.

Scaffolding

First introduced by Wood, Bruner and Ross in 1976, scaffolding in essence is the provision of assistance for students to overcome any difficulties beyond their current capacity during their learning experience. This includes setting suitable aims, nurturing specific required skills, and promoting effective self-reflection where the provided 'scaffold' will help pupils come to their own conclusion. Scaffolding encompasses the idea of the 'zone of proximal development' (ZPD)

(Vygotsky, 1978). This describes the 'zone' between what a pupil may achieve by themselves without prompting, and that which may be achieved with the use of a 'scaffold' or support (Lin, et al., 2012). As pupils begin to progress towards the desired goal, the specific scaffold should start fading, thus promoting the pupil's responsibility in the ability to achieve. Within a science context, the use of appropriate scaffolding is not disputed, however more research may benefit teaching practitioners in designing effective scaffolds to suit the specific needs of each individual in a classroom, perhaps through the use of computer technology which manages the personal learning progression of each learner (Pea, 2004).

There are various features of scaffolding which could be implemented during learning in order to adequately support pupils during the completion of an activity within secondary education (Van de Pol, et al., 2010). One such feature involves the reduction of the complexity of a task by breaking up the task into small, "bite sized" steps which are individually more achievable for struggling pupils (Pritchard, 2008). The pupil will then feel positively equipped to complete the required task through following these smaller steps. Another feature of scaffolding includes the early correction of any mistakes and misconceptions of pupils, and the effective use of praise to reinforce correct understanding of students. The pupil's awareness and sense of direction could be further enhanced through the discussion of a model answer. In this way, as the correct answer is modelled and discussed, the student will be informed about how to answer the question and should be able to emulate this (Meggitt, 2006). The use of scaffolding therefore has the potential to make students more competent in using specific skills and knowledge to complete a task. As discussed in the literature review, the positive impact of scaffolding as a tool to assist students is widely recognised in the relevant literature.

It was important that the type of scaffolding implemented during this investigation could lead to an observable impact in the post test results (Westwood, 2004; Sticher, 2010). The scaffolding used existed in the form of a success criteria which was broken down in suitable categories and explained to the students. The ultimate hypothesis in using success criteria as the scaffold was that the post test results would show a positive impact on the attainment levels of the pupils. Specifically, the pupils should be able to gain a better knowledge of the steps needed to achieve a

higher mark when answering the QER question (Meggitt, 2006). The provision of a success criteria was also linked to the discussion and explanation of the model answer.

Success criteria

Alongside the model answer discussion, a further type of scaffolding used was the provision of success criteria. Success criteria in its simplest form, is a list of features or targets which are required to be met by the pupil in order to complete a piece of work to a high standard (Hattie, 2012). It is a useful tool in assessment for learning, in that it may be used in quickly assessing how successful a student has been in meeting the requirements when completing an activity (Heritage, 2007; Bresciani, et al., 2010). Success criteria is a form of feedback which may be discussed with a class to make them more aware of what is expected of them during the lesson to highly achieve; it may also cause students to become more motivated to complete a task to a good standard (Hattie, 2012). A study conducted by Wiliam (2011) suggests that the success criteria should not be created with the class but instead, should be created and driven by the teacher so that it guides the pupils in a particular direction. In contrast, Hattie (2012) has suggested that it is more beneficial to involve the pupils in the creation of the success criteria in order to increase pupil engagement and enjoyment of learning. In addition, by discussing success criteria about how to answer a question, pupils could be equipped to answer a different question in a similar context (Wiliam, 2011). This investigation proposes to test the suggestions outlined by Wiliam and Hattie about the way that providing success criteria affects pupils' literacy skills and overall ability in attempting a QER question. In order to test these conclusions, in the intervention stage of this investigation, pupils were provided with set criteria on which they would be tested. Discussion and explanation about the criteria were provided to pupils.

Discussing model answers

Feedback to pupils is fundamental for effective learning within the classroom. The majority of pupils would agree that feedback from a teacher helps to further their understanding of a topic. Of the different types of feedback, the discussion or modelling of an answer is suggested to be a fast and effective method of providing feedback to pupils. A study conducted on 155 biology students

at university showed that although pupils seemed to prefer personal comments over modelled answers, pupils performed better on model answer questions during examinations, after the lecturer has discussed and modelled the answers with them (Huxham, 2007). However, the experimental design of this study would be improved if the markers were blinded to the method of feedback.

In reference to the available literature, I decided to use scaffolding in the form of success criteria and the discussion of modelled answers as it has been suggested that these approaches are most likely to help inform and equip the students, specifically in attempting a long answer scientific question. I mostly reflected a behaviourist approach in this investigation, and a positive result would consolidate the evidence that this can lay a strong foundation of learning for students in secondary school level science lessons.

School Policy and Practice

One of the main priorities of school X is to improve the standards of literacy and numeracy within each subject across the curriculum with the primary aim of improving pupils' overall learning experiences and attainment levels during examinations. Donaldson underlines the importance of this aim in stating that literacy and numeracy competency is fundamental for education and is required for pupils to gain access to the whole curriculum (Donaldson, 2015). The LNF has been listed as a priority for improvement in both the school improvement plan (SIP) and the science departmental improvement plan (DIP). In order to improve the standards of the LNF, both plans outline certain actions and strategies needed, and state success criteria. According to the most recent Estyn report, school X has invested a sufficient amount of time and attention to develop the literacy and numeracy skills at key stage 3 through the introduction of additional English and mathematics lessons; numerical reasoning lesson for year 7s; and a literacy reinforcement lesson for year 8's (Estyn, 2013). School X also works with partner primary schools to help with the development of literacy provision to pupils. Furthermore, school X has also explicitly incorporated the skills within the LNF in all lessons, and all pupils are made aware of the purpose of developing their literacy and numeracy skills and how these skills can be used in all subject areas.

The school has strategies in place to develop the standard of literacy skills of pupils to adequately prepare them for GCSE examinations. The ongoing improvement of pupils' literacy skills should equip pupils with the necessary vocabulary and writing style to effectively communicate their ideas in the exams. To achieve this, school X makes use of long answer past paper questions to provide similar challenge as a QER question within an examination. In doing this, the teacher shows and discusses a model answer and describes the different literacy skills evident in the answer. For example, pupils are taught the correct layout of a quality answer, the specific language including key scientific words, and the importance of correct spelling, punctuation and grammar. Further opportunity to practice these skills in answering QER questions will be provided as part of the scheme of work; this helps each pupil become confident in the correct application of literacy skills in science exams. The numeracy and literacy skills of all pupils in school X are monitored to ensure that these skills are continuously being improved throughout each pupil's time in the school.

Scaffolding forms an important part of school X's action plan to ensure that all pupils are able to access the curriculum across all subject areas. Most teachers in the school reflected a similar use of scaffolding used for this research project, in breaking down the question into bite sized portions in order for the pupils to more easily identify the necessary elements for a model answer. I also observed teachers explicitly highlight the different elements of the LNF in supporting the pupils' development.

Methodology and Ethics

The ethics of this research investigation considered carefully. Before the research took place, all pupils in the class were informed in detail about what the study involved, and any questions raised by the pupils were dealt with. The verbal consent of all pupils was requested and obtained individually. Pupils were also able to communicate the details of this study with parents or guardians beforehand, and were able to drop out from the study at any point. In keeping with the requirements of the Data Protection Act 1998, the involvement of every pupil was on a confidential and anonymous basis. Pupils were referred to numerically to meet these requirements and avoid bias in the collection or analysis of results. The investigation was carried out in keeping with the guidelines of the British Educational Research Association (BERA, 2018).

For this research investigation, testing both before and after in the intervention (pre-test and post-test) was used to produce the required data to answer the research question (Cohen, et al., 2013). The research involved a total of 18 pupils who were initially asked to answer a QER question (the pre-test). These same pupils then attempted the same QER question following the implementation of the intervention (post-test) the next working day. The intervention consisted of the provision of success criteria, and the discussion of a model answer.

Before this research was undertaken the pupils were taught a specific scientific topic (the structure and function of the human heart) during lessons, which was part of the current scheme of work. This is because the pupils needed the necessary foundation knowledge of the topic beforehand in order to sufficiently complete the QER question. Teaching the scientific context first to pupils is supported by the theory of behaviourism, which has already been discussed in this paper. Importantly, the pupils attempted the pre-test with no scaffolding support in place and specifically with no sight of the success criteria or model answer.

Following the lesson on the structure and function of the heart, pupils were instructed to produce their own success criteria of what a model answer may contain. This, without the support or guidance from a teaching practitioner, allowed the pupils to demonstrate their own interpretation of what should be included in an answer to achieve full marks. Using this success criteria, the pupils were then asked to complete a long answer scientific QER question in relation to the knowledge of a topic they had gained from the previous lesson. Once completed, the answers to the QER question were collected and marked in accordance with the success criteria for the particular question which was sourced from the WJEC question bank website (appendix 1). The data received from the marked answers was collated and presented on an excel spreadsheet document and acted as the pre-test (control) data.

Thirdly, within the subsequent lesson, the process in which pupils were asked to complete the same QER question was repeated, except during this occasion the pupils were subjected to scaffolding as previously discussed. This was conducted in a section of the lesson containing a discussion of success criteria, and a model answer to the QER question (appendix 1) (Meggitt, 2006; Wiliam,

2011). A PowerPoint presentation was used as a visual aid to this section of the lesson to aid the pupils' comprehension. Key features needed to be included were highlighted, as was the importance of addressing specific command words within the question such as 'describe' and 'explain'. Pupils were also taught of the importance of individual success criteria and how their answers should be constructed to meet each success criterion in a coherent and logical manner, thus demonstrating quality higher order literacy and communication skills. After this intervention the pupils were instructed to complete the same QER question for a second time, the answers of each pupil were then marked and recorded as the post-test data in the same format as the control data.

After collection, the pre and post intervention data was analysed, allowing a conclusion to be drawn concerning the impact the intervention had on the achievement of the pupils when completing QER long answer scientific questions.

Evaluation

Sequence of lessons

The lessons prior to the research being undertaken focused on teaching pupils the relevant scientific content. This entailed providing pupils with information regarding the circulatory system, with a specific focus on the structure and function of the human heart. This topic was covered over two lessons. This process reflected a behaviourist approach to learning as discussed above (Kirschner, et al., 2006). Following this a constructivist and socio-constructivist learning approach was included in that the pupils were able to continue to learn and demonstrate their acquired knowledge through the completion of set tasks (Vygotsky, 1978).

Once the pupils showed sufficient knowledge of the structure and function of the heart, the consecutive lesson was dedicated to the research investigation. In this lesson, the research process and purpose was described to the pupils and the pupils were given the option to opt out of the investigation or provide their consent. The pupils were then asked to attempt the QER question without support and guidance from the teacher (pre-test), displaying a constructivist view of learning (Palmer, 2005; Aydisheh & Gharibi, 2015). This involved the pupils to apply their prior

obtained content knowledge, the key information provided, and their own interpretation of a success criteria which was required to be achieved to answer the question to the best of their abilities.

In the next lesson, scaffolding in the form of a discussion of appropriate success criteria and model answers occurred was guided and influenced by the teacher, reflecting the learning approaches of behaviourism and socio-constructivism. After this, the pupils were then asked to attempt the same QER question with this support available (the post-test). Behaviourism was evident as the teacher guided and led the discussion of a model answer and the ways to meet the success criteria to a level of which the pupils understood in order for the pupils to reflect their understanding in the future. In addition, as the pupils self-directed and engaged in a discussion of the efficacy of the success criteria, a socio-constructivist approach to learning was evident. Behaviourism, constructivism and socio-constructivism were therefore seen working together at different stages in the project (Martin, 2012).

Resources and Tasks

The scientific QER question which pupils were tasked with during this investigation was at the level expected during science/biology GCSE examination. The question required the pupils to apply knowledge regarding the structure and function of the heart in order to describe the route of blood through the heart whilst also demonstrating sufficient literacy skills to produce a well-structured and balanced answer. A report produced by the WJEC suggested that overall, pupils displayed poor literacy skills resulting in the inability to construct coherent answers during examination (WJEC, 2016). These question types are therefore important in assessing pupils' ability to apply both their scientific knowledge and literacy skills to produce a good answer. I believed that it would be relevant and interesting to investigate the impact of scaffolding and support on the improvement of pupils' ability to communicate their ideas effectively and produce a well written answer. Furthermore, another report showed that some foundation tier pupils struggled to apply enough information to access the marks in the QER question, whereas higher tier pupils appeared to achieve more highly (WJEC, 2016b). As the year 10 class were a low ability set, it seemed appropriate to involve this pupil group in the investigation. This also shows the

significance of finding methods which aid in improving and encouraging the literacy skills and exam technique of pupils in order for pupils to achieve.

The main form of scaffolding and resource used during this investigation was a PowerPoint presentation slide which was shown at the front of the class, displaying the appropriate success criteria required to be met in order for pupils to achieve highly (appendix 1). The presentation also included key information related to the structure and function of the heart which acted to promote the discussion of a model answer. I decided to use this visual support to show the pupils how to incorporate their acquired scientific knowledge and literacy skills to construct a well written and structured response which met the requirements of the QER question and success criteria.

For pupils to obtain full marks, good literacy and communication skills, as well as appropriate scientific knowledge needed to demonstrated (WJEC, 2016b).

Evaluation of results

Recorded and analysed using Microsoft Excel spreadsheet, the results of this investigation are shown below.

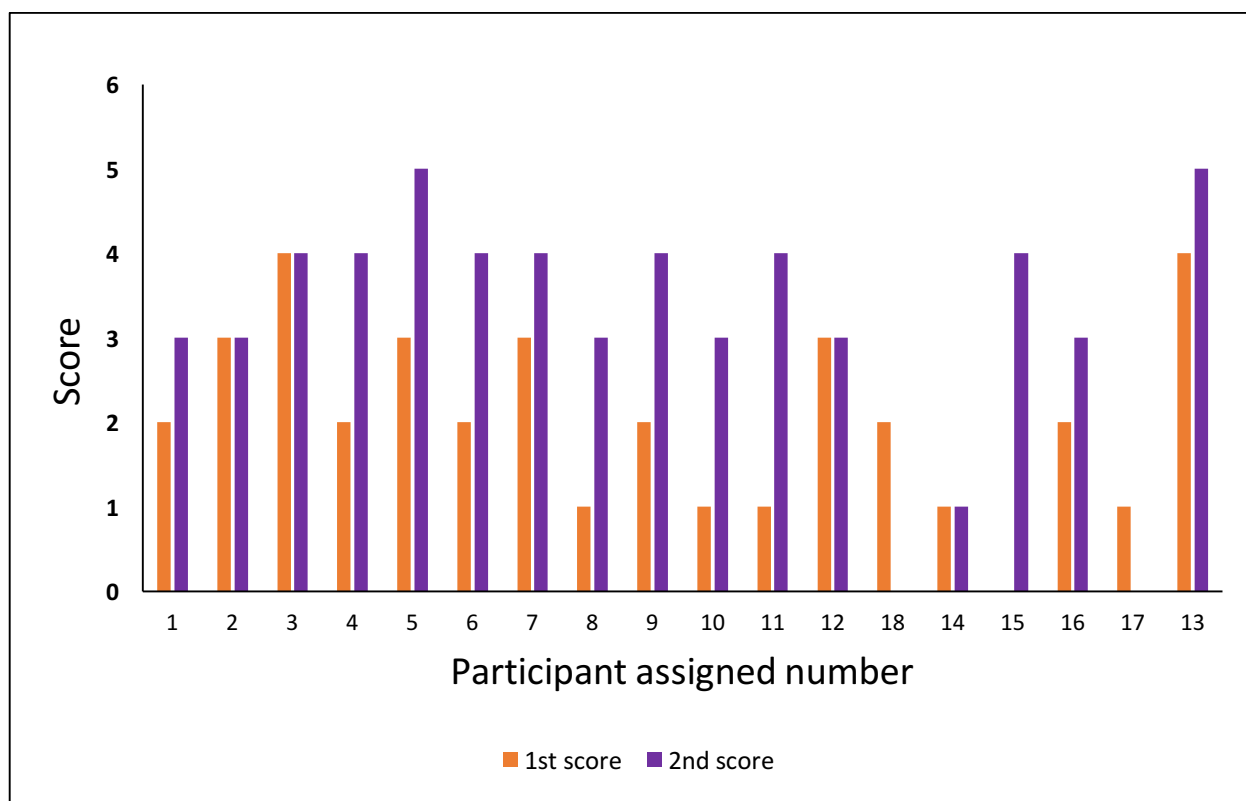


Figure 1. A graph to show the attainment score of pupils in a QER question before (orange) and after (purple) the intervention.

The results of this investigation are as follows: The average (mean) score achieved in the pre-test was 2.1 marks out of a possible 6 (35 %), while this rose to 3.2 marks (53 %) in the post-test. 12 out of the 18 participants (66.6 %) showed an improvement of the obtained score during the second attempt; 4 out of 18 (22.2 %) of participants obtained an equal second attempt score as the first; and 2 out of 18 (11.1 %) participants achieved a lower score in the second attempt compared to the first attempt.

From the results shown in Figure 1, it is clear that the majority of pupils benefited from the provision of scaffolding and support as a means to improve attainment scores in that 66.6 % of participants obtained increased marks during the second attempt when compared to the first attempt. This finding therefore suggests that overall, this intervention had a positive impact on the participants' attainment scores for the QER question. However, this conclusion may be inaccurate as due to the time restriction, pupils were tested using the same QER question for the second time,

rather than giving them the opportunity to apply their skills to a different QER question related to a different topic. On the other hand, as 22.2 % of the participants in this investigation acquired the same score in both attempts at the QER question. The intervention appears to have had little impact on the performance of this minority. Furthermore, a percentage score of 11.1 % participants obtained a lower score post intervention, showing that the intervention may have had a negative impact on their scores and therefore, the participants' ability to access and apply higher levels of literacy in comparison to that during the first attempt to address the QER question. The data obtained from these results therefore, supports the value and purpose of the provision of scaffolding support as an intervention method in the completion of scientific QER questions (Westwood, 2004).

In regards to the post test results, it is evident that the provision of scaffolding failed to positively impact 33.3 % of participants in this study. When marking pre and post intervention QER answers, it was apparent that some participants struggled to retain the actual scientific content related to the topic and therefore, appeared unable to communicate the necessary facts, and were some way off communicating their ideas in a literate, coherent fashion. Although this could be explained in that the studied cohort were a low ability class, and the relevant scientific information was taught to the pupils over a period of two lessons prior, perhaps not enough time was allocated to teaching the necessary information. In general, while pupils seemed to understand some aspects of the topic, often the scientific knowledge was not communicated and expressed in clear sentences. Thus, some pupils failed to achieve high marks as their answers lacked sense and were not accessible for the reader. There are several possible reasons behind this finding.

A further possible explanation for the limited impact of the use of scaffolding for some pupils during this study includes that the scaffolding only existed for a short period of time, namely 30 minutes. According to the available literature, the effectiveness of scaffolding or support is largely dependent on the time frame over which it is implemented (Sharma & Hannafin, 2007). For example, the main purpose of a scaffold is to guide and support a pupil until the pupil becomes confident enough to complete the set task independently and therefore, without the aid of the scaffold (Sharma & Hannafin, 2007). However, this process of dependency to independency may take a significant amount of time. The lack of time allocated to applying the relevant scaffold in

this project was due to the limited time frame available to carry out the investigation within the scheme of work. The pupils therefore may not have benefited from the support provided by the scaffold, and the development of their literacy skills did not have sufficient time to positively impact their achievement when answering the QER question.

Furthermore, it is possible that the choice and application of scaffolding techniques were unsuitable for the pupils involved. Perhaps the scaffolding support failed to enable the pupils to make connections between their newly acquired knowledge and information stored in their long term memory - which is necessary for learning (Webb & Mastergeorge, 2003). This could act as a possible explanation for the 33.3 % of participants who did not benefit from the support provided. In addition to this, the pupils may have found it difficult to make connections between the scientific information and their literacy skills in order to produce a well written answer to the QER question. This highlights the importance of the continuous development of pupils' literacy skills throughout their secondary school experience within all subjects, and how to apply these skills to effectively communicate and complement their knowledge. This also highlights the need to ensure that any scaffolding used within a classroom is well considered and tailored to the individual needs of the pupils (Van de Pol, et al., 2010). However, the majority of pupils appeared to benefit from the chosen scaffolding, suggesting that to a certain extent, the support provided was differentiated and tailored to the individual requirements of these pupils (Westwood, 2001).

On the other hand, the participants recorded to have been negatively impacted by the scaffolding were pupils with a lack of motivation and effort (Palmer, 2005). Two of these pupils did not make an effort to attempt the QER question during the second test. A suggested reason for the lack of motivation includes that the chosen scaffolding method did not suit the individual needs of these pupils to learn effectively (Westwood, 2001). This may have skewed the results, and therefore the effectiveness of the scaffolding used may not have been truly reflected, as the majority of pupils achieved more after the scaffold was implemented.

Upon reflection on the chosen intervention method, a possible cause for the lack of well-written, scientifically accurate answers could be due to that the pupils were not supported enough in structuring sentences, which resulted in response answers lacking depth and understanding (Welsh

Government, 2014). In terms of the scaffolding provided, there was more emphasis placed on how pupils should structure and communicate an answer as a whole during the discussion of a model answer, as opposed to how to structure and convey each sentence individually to create a high standard whole response. If this study were to be repeated, a greater emphasis and more time would be spent on supporting pupils in constructing sentences in order to convey meaning (Welsh Government, 2014).

Limitations and future development

In order for my teaching practice to develop and progress, the limitations of this investigation should be addressed and reflected upon. The first limitation to be discussed refers to the fact that the scaffold used may not have been tailored or differentiated enough to match the ability and needs of the pupils (van de Pol, et al., 2015). Existing literature would suggest that the individual needs of each pupil in the classroom, regardless of attainment level or background, should be met through considered differentiation teaching methods. As the studied class was a low set year 10 class, perhaps the expectation for these pupils to complete a long answer QER question without support in the first instance, and to communicate their scientific knowledge with good literacy skills was an unrealistic demand. Therefore, the results obtained in this study may not have been firstly, a true reflection of the intervention method use and secondly, a real representation of the pupils' abilities.

In addition to this, another problem exists in that this investigation was only conducted on a low ability class in which many of the pupils did not exhibit effort or willingness to learn. If more time was allocated, this study could have been conducted on pupils of mixed and high attainment levels which may have resulted in a more accurate representation of the impact of the scaffold in raising pupils' attainment levels in a QER question through the development of literacy and communication skills. Furthermore, the lack of motivation and effort displayed by the pupils and that some pupils refused to complete the set tasks, may have skewed the results and gave the false appearance that the intervention method negatively impacted the attainment levels of these pupils. If repeated, a true representation of the scaffolding technique may be achieved by including pupils of all educational abilities. In future, I will aim to dedicate more time to prepare an adequately

differentiated scaffold and I will ensure that more time will be invested in the provision of the scaffold for each individual pupil to become increasingly more independent and confident in the completion of set tasks (Sharma & Hannafin, 2007).

Another limitation of this study includes the low number of participants involved. Having a low number of participants during a study can result in failure to produce a statistically significant finding (Button, et al., 2013). Due to this limitation, a thorough reflection of the success of this intervention method may not have been achieved. A higher number of participants would have led to a more comprehensive representation of the impact of the use of scaffolding on the students' ability to complete the QER question. The impact of this limitation may have been reduced if more time was available to conduct this investigation. (Sharma & Hannafin, 2007).

During the investigation, the pupils were instructed to complete the same QER question before and after the intervention was introduced. A limitation to this is that this method did not provide the pupils with the opportunity to display their developing literacy skills within a different context by completion of a different QER question (Hodgen & Wiliam, 2006). By testing the pupils to answer a different QER question of a different scientific topic, perhaps the true impact of the intervention method could have been reflected more effectively. This application of literacy skills would have provided a more thorough representation of the intervention and whether it had more of a positive impact on the pupils' ability to apply literacy skills appropriately.

Furthermore, another limitation exists in the form of potential bias during the marking of the completed QER questions. For example, human error and bias may have occurred due to the interpretation of the marking scheme used (Oppenheim, 2000). This interpretation may have influenced the basis of awarding marks to pupils' responses and therefore, affected the data acquired during this investigation. It could be argued that the use of the mark scheme which is used across the United Kingdom by examiners and teachers to mark answers to this particular QER question could serve in reducing the level of bias in this study. To improve this, perhaps the use of a second marker could be used to reduce the level of bias.

Conclusion

In conclusion, I chose to examine the role of scaffolding support as I felt this would be an area which would be useful for me to gain experience in and understand the evidence for, at the start of my teaching career. The effective use of scaffolding can enable a teacher to help every pupil in the class gain access to each lesson and develop their knowledge and ability; it prevents leaving any individual behind. The area of literacy skills within science was focused on as literacy skills are an area of current interest (of Donaldson, for example) and undoubtedly are a cornerstone of secondary education (Welsh Government, 2014). My subject of biology is particularly suited within the sciences, for the expression and development of literacy skills. The Quality of Extended Response question at GCSE level tests both the scientific understanding and the application of writing skills in the exam candidate and this proved a convenient way of testing the effect of scaffolding on both of these domains.

Although there were some limitations which have been discussed at length, this was a simple and well-designed study which demonstrated the positive effect of the chosen scaffolding techniques in the majority of participating pupils. The use of success criteria provides pupils with a clear and methodical route to success, while the display and discussion of a model answer encourages aspiration to excellence (Wiliam, 2011). In tailoring these resources and the ensuing discussion to the individual needs of each pupil, an individualised approach to teaching can be achieved. The positive result of this study has encouraged me to continue to provide tailored support to my pupils, and to seek to further develop my skill as a teacher in training.

The study results showed that in a significant minority of the involved pupils, the scaffolding intervention made either no discernible difference to their score in the QER question, or indeed had an apparently detrimental effect (figure 1). The reasons for this have been examined in some detail, and include that the scaffolding support may have been poorly chosen or inexpertly applied; and that the pupils lacked sufficient motivation to engage in the intervention and post-test part of the investigation. This highlights the importance of making efforts to engage pupils with the curriculum at every possible point, and to endeavour to use scaffolding resources and techniques which are relevant and tailored to the specific classes and pupils for whom they are being used.

Upon reflection of the results and the limitations of this investigation, during my teaching career I will ensure that all lesson content and scaffolding methods are appropriately differentiated for all pupils, such that whatever their ability, all my pupils may be able to gain access to the curriculum and to progress in their learning experience. I will also endeavour to provide sufficient time dedicated to providing support for pupils in structuring sentences to observe improved writing skills and therefore to enable pupils to effectively communicate their scientific ideas. I will also give pupils the opportunity to apply and develop the literacy skills that they may have enhanced during the implementation of scaffolding in different contexts. In addition, I will ensure that scaffolding interventions are given to pupils with sufficient time for pupils to enhance their different skill sets (Sharma & Hannafin, 2007). Lastly, I will aim to encourage and motivate pupils to develop their literacy skills within science alongside their scientific content knowledge, in order to equip them to independently communicate their ideas in a confident and capable manner. Informed, confident and literate students will be best placed to fulfil their ambitions, and make a success of their lives.

Appendix 1.

This appendix contains the WJEC marking scheme for the QER used during this investigation. The success criteria and model answer were drawn from this source.

Question	Marking details	Marks Available
9/4	Indicative content The muscle of the right ventricle contracts and pumps blood through the valves of the pulmonary artery into the lungs. Blood then leaves the lungs, passing into the pulmonary vein, re-entering the heart in the left atrium. 5-6 marks The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. 3-4 marks The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. 1-2 marks The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. 0 marks The candidate does not make any attempt or give a relevant answer worthy of credit	6
Question 9/4 Total		[6]

Success Criteria

1. All relevant information must be included.
2. No irrelevant information.
3. Use scientific language (use the key words given).
4. Key spellings (ventricle, atrium, pulmonary).
5. Logical flow to the answer.
6. Accurate spelling, punctuation and grammar.

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