

LEVEL 7 ASSESSMENT SPECIFICATION

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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.		

Introduction

The aim of this piece of classroom research was to identify if a technique to break down complex questions requiring scientific literacy, such as those found in PISA tests, improves pupils ability to answer them, therefore improving the results attained. PISA is the Organisation for Economic Co-operation and Development's (OECD) Programme for International Student Assessment. This research was taken out in a top set year 8 class (hence fore known as class Y) in school X. School X is a mixed gender secondary, English medium school with pupils aged 11-16 located in the local education authority (LEA) of Swansea. When the school was last inspected the school was awarded "Excellent" in all inspection areas (ESTYN 2017) Class Y consists of 15 boys and 15 girls with no pupils with identified additional learning needs (ALN) or pupils with English as an additional language (EAL). No pupils in the class are eligible for free school meals.

This research question was selected as improving pupils ability to perform in PISA tests has become a focus due to countries placing an increased importance on PISA results, as well as the scientific literacy required to successfully answer these questions also being a key part of the GCSE Science curriculum, in particular the quality of extended response (QER/QWC) questions found in all GCSE Science papers. Despite this importance placed, pupils in wales have struggled in previous PISA tests (Bybee 2009), and, as, such identifying methods to improve pupils' performance in these types of questions would greatly improve Wales's performance in PISA tests, as well as set pupils up for success in their GCSEs.

When pupils' science skills have been assessed by PISA the scores have been lower than the other UK countries' (OCED 2010). OCED (2010) suggested that science is often still taught superficially and learners lack the understanding required to successfully apply scientific ideas. Also identified was that traditional classroom practice doesn't allow pupils to develop strong evaluative and reflective elements required by PISA questions (OCED 2010).

Literature review

Although the Welsh Government have expressed a commitment to raising standards in education, a major focus so far in schools has been on the implementations of the frameworks for Literacy and Numeracy (2013) and digital competency (2016), with a lacking in addressing the variety of skills required for pupils to succeed in science (Bybee et al 2009).

Scientific literacy has become the term used to express the broad and encompassing purposes of science education (Bybee 2008), with Bybee (2008) emphasising the importance of incorporating science related social issues and scientific literacy into assessments and school programs in order to increase levels of scientific literacy. Scientific literacy has had a number of definitions, from numerous perspectives (Norris & Phillips 2003, Driver et al 2000). Bybee and McCrae (2011) refer to four interrelated features that involve an individual's scientific knowledge and ability to identify questions to acquire further knowledge, their understanding of the features of science as a form of human knowledge, their awareness of how science and technology shape environments, as well as their willingness to engage in science related issues. Wallace (2004) defines scientific literacy as being comprised of the abilities of pupils

to think meta-cognitively, to read and write scientific texts as well as apply these elements to a scientific argument. With Kuhn (1993) stressing that an understanding of argumentation is a foundation for everyday problem solving, Butler & Winne (1995) suggests the importance of pupils monitoring their own learning and making necessary modifications is essential for scientific literacy.

The Organisation for Economic Co-operation and Development, through their Programme for International Student Assessment (PISA) make use of the “Gräber” model of scientific literacy as a combination of what people know, what people value, and what people can do to frame their question categories in science as “Scientific concepts, scientific processes and scientific situations (Holbrock & Rannikmae 2009).

There has also been a general agreement within the scientific community that the nature of science should be a key element of scientific literacy (Garcia-Carmona & Accuedi-Diaz 2018). This has been potentially contradicted as, historically, the objective for pupils has been to be familiar with skills of scientific practice, however there has been little evidence for a need of the Meta knowledge of scientific practice including the nature of science (Garcia-Carmona & Accuedi-Diaz 2018).

The importance of science to a pupils overall education is being pursued, with many countries revising their science curriculum so it is relevant for all pupils, not just those who may choose to pursue science as a career (Fensham 2004). Despite this, however, Shamos (1995) identifies that the prospect of common science literacy is difficult, and proposed that an effective approach is to teach with a cultural imperative, with a focus on central theme of practical imperatives, rather than content, and a need for the proper use of scientific experts for developing a curriculum for scientific literacy. Roth et al (2004) argue the importance of including scientific literacy in education reform due to the science found in everyday life being different from that found in labs, with previous reforms failing to produce scientifically literate citizens (Shamos 1995).

Reform of science education involving a focus on monitoring and accountability has become a key part of the globalization of science education (DeBoer 2011). This form of monitoring is increasingly being used to determine the effectiveness of a country’s education system (DeBoer 2011). Organisations such as OCED have the intention of enabling competition and aims to raise standards due to the perceived economic benefit of increased knowledge of science and technology (DeBoer 2011), however, results of the PISA tests (2015), as well as various studies into the performance of countries in these tests, has suggested that what is best for individual nations may not transferable to all. This is particularly difficult as the creation of an overall framework is problematic because it requires broad consensus when there are often competing interests from different stakeholders (DeBoer 2011).

PISA was launched in 1998, with the aim of measuring how well prepared 15 year olds are for life in the 21st century. Previously assessment within science has been concerned with how well what has been taught has been learned and can be recalled (Fensham 2009). However PISA took a different approach to assess ability to apply knowledge to different

situations (Bybee et al 2009). This was particularly evident in the 2006 PISA tests where science became a major domain, using real life situations as the starting point for the construction of the test. In the PISA tests, 3 competencies are assessed in science, identifying scientific issues, explaining phenomena scientifically and using scientific evidence, with questions identified as assessing one of these three competencies (OCED 2010).

The importance of PISA tests has proliferated since their inception, with PISA results being presented as evidence of countries' knowledge and skills (Gorur 2011). Despite these tests being used internationally to construct education systems, concerns have been raised of the certainty of claims of large scale tests when a sociocultural understanding is adopted (Wertsch 1991). The effectiveness of these tests is also questioned by Sjøberg (2007), as little is known about how pupils approach this type of test, with pupils often misunderstanding the questions presented (Harlow & Jones 2004).

A key part of the approach PISA takes to approaching assessment has been to attempt to make the questions relevant to a wide variety of pupils (Serder & Jakobsson 2015), however, a study to investigate how pupils approach these questions has suggested that inserting issues with "relevance" into questions does not automatically make them more interesting and that pupils will often position themselves as unwilling to engage, making them too uninterested to achieve (Serder & Jakobsson 2015).

The advantages and disadvantages of using PISA as a measure of scientific literacy has been an important area of research into the improvement of the scientific literacy of pupils. Hanushek & Woessmann (2010) suggested that effective school policy raising cognitive skills is an important force in economic development and that since PISA tests concentrate on the impact of schools, the evidence suggests that improving PISA results can have strong economic effects on the countries. Breakspear (2012) attempted to examine the impact of PISA on education reform in examined countries', and demonstrated that PISA has become a reliable instrument for benchmarks of performance, with many countries now having set PISA based performance targets. Countries which achieve high PISA results have education policies which give a strong emphasis on teaching and learning (Sahlberg 2007), however much of the research into the effects of PISA has been on countries with relatively poor results. Wales in particular is one of these countries, with much of the discussion which prompted the curriculum reform suggestions by Prof Donaldson stemmed from poor PISA results (Donaldson 2015).

Poor performance in PISA tests has increased the discussion on scientific literacy and ways to improve teaching and learning in science (Duit & Treagust 2003). This has led to a focus on supporting schools and teachers to rethink the representation of science in the curriculum, as well as enlarging the repertoire of tasks, experiences as well as teaching and learning strategies available (Duit & Treagust 2003). A problem of having quality interventions is that it has been difficult to bridge the gap between research and practice within classrooms (Duit & Treagust 2003).

Several members of the research community lament the lack of influence that research into education has had on teaching and learning within schools (Yore et al 2010). An example of the positive effect of research-impacting policy is the influence the PISA results had on education reform in Germany (Neumann et al 2010). In contrast, a negative effect was shown in Denmark where PISA results were the prompt for education reform which ultimately did not lead to improvement. Dolin & Krogh (2010) suggests this was because the assessment framework and assumptions PISA takes did not align with the fundamental goals and attitudes of Danish education.

The use of large scale achievement tests in order to assess the quality of a countries education system has also been challenged. Large parts of the literature has established that achievement tests, such as PISA do not adequately capture character skills that are valued in the labour market, as well as in school (Hanusheck & Woessmann 2012). The use of these tests has also been criticised by Carnoy et al (2015) suggesting that once the goal of education reform is reduced to the improvement of PISA results; the next logical step is to align curriculum and teaching with these assessments, potentially narrowing the curriculum and not giving pupils the wide range of experiences.

A demand for interventions which can improve the scientific literacy in school systems has been created due to competition for places on the PISA results table (Auld & Morris 2016). Despite many countries focussing their effort into improving their results in PISA tests, there is less of a consensus in how to improve pupils' ability to answer the type of questions that these tests pose. Successful interventions should take into account the wide variety of competencies that are required in scientific literacy.

Bybee & McCrae (2011) investigated the link between the attitude of pupils and scientific literacy, suggesting that positive attitudes generally correlate positively to performance. Several studies have suggested that those pupils who experience high levels of inquiry-based activities have increased levels of scientific literacy (Bell et al 2009, Furtek et al 2012, Minner et al 2010, Tamir et al 1998). With Rocord (2007) noting that pedagogical processes based on inquiry are effective, and Yip (2001) describing the approach as a strategy that fostered creativity and intellectual scepticism, and the active participation and interaction of pupils. This approach has been challenged by a study by McConney et al (2014) which suggested that science students who have access to low levels of inquiry orientated learning activities had above-average levels of scientific literacy but a below average interest in science. Cairns (2019) also suggested that inquiry based teaching activities are negatively linked to achievement but positively linked to interest in science.

Part of the challenge of this area of research has been the result of a debate as to what constitutes inquiry, and a suggestion that there is a wide range in quality of activities, producing a range of results, demonstrating not all inquiry is equally effective (Yip 2001). This has prompted Goldacre (2013), suggesting teachers embed research into practice, be supported by advancing interest in an understanding of what constitutes enquiry, and then implement the most effective methods. In contrast however Wilson et al (2010) presented that pupils who use inquiry based activities produced significantly higher levels of achievement,

which suggests that the quality of the activities may be the key to producing positive improvements. An increased use of inquiry activities has also coincided with constructivist principals (McConney et al 2014). These constructivist principles centre on learners personal construction of knowledge and that science in schools should help students understand how scientific ideas are developed and appreciate the usefulness of the skills and processes of scientific enquiry (Tweats 2006). Prain & Hand (1996) presents a constructivist approach emphasising the role of pupils own language, however also argue that there is a debate of the kinds of tasks that enable secondary pupils to effectively learn science.

Research has suggested that there are critical periods in the formation of skills when investment and intervention is most valuable (Heckman & Kautz 2014), suggesting that to be successful in improving these skills, interventions should focus on these key times.

With the nature of science being a key part of many definitions of scientific literacy, research has indicated that pupils do not develop the nature of science through learning science or through science enquiry and that if pupils are to gain an understanding of the nature of science it should be explicitly taught (Abd-El-Khalick 2002). Focussing on the nature of science has also shown positive effects, with Khishfe (2012) showing that there are strong connections between ability to argue and counter-argue points in questions and knowledge on the nature of science. It was also suggested that the optimum context to teach pupils about the nature of science and argumentation might be in contexts pupils are familiar with and include activities that emphasise argumentation and the explicit nature of science (Walker & Zeidler 2007).

It has also been demonstrated that it is beneficial for pupils to explicitly teach skills such as writing research questions that are meaningful and testable, as well as teaching the process of making inferences that are linked to the research questions (Cairns 2019). Sandoval & Reiser (2004) also suggest a helpful intervention is facilitating collaboration and reflection in authentic context through active feedback.

Interventions to improve teaching and learning are a key part of action research within education, however measuring the success of an intervention can be difficult, particularly if the criteria for success are not adequately defined. Evaluating the evidence from research interventions is difficult due to there often being only short term follow up, which may not truly reflect the true effect of an intervention, for example if an intervention has a large effect but the improvements are short lived

A common solution for all is also a difficult prospect due to teachers differing on learning patterns as well as the quality of teachers learning and professional development making the implementation of reform difficult (Anastasiadou et al 2013). The ability of school science to prepare future scientists is also under question as studies have suggested that there is a strong negative correlation between interest in science and pupils achievement in Science tests (Wallace 2004).

De Landazábal et al (2010) suggests that a difficulty in assessing pupils scientific literacy can stem from teachers tending to assess only some competencies required and use questions of

only one competency level, and that to help develop pupils' scientific literacy, teachers should assess a variety of competencies of varying difficulties. Teachers could also benefit from reflecting on the nature of the required competencies and the strengths and limitations of assessment tasks (De Landazábal et al 2010).

The difficulty of large scale experimentation is that schools are accountable to a wide range of stakeholders, including parents and inspectors, which may prompt schools to be hesitant on enacting change which could have detrimental effects on performance and the wider effects this could have on the school (Donovan 2013). A further difficulty of implementing extensive interventions in science education is that they can be expensive and time consuming (Hong 2010)

A common feature of successful interventions is that they promote attachment and provide a secure base for exploration (Heckman & Kautz 2014), as well as have a clear definition of what question is being asked (Donovan 2013), and a distinct indicator of success and strategies for implementation and dissemination (Donovan 2013).

A key skill which is required to answer PISA style questions is that of inference, where pupils are required to reach conclusions beyond immediate data to finding patterns and using decision making to reason with texts in a variety of situations. Following this line of research, a successful intervention by Fang & Wei (2010) showed that even a modest amount of reading infusion had a positive effect on scientific literacy of pupils, compared to just teaching strategies to pupils. This suggests that a pupil's ability to reason with texts improves their ability to answer questions requiring scientific literacy skills (Fang & Wei 2010).

Penuel & Fishman (2011), in a review of intervention research, suggest that the type of intervention research which can be most useful is that which develop and gather evidence of the efficacy of interventions. Penuel & Fishmann (2011) also promotes the benefits of Design based implementation research, which is research which focusses on what is required to bring the benefits interventions to provide to all pupils, and establishes solutions to scaling and implementation compared to traditional intervention research which focusses on one level of educational systems. As such this approach has the aim of improving the implementation process.

Demirbag & Gunel (2014) showed that pupils who are taught argument based science tasks achieved better results in achievement tests as well as higher performance in writing and argumentation, whereas previous research has strived to identify deficits in pupils' skills, further research has the ability to design scaffolding to improve these skills (Fischer et al 2014). Previous research into pupil's skills has suggested that pupils have problems generating high quality responses (Kelly & Takao 2002), and they also exhibit limited quality of argumentation. Research in improving these responses has also typically involved including pupils in research related activities and debates which are problem based (Dochy et al 2003).

Where interventions have been successful, it has been shown that it is crucial to provide scaffolding, with van Joolingen (1993) showing that when pupils are provided with sentence starters or examples of how to form hypothesis, their ability to produce hypotheses improved.

An approach to improving this type of assessment, which could potentially aid in understanding how pupils approach this type of question, would be to observe the process of pupils answering these questions to identify the approach they take (Serder & Jakobsson 2015). A possible strategy for the improvement of scientific literacy skills of pupils has been using scientific texts to scaffold literacy tasks, and improve pupils' interest in Science (Tan 2015).

Even if an intervention is shown to be effective and implementation is considered it can still be difficult to gain widespread effect due to policy makers and those in education able to make decisions on reform not being familiar with the particular language and methodologies of education research, and as such closer links between researchers and policy makers may be required (Evans & Yuan 2017).

Auld and Morris (2016) argue that even well-meaning intervention are difficult to evaluate as many of the best practice claims are analytical rather than empirical, making them difficult to compare to each other. They also suggest that in order to be considered by policy makers, researchers are forced to produce authoritative claims, when the data produced not necessarily lend it to such straightforward policy claims. This is particular evident when intervention results are implemented across a wide range of schools, with a variance of results shown when implementation of interventions is teacher specific, potentially misrepresenting the intent of the researcher (Osborne et al 2004).

School practice and policy

School X typically incorporates exam practice for the QER type questions, requiring scientific literacy skills in their GCSE scheme of work, to prepare pupils for when they face these questions in their GCSE Science exams in year 10 and year 11. As PISA tests are typically sat by pupils in year 10, little preparation is usually undertaken for the scientific literacy required for these questions when pupils take them.

In the department's development plan (appendix I), they currently identify implementing homework tasks in key stage 3 as a route for developing cross curricular skills, including those identified as necessary for scientific literacy style questions. School X has also incorporated a skills week into its calendar for all key stage 3 pupils. This "Skills week" has been designed to help develop the cross curricular skills of its pupils, with each year group focusing on a particular topic across all timetabled lessons. The intent of this skills week is to provide a clear development of skills, providing staff with opportunities to make these skills explicit in their area of learning, with the school also making clear links to the recommendations set out by Donaldson (2015). By providing pupils with high quality, challenging experiences it allows staff to collaborate to plan themed schemes of work which

incorporate the skills required to make pupils scientifically literate as well as succeed across the curriculum.

School X also implements inquiry style tasks throughout key stage 3 with several of the units of study using investigations where pupils have to make use of the skills required to successfully plan and carry out an investigation, and helps them develop the key competencies of scientific literacy which may help prepare pupils to transfer these skills later on in school when they are set questions which require these skills. A potential shortcoming of this approach, however, is that because the skills development is restricted to a single week out of the year, it may have a narrow scope, with pupils not taking the skills they develop during this week across to tasks and activities outside of this week.

School X currently uses booklets which have tasks related to the literacy and numeracy frameworks linked in with the unit topics of the KS3 curriculum. These “LNF” booklets make use of self and teacher evaluation, to judge the current skill levels of pupils. The literature suggests this is a positive approach, as when considering approaches to improve cross curriculum skills, it is important to understand the details of the achievement gap that is trying to be addressed, with many educational stakeholders potentially underestimating current achievement gaps (Greenleaf & Hinchman 2009).

Methodology and Ethics

Research studies will often give strength to careful research design and a focus on reliable measurement of variables and the detailed examination of evidence (Biddle & Anderson 1986). However, the subject matter of education research are phenomena set up with particular purposes in mind, as well as with various participants and stakeholders with often conflicting purposes (Biddle & Anderson 1986).

The methodologies selected for this research were firstly a pre-intervention diagnostic test to assess baseline ability, and an intervention explaining how to use inference square to break down PISA style questions. Following the intervention, a post-intervention diagnostic test was administered to assess the effect of the intervention. The questions for the pre and post-diagnostic tests were selected from the Science PISA test questions in 2006, where science was a focus (OCED 2006) and is made up of an explanatory text and four questions based on this. Using PISA questions as a way to assess the scientific literacy of pupils tested allows the assessment of pupils to attempt explaining, justifying and evaluating one another's ideas, which are central to scientific practice (Goldman et al 2016).

The particular questions selected for the pre and post was from the PISA Science test administered in 2006 (Salz 2009), where science was the main focus (OCED 2006). It consisted of an introductory text and three questions which assessed the competency of identifying scientific issues, and one question which assessed the competency in using scientific evidence. When selecting a question to use in a test for a piece of research, it is important to consider its difficulty. Not only is this a vital part of assessment within a classroom, the difficulty of a question has implications for the results produced within the research. Difficulty of a question is not only how cognitively complex and question is, but also how difficult particular pupils find the question on the day it is set, with one not necessarily being sufficient to predict the other (Le Hebel et al 2017). The question selected was also used in a study by Le Hebel et al (2017), which investigated the relative difficulty of items within PISA tests.

The question selected, Q8.4 "Sunscreens (Salz 2009) required pupils to identify key information from an introduction which was long and complex, having high cognitive demand (Le Hebel et al 2017). They also had to understand the purpose of the experiment within the question, as well as make connections between the roles of the different components and memorise how they reacted to sunlight. Part four of this question requires pupils to not only understand the complex introduction, but also to represent the meaning of the four diagrams provided, selecting the relevant information in order to answer the question. They also had to be able to make connections between all this information in order to justify their choice. For both the pre and post-test the pupils were given twenty minutes to complete the four parts of the question.

For the intervention, the pupils were taught how to make use of an inference square to break down the required questions. This intervention took place over a whole lesson with explicit instruction on how to use the technique, first with a step by step example, and then several

QER questions from past GCSE papers. Other examples of PISA questions were also provided for pupils to practice using the inference squares in order to answer these questions.

During the post-test, pupils were provided with the questions from the pre-test as well as with a number of inference squares to make use of to help them answer the questions. When assessing the answers produced by the pupils for each of the three multiple choice questions one point was assigned for a correct answer, and for the extended response question one point was awarded for partial credit and 2 points were awarded for full credit. Partial and Full credit were assessed according to the guidance provided in the PISA sample questions document. Several studies in science education have found that pupils can lack the skills to make sense of the complex information presented in scientific texts and assessments (McLuckie et al 2007), so integrating scientific literacy and strategies for inference, has the potential to improve pupils' ability to do this.

The limitation of this method is that, not including a control class means that potentially, the results may not be due to the intervention and could be due to other factors. It may also be due to the small sample size involved in the research or the reliability of the results is in question.

Class Y did not contain any additional learning needs (ALN) or English as an additional language (EAL) or eligible for free school meals (eFSM) pupils and so do not accurately represent the average class in Wales. As such, the success of an intervention may not be applicable or transferable to other groups. This is additionally troubling as these pupils are traditionally those with reduced performance and require further help. Class Y is also a year eight top set class, and this is earlier than PISA assesses pupils as well as before GCSE preparation is typically done in school. The reasoning for selecting this class was that development of skills is a dynamic process in which it has been shown that early intervention lays the foundation for later development (Heckman & Kautz 2014). Providing an intervention to improve pupils' scientific literacy in year eight was intended to lay such a foundation for further development of skills. A potential limitation to the selection of this class is that by using PISA questions intended for older pupils, the questions may be too difficult to answer and, also, the unfamiliar subject matter or context may cause pupils due to give up due to disinterest (Dweck & Legett 1988)

A further limitation, as with many studies of this type is it only allows the ability to record narrow effects (in this instance, the performance on the questions provided) of an intervention (Heckman & Kautz 2014). Without knowing the full range of potential outcomes affected it is difficult to measure the full affect the intervention had (Heckman & Kautz 2014). In contrast it can also be possible to underestimate the value and importance of education improvements, as it has been demonstrated that relatively small improvements in skills can have large effects on the future wellbeing of pupils (Hanushek & Woessmann 2010).

A limitation of the three lessons of the research all taking place on the same week is that whether the effect of the intervention is long lasting is not shown. Studies on programs with long follow ups have shown that interventions can have positive effects on performance,

however the benefits can fade as time since the intervention has passed (Heckman & Kautz 2014)

Ethical consideration was taken when designing and implementing the research trial, with all research activities following the guidelines in the UWTSD Code of Ethics: Research Ethics & Integrity Code of Practice 2017-2020, as well as Ethical Guidelines for Educational Research (BERA 2011). The anticipated risks to participants that included participants could feel pressured to take part because their teacher was the researcher. These risks were addressed by explaining the informed consent process to all participants, emphasising that there will be no impact on progress or attainment based on participation, and that all data will be treated confidentially and anonymous in the write up of the research. The participants were also informed that they have the right to withdraw from the process at any point.

Evaluation

fig.1. Mean class scores for pre and post intervention tests

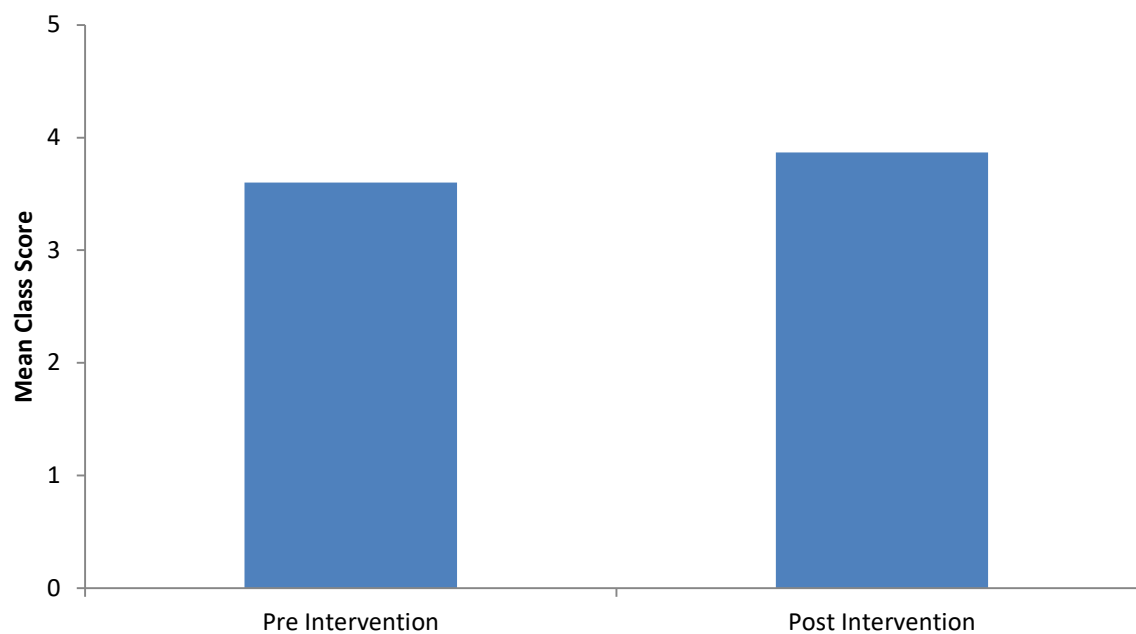


fig.2. Whole class scores for pre and post intervention tests

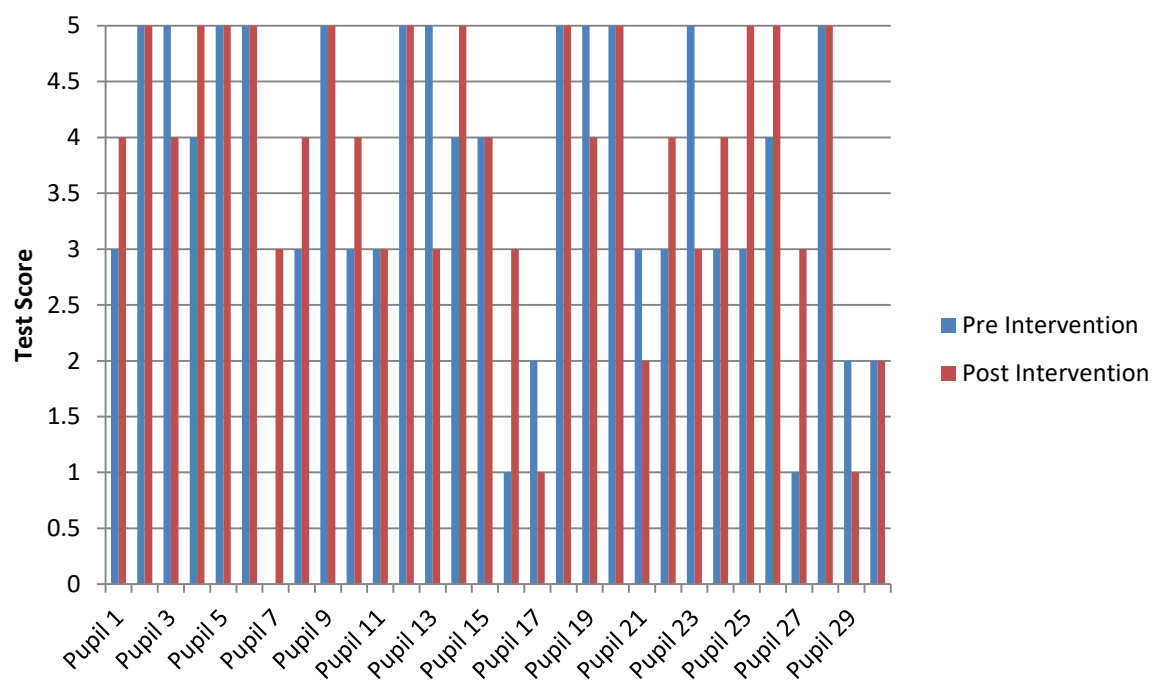
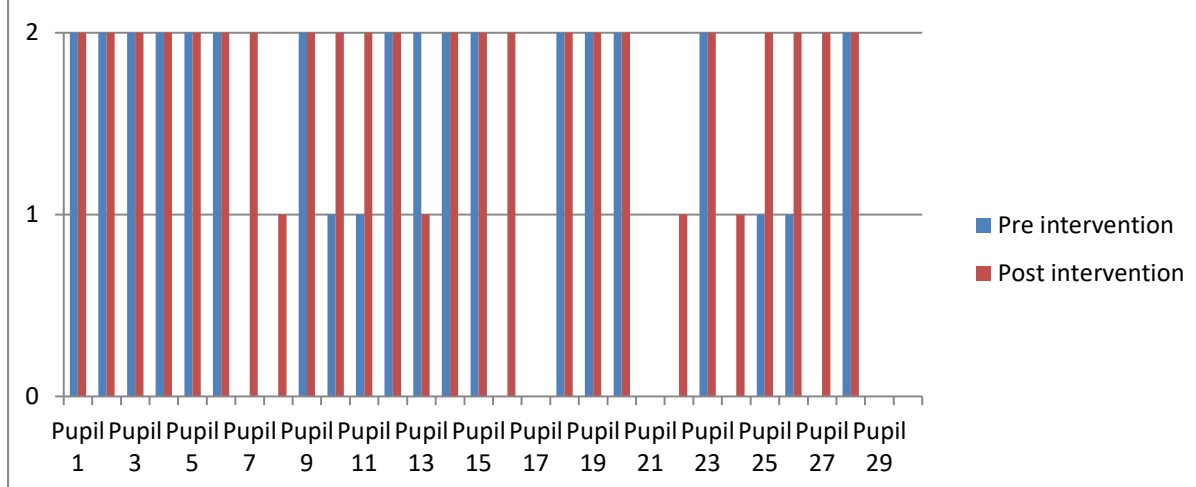


fig.3. Class results for extended response question pre and post intervention



The results showed that, between the pre and post diagnostic test, the class mean score for the complete test improved from 3.6 to 3.867 as shown in fig.1. The number of pupils who received either full or partial credit for the extended response question (Q8.4) also increased from 20 to 26 and the number of pupils receiving full credit for the extended response question increasing from 16 to 22. 12 out of the 30 pupils increased their score on the test following the intervention, with 7 pupils receiving a lower score on the post-test (fig.3.). Only one pupil received a lower score on the extended response question following the intervention, and four pupils still scored 0 on the extended response question following the intervention. None of the pupils scored 0 on the test either pre or post intervention.

Pupils' ability to answer the question provided appears to have increased following the intervention. This was particularly evident in the extended response question (Q8.4), which assessed pupils' competencies' in using scientific evidence, as the overall marks on the first two questions decreased, and the third question increased from 23 to 25. In contrast, the increase of pupils receiving any credit for the extended response question was from 20 to 22. A possible explanation for small improvement overall is that the class was high achieving, with the percentage of the pupils in the class able to correctly answer each individual question in pre-test being higher than when the test was administered in the OCED countries (Salz 2009).

Following the post-test, pupils were provided with exit tickets in order to assess how they felt about using the technique as well as the effect they think it had on their performance and whether they would use the technique again in future. One shortcoming expressed by pupils in this piece of research was with the physical inference grids themselves, and how each section potentially did not have adequate space for each point and that if the same inference grid was used for multiple questions, confusion may occur.

In the first lesson of the series of three research lessons, the pupils were provided with the “sunscreens” question, introduced to the research process as well as being advised that they would be able to withdraw from the research process at any time. As many of the pupils in this year 8 class may not have been familiar with the type of extended response question provided in PISA tests, I introduced these types of questions and explained the task required of the pupils. I also explained the importance of scientific literacy and when pupils are likely to be required to answer these extended response questions in their future academic career. These explanations were designed to relieve potential anxiety about facing an unknown task, which has been suggested to hinder pupils’ performance particularly in cognitively complex tasks (Harlow & Jones 2004). When introducing the test, I made sure that the instructions, as well as the aims and expectations of the tasks were clear, as it has been shown that, if this is not made clear, pupils may fail to engage with the tasks (Sullivan et al 2015).

When the pupils were provided with the question, many of the pupils expressed that this question was too difficult and that they didn’t understand it. This expression of difficulty may have been due to the pupils being unfamiliar with the type of question, as well as because the introductory text of “sunscreens” having a high cognitive demand (Le Hebel et al 2017). The potential problem with more cognitively complex tasks is that they can potentially be too taxing for most pupils, with studies indicating pupils often misunderstand the questions they are presented (Harlow & Jones 2004). These high cognitive demand tasks can also exclude more low ability pupils, as these pupils can often fail to develop strategies and higher order executive routines which can enable them to select appropriate strategies to approaching tasks (Toh et al 1997).

The PISA question “sunscreens” required the pupils to analyse the text and infer the purpose of the investigation taking place. Very few of the pupils would likely have been familiar with the nature of substances absorbing different amounts of light however, most, if not all, would be able to guess how sunscreens work to protect you from the sun. Having a question involving a context that pupils are familiar with has been suggested to improve pupils’ ability to learn and present scientific arguments (Walker & Zeidler 2007). However, despite this relevance to pupils, the levels of interest compared to some of the practice questions in the intervention coming from past GCSE papers suggests that, as Serder & Jakobsson (2015) proposed, adding so called relevant topics into questions does not automatically make them more interesting to pupils. This question in particular may cause difficulty as although the question requires the identification of scientific ideas and the analysis of scientific evidence, one pupil in the class suggested it was more like an English comprehensive question, and struggled to see the relevance to scientific skills.

The class selected were a top set class, in school X sets in year 8 are made up of two form groups split into two sets so there may be a mix of ability within the sets. Although the most able in the class may be able to cognitively cope with the task, the lower ability pupils may have struggled. Due to this range of ability, pupils can face difficulty if they think of scientific ability as being innate, with Dweck & Legett (1998) suggesting that pupils can give up on tasks they perceive as difficult in a relatively short amount of time, even if they do possess the skills to ultimately complete the task.

Having taught the class throughout my teaching placement, I was able to ascertain that the class has a high interest in science; many of the pupils in the class are high achievers and expected to receive high levels of attainment. The interest in science may suggest higher achievement as indicated by Bybee & McCrae (2011), however this may not always been the case, with Wallace (2004) suggesting a negative correlation between interest in science and achievement in Science tests. The time the pupils were provided to complete the question, was longer than pupils would usually have to complete this type of question. This potentially made pupils more able to answer the question than if they were more restricted for time. In GCSE papers and PISA tests pupils are also required to answer many more questions than was required in the pre-test. They are also expected to answer a greater variety of questions with different cognitive demands. This potential reduction in difficulty may limit the efficacy of the results, however this was done to attempt to mitigate that this class was a lower age than those pupils who typically take PISA style tests.

The lesson was opened with an explanation of the inference grid, the purpose of each of the sections of the grid, and how it is currently being utilised to break down complex texts and concepts in order to better answer questions. As pupils were not familiar with the concept, I made sure to give a worked-example, as well as step by step instructions how to fill out the inference grid using the information provided, and how to use this broken down information in order to answer the questions. A key part of the intervention of inference squares is that they are ultimately a tool for scaffolding of answers for the extended response type questions. These types of interventions which provide scaffolding have been successful in helping pupils improve their skills (Van Joolingen 1993), however, as with most types of scaffolding, questions should be asked of whether pupils familiarity with the technique negates the use of inference grids with these questions, and whether if, when taken away, pupils will still be able to still utilise the skills required to answer the questions.

Following this introduction, the pupils were given example questions and blank inference grids. By having the pupils break down the questions and fill in the grids in pairs, they were using combinations of their scientific skills, as well as their collaboration and communication skills to express the ideas they were coming up with, due to previous interventions which facilitate collaboration showing positive results (Sandoval & Reiser 2004). Going through these worked examples and having pupils feed back to the class how the example questions should be broken down enabled pupils to express their own ideas on how the grids should be utilised and how they would be able to make use of them in answering questions. The final part of the lesson was a plenary in order to assess how well the pupils had learned how to make use of the technique, and to make sure that pupils would be able to make use of the technique when they completed the post test. An aim of the intervention was to give pupils more belief in their ability as well as improving skills, as beliefs of self-efficacy have been shown to enhance the deeper learning that these more cognitively complex tasks require (Yaeger & Walton 2011).

The pupils were given the same question for the post test in order to allow direct comparison between results to see if pupils improved following the intervention. A benefit of being present when the pupils undertook the tests was that it was possible to observe the approaches

that pupils gave, which was suggested by Serder & Jakobsson (2015) as being more valuable than simply having the answers pupils provide. This is not normally possible through these types of tests which are administered to a large number of pupils from many countries.

After the pupils had completed the post-test the inference grids which were used to answer the questions were collected, and these showed that, even following one lesson's instruction on their use, there was a varied response to the technique. Some of the pupils had made extensive use of the technique, filling the grids with the key information from the introductory text as well as the questions, whereas some of the pupils had only made small notes onto the grid, with one pupil not making use of the grid. This has implications for further research into the intervention technique as the improvement shown following the intervention may not be completely attributable to the intervention.

Following the post-test, I used part of a lesson to provide feedback to the test as well as the whole research process. This was to make sure that, as well as providing feedback to the pupils on how the intervention affected their performance, it also explained why the approach the pupils took was incorrect rather than just correcting their errors and feeding back the correct answers, which has been suggested to improve pupils' self-belief (Roscoe & Chi 2007).

The series of lessons overall required pupils to express many of the skills which numerous definitions of scientific literacy cover, including encouraging pupils to think meta-cognitively and apply them to a scientific argument (Wallace 2004, Kuhn & Dean 2004). A limitation of the research was its small scale, however the benefit of this was that the research aim and criteria for success could be easily defined, by restricting the test to four questions; the success criteria were simple, which has been demonstrated as a failing of many examples of action research (Donovan 2013). By directly using PISA questions to assess pupils' scientific literacy skills, the aim was to overcome one of the limitations of some interventions in which the results are analytical rather than empirical, making them difficult to compare (Auld & Morris 2016).

Conclusion

In conclusion, the intervention appeared to have had a small effect on the ability of pupils to complete a cognitively complex scientific literacy question. The intervention seemed to have had the greatest effect on the extended response question (Q8.4), suggesting that this technique may be beneficial for pupils to implement for attempting this type of question.

Due to the limitations of this research, and the importance of these types of questions to the GCSE curriculum as well as the goals of Welsh curriculum reform as suggested by "Successful Futures" (Donaldson 2016). Further research should be taken out in order to further explore the effectiveness of interventions in order to improve the scientific literacy of pupils.

From the feedback received from the pupils following the research lessons, a longer instruction period with more practice using the intervention techniques would be valuable for

pupils to gain the potential benefit of the intervention, particularly if this benefit is to not be short lived, which Heckman & Kautz (2014) suggest is likely for many intervention strategies if there is little to no follow up. In order to gain the expertise in this intervention technique through practice, implementing it early in the school experience, as with this year 8 class, could potentially benefit pupils when they come across these scientific literacy style questions later in school with the benefit of starting interventions early for their long term effectiveness being suggested by Heckman & Kautz (2014), however it has been proposed that this perceived benefit is due to these studies having long follow up periods, compared to studies involving later interventions (Heckman & Kautz (2014). Caution should be taken, as the logic of developing skills of pupils across the curriculum if the focus of this is placed on widespread tests such as PISA there is a risk of narrowing the curriculum to solely preparing pupils for these kinds of tests (Carnoy et al 2015). Research has also suggested that focussing solely on the results of large scale tests is problematic, as they do not take into account character skills which are valued in school and the wider labour market (Heckman & Kautz 2014).

A possible positive approach for further research could be incorporating the type of extended response questions into pupil investigations, as although the literature disagrees on the effect of including inquiry based activities into the curriculum (McConney et al 2014), when this type of activity has been high quality, positive results have been shown (Yip 2001). Carrying out investigations which require use of scientific literacy skills also allows pupils to develop an understanding of the nature of science, a fundamental skill of scientific literacy, but only if taught about this explicitly (Abd-El-Khalick 2002). By incorporating the skills of scientific literacy into these investigations, it not only improves their relevancy to actual scientific investigations, but also the nature of science, which was shown by Khishfe (2012) to allow pupils to improve their ability to make connections between scientific arguments. As well as providing a practical and exciting avenue for the development of scientific literacy skills, investigations allow pupils to be explicitly taught skills such as writing research questions which are meaningful and testable, as well as teaching the process of making inferences linked to research questions, which has been suggested as beneficial for pupils scientific literacy skills (Cairns 2019, Dochy et al 2003), and improving the level of quality of response (Fischer et al 2014, Kelly & Takao 2002).

Although the technique of inference squares seemed to be effective in improving performance and many of the pupils found it an effective technique for answering the questions provided, caution should be used on making the kind of authoritative claims on their efficacy that are often required by policy makers to implement them in a widespread way (Auld & Morris 2016). Despite this, inference squares are potentially a useful tool to incorporate into preparing pupils with the Scientific literacy skills vital for success in school science, in particular for QER questions at GCSE and for PISA style tests, This tool should, however, be used in combination with other techniques, in order to discover what is most effective for individual pupils, to improve their scientific literacy

Limitations

A limitation of this piece of research was that it was only on a very small scale, and providing the intervention to only one class restricted the applicability of this research to pupils of other social classes, demographics or cognitive ability. Due to this limitation, further research into this area should attempt to involve as wide a cohort as possible, including a variety of different pupils to make the results of the intervention as applicable to as many pupils as possible. Caution, however, should be applied as widespread implementations of interventions are teacher specific which can a variance of results (Osborne et al 2004).

Another limitation was that a control class was not used in order to assess whether any improvement was caused by chance, or by the effect of the intervention. This could have been exacerbated by having the same questions for the pre and post-test, as, although this was intended to allow direct comparison between results, this could have resulted in pupils' improvement coming from them now being familiar with the question and there being a lower shock of being presented with an unfamiliar complex task (Toh et al 1997).

Further research involving scientific literacy would benefit from a wider variety of test questions, drawing from a greater range of topics. As both of the tests in the trial focussed on a single PISA question, if pupils were not able to find the topic relevant they may have lost interest and not applied their knowledge to the topic and given up too quickly (Dweck & Legett (1988), and so the tests may not have been a true reflection of the pupils scientific literacy.

A further limitation is that the piece of research took place over three lessons in one week. This meant that it was not possible to measure the long terms effects of the intervention. As such it may have been possible that the improvement shown by the pupils following the intervention may have diminished if the pupils were to attempt the test again following a longer period of time. Additional research into the effectiveness of an intervention would benefit from longer term study. Science lends itself well to this as the curriculum throughout the year is divided into discrete topics, and so the Scientific literacy could be tested with a set of cognitively complex questions following the end of each unit, where the pupils are provided with the inference square to complete them. A refresher could also be provided every term to ensure pupils are still able to make use of the technique. By restricting the research testing to once per unit, it also potentially minimises the risk of narrowing the curriculum to focus on performance on these PISA style tests, which is a risk as their importance increases (Carnoy et al 2015).

Another limitation is that the class; the test was administered to a high achieving class, being the more able pupils in a group of two form classes. This was evident in the results of the pre-test. In all of the questions, a higher percentage of class Y were able to answer the questions correctly compared to pupils across the OCED countries (Salz 2009). The results of the pre-test being so good means that it is difficult to assess whether any improvement due to the intervention will be possible to be achieved by less able pupils or if the task will still be too cognitively complex for the intervention to have any significant effect. Also, if less able

pupils are able to utilise the intervention technique. Research should also look into the scientific literacy skills of less able pupils to determine if different techniques would be beneficial for them, and if intervention techniques which are successful for more able pupils are more or less effective for them

A limitation of the questions selected for the research test was that they only assessed two of the three competencies that PISA Science questions assess, with Perez et al 2010 suggesting that to adequately assess pupil's scientific literacy, pupils should be assessed across a wide variety of competencies involving questions with a variety of difficulties. If future research were to take this approach, care should be taken not to overload pupils as this can lead to further disinterest in the process and science (Serder & Jakobsson 2015).

The importance of widespread tests such as PISA on education reform, as well as the focus on the skills covered by scientific literacy that many countries curricula, in particular Wales reforms suggested by "Successful Futures" (Donaldson 2015) has increased in recent years. I would recommend that future research focusses on incorporating the type of questions throughout the curriculum so that pupils experience them in a wide variety of concepts and topics, making them more familiar with them and, as such, much more likely to be able to answer them correctly. Future research on interventions improving scientific literacy should focus on ways to make sure interventions are able to help a wide variety of pupils to improve their ability to answer extended response question regardless of their academic ability or additional learning needs, and to also make sure that when evaluating the success of an intervention, the ability to implement it successfully is also evaluated to judge whether it will have a meaningful effect.

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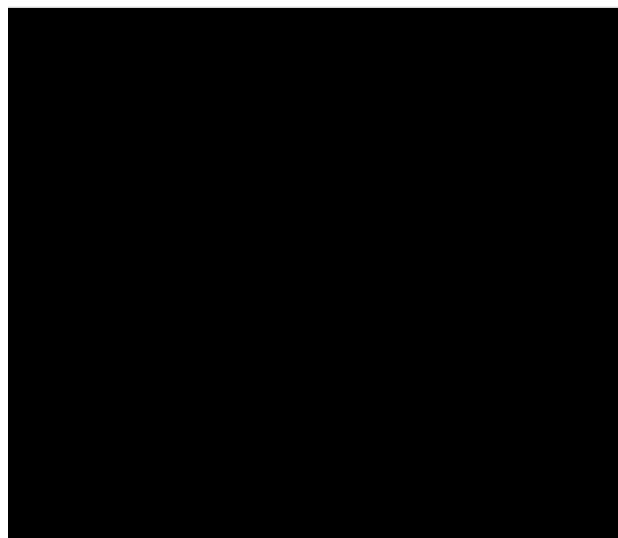
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[REDACTED] Comprehensive School

Ysgol [REDACTED]



**[REDACTED]
Development Plan 2018 - 2019**

Whole School Development 2018-2019 on a Page

IA1 Standards

1. Maintain current high levels of performance, monitoring any trend anomalies.(85% Level 2+/WBQ, A/A* 40 %+, MAT, eFSM)

IA2 Wellbeing and Attitudes

2. Improve attendance (95.5%)
3. further develop pastoral and wellbeing provision (Breakfast, Mental health and wellbeing, sleep and screens, tolerance, mutual respect and prevent)
4. Behaviour

IA3 Teaching and Learning

5. Effective pace, stretch and challenge (MAT) and plenaries
6. Skills including DCF

IA4 Care, Support and Guidance

7. Sexting and substance misuse
8. Monitoring of IDP's

IA5 Leadership

9. Curriculum change and Donaldson
10. Refine improvement planning /specific areas for development
11. (GDPR)
12. Building and Leisure resource improvement

Trends

Key Stage 3

The following table shows the percentage of all pupils, boys and girls gaining level 5+, level 6+ and level 7+ from 2014/15 to 2016/17.

Key

The

	2014/15				2015/16				2016/17			2017/18		
	L 5+	L 6+	L 7+		L 5+	L 6+	L 7+		L 5+	L 6+	L 7+	L 5+	L 6+	L 7+
All Pupils	95	80	46		96	78	34		98	80	39			
Boys	95	76	40		96	66	20		98	74	37			
Girls	95	85	54		97	89	47		99	87	43			
Quartile	4	1	1		3	2	2		3	3	1			

Stage 4

table below shows the percentage of pupils who achieved each grade and the percentage of pupils who achieved grades A* - C since 2011/12. A*-A since 14/15.

Year	2014/15	2015/16	2016/17	2017/18	
Core	77.3/14.3	82/15.5	78.5/18.5	Double 1	87/27.8
Additional	75/16.7	65/14.9	70.9/19.7	Double 2	81.5/16.7
Biology	98.9/61.3	97/61.1	98.8/69.9	Biology	97.5/69.6
Chemistry	97.8/64.5	97/62.2	98.8/62.7	Chemistry	98.9/65.2
Physics	98.9/61.3	94/55.6	98.8/63.9	Physics	97.8/68.5
Quartile	3	3	3	Quartile	

IA2: Wellbeing

- Well organised and structured courses at both key stages ensures consistency and security for pupils, teachers and parents. To engage all pupils, we aim to ensure that materials provided are current, stimulating and challenging. These materials as well as extra-curricular revision classes and Moodle provide support pupils in terms of their emotional wellbeing around their learning as well as being easily adaptable for ALN pupils. They further support MAT pupils in terms of providing extension work and to support their talent in other subjects/sporting areas in case of lessons missed for practise. The electronic nature of our materials enables easy adaptation according to pupil (and parent) needs and voice as well as current issues. It also allows for modification when required for example for pupils with visual difficulties. Personalised learning is supported by Moodle.
- Individual and group activities provided for example in pupil booklets, skills week and through investigations allow continued development of independent learning and skills including: critical thinking and problem solving, creativity and innovation, digital competence, planning and organisation, personal effectiveness in lessons are continuing to develop resilient learners and raise standards.
- Pupils feel safe and secure in terms of laboratory safety and routines established by teaching staff in an environment of mutual respect.
- There are high expectations of good behaviour with the departmental behaviour policy feeding into that of the whole school including the use of a 'level two' lunchtime mentoring session supported by staff from all departments.
- Many pupils willingly take part in voluntary extra-curricular activities for example presenting at the year six open evening and options fair or taking part in 'Messy Science Club'. Participation in extracurricular activities and extended learning is high and allows pupils to further develop their knowledge and understanding of the subject and see it in a real life context.
- Centralised tracking ensures pupils receive the correct support via setting, mentoring, and tier of entry as well as re-sit advice.
- There are effective links via moderation and standardisation with the cluster primary schools.
- Health and well-being advice is included in courses where possible for example on drugs, alcohol, healthy eating, carbon monoxide, mobile phone and lab safety.
- Pupils are encouraged where possible to develop as ethical and informed citizens for example through skills booklets and the sustainability topic.

IA3: Teaching and Learning

- Staff set high expectations of themselves as teachers and the pupils in their care. They are specialist subject teachers with a range of expertise.
- Well organised and structured courses at both key stages enables all teachers to develop pupil knowledge as well as skills. In support of this, staff plan and create effective and motivational resources which are shared across the department including: notes; activities; practise questions and extension work (closely matched to the national curriculum and examination board requirements) as well as opportunities for pupils to develop wider skills.
- Science is fully supportive of and makes a significant contribution to the whole school development of literacy and numeracy for example reading behaviours, numerical reasoning tasks and NILE aspects are incorporated into the SOW at KS3 and KS4. Teacher modelling, QED answers also aids

Key Developments

2018-2019:

Whole School/Department

- To maintain current high levels of performance, monitoring any trend anomalies.(85% Level 2+/WBQ, A/A* 40 %+, MAT, eFSM)
- Wellbeing provision
- MAT and 'challenge for all'
- Excellent teaching and learning with focus on pace, and plenaries
- Further Development of skills: Literacy, Numeracy, and Digital Learning (DCF)
- Further develop Bilingualism
- Curriculum Change and New Qualifications
- Refine improvement planning/specific areas for improvement (DDP)
- GDPR
- To provide advice/mark schemes for the four main KS3 investigations
- To continue improvement of quality of KS3 booklets
- To continue to develop a data entry system
- Continued differentiation of KS3

Science Development Plan 2018– 2019 Blue = Whole School Black = Department

CIF Reference	Focus for Improvement	Action(s)	Expected Impact/Success Evidence	Lea d Sta ff	Resources / Cost/PLD	Timesc ale	Monitoring Evidence	No Action		
								Some Progress		
								Good Progress		
								Embedded		
Inspection Area 1: Standards										
1.1.Standards and Progress; 1.2 Standards of groups of learners; 1.3 Standards and skills										
IA1	To maintain current high levels of performance, monitoring any trend anomalies.(85% Level 2+/WBQ, A/A* 40 %+, MAT, eFSM)	1. Continue to strive to stretch and challenge all children effectively in all lessons. Lesson observations with specific and shared focus on standards as well as teaching.	Maintained high levels of outcomes both at KS3 (98.2% L5, 79.5% L6, 39% L7) and KS4 (100% A*-C and 62% A*-A TA/80% A*-C and 20% A*-A DA)	JAB CD All Staff	Teaching and Learning PLD for all staff/whole school INSET	June 2018	- Results data analysis - Lesson observations - Book scrutiny	Dec 18	Apr 19	Jul 19
		2. Consistent tracking of individual pupil performance and trends of performance to inform teacher planning, monitoring of pupil attainment and mentoring	- Individuals pupils and parents aware of realistic and ambitious targets - Pupils challenged to achieve highest levels of attainment	JAB CD CAL All Staff	Whole school tracking system	December 2017 April 2018 June 2018	- Mentoring records - Tracking and trend data	Dec 18	Apr 19	Jul 19
		3. Maintain focus of 'challenge for all' for all lessons	- Maintained A/A* Grades at KS4 (A/A* 40 %+) - Evidence of challenge in pupil portfolios and lesson observations	JAB CD AS All Staff	Whole school INSET lesson observation training for all staff	November 2017 January 2018 June 2018	- Tracking data - Book scrutiny - Lesson obs - Termly RAYG	Dec 18	Apr 19	Jul 19
		4. Include a focus for provision for MAT in lesson observation proforma. (Shared understanding and use of lesson observation criteria to aid the scaffolding of standards and challenge of MAT.	- Lesson observations identify stretch and challenge of MAT pupils - Maintain focus of 'challenge for all' for all lessons - Maintained/improved 62 % A/A* (TA)/20% DA and Level 7+ 39%.	SLT All Staff	Whole school INSET and copying costs £500	January 2018	- Lesson obs proforma - Lesson obs records	Dec 18	Apr 19	Jul 19

		5. Continue to provide extension and open ended tasks to stretch MAT pupils.	Maintained/improved 62 % A/A* (TA)/20% DA and Level 7+ 39%.	All faculty staff	Photocopying costs.	Ongoing	- Lesson obs proforma - Lesson obs records - Book monitoring - Results	Dec 18	Apr 19	Jul 19
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Science Development Plan 2018– 2019 Blue = Whole School Black = Department

CIF Reference	Focus for Improvement	Action(s)	Expected Impact/Success Evidence	Lead Staff	Resources / Cost/PLD	Timescale	Monitoring Evidence	No Action		
								Some Progress		
								Good Progress		
								Embedded		
Inspection Area 3: Teaching and Learning										
3.1. Quality of Teaching; 3.2. Breadth and Balance of Curriculum; 3.3 Provision for Skills										
3.1.	MAT provision and ‘challenge for all’	Continue to provide extension and open ended tasks to stretch MAT pupils.	Maintained/improved 62 % A/A* (TA)/20% DA and Level 7+ 39%.	All faculty members	Photocopying costs	Ongoing	- Lesson obs proforma - Lesson obs records - Book monitoring - Results	Dec 18	Apr 19	Jul 19
3.1.	To maintain and further develop excellent teaching with effective pace of lessons that stretch and challenge pupils and plenaries that consolidate learning (ESTYN)	- Use of KS3 and 4 maps to ensure pace pf delivery. - Whole school lesson plans with timed activities during lesson observations. - Plenary ideas shared on staff drive and focus in lesson observations.	- Increased good/excellent lesson observation grading of ‘consolidation of learning’ and ‘effective plenary’ micro aspect of lessons - Positive pupil voice and shared practice evident in lesson observations and Headteacher/ triad/departamental reviews	SLT JAB	Photocopied and video resources for all staff £400	March 2018	- Bilingual INSET Evaluations - Lesson Observations - Pupil Voice - Headteacher reports	Dec 18	Apr 19	Jul 19
3.1	To provide advice/mark schemes for the four main KS3 investigations.	Departmental leaders to provide exemplar materials/mark schemes/results for teachers.	Consistence in attributing levels and scientific language used to support scientific predictions and explanations.	CALs	NA	Y7 – Feb half term Y9 – Oct (bubble fact) and beginning March (spring) Y8 is completed	- Staff drive - Moderation - Cluster meeting	Dec 18	Apr 19	Jul 19
3.1	To continue improvement of quality of KS3 booklets in terms of any remaining graphics difficult to read and CALS to	To continue to check format of KS3 booklets to ensure that they are accessible to pupils in terms of reading age/graphics etc.	Booklets easily accessible to pupils of all abilities as well as staff teaching out of subject area.	All	N/A	Ongoing – to review booklets in meetings where possible.	- Booklets - Meetings	Dec 18	Apr 19	Jul 19

	provide afore mentioned mark schemes.									
3.1 *	To develop and introduce Donaldson style homework opportunities into KS3.	1. Departments to discuss potential tasks and to include them onto a central PowerPoint. 2. Try to include digital competency where relevant.	• Pupils make links between their topics and wider world whilst developing essential cross curricular and wider skills (Donaldson).	CALs	Potential home school resources	Jul 19	• Pupils voice • Staff drive/SOW • Ppoint • Book scrutiny/photographs/pupil work	Dec 18	Apr 19	Jul 19
3.3.	Further development of Literacy, Numeracy, Digital Competency and Skills Weeks in line with Donaldson recommendations to raise attainment	1. Continued use and update of LNF KS3 booklets (RMC) 2. Digital competency framework considered when developing new KS3 homework tasks.	• Improved levels of literacy and numeracy and staff understanding of areas of strength and weaknesses	PM ERB	INSET training Resources created by HD and PTM	July 2019 Review	Pastoral Leaders voice Test data Pupil Voice Staff Voice Book Scrutiny	Dec 18	Apr 19	Jul 19
3.3.	Further develop bilingualism across the curriculum	1. Whole school INSET to include shared effective practice and ability group development of bilingualism 2. Equipment sheets in pupil books 3. Booklet headings in Welsh (also on Moodle) 4. Continued use of mats	• Improved levels of bilingualism in lessons and across schools • Lesson observations identify opportunities for bilingualism • Videos of effective practice to share and available as a teacher learning resource and training tool	SLT AS SLH CAL's All Staff	Photocopying costs	July 19	Book scrutiny Lesson obs	Dec 18	Apr 19	Jul 19

Science Development Plan 2018– 2019 Blue = Whole School Black = Department

CIF Reference	Focus for Improvement	Action(s)	Expected Impact/Success Evidence	Lead Staff	Resources / Cost/PLD	Timescale	Monitoring Evidence	No Action Some Progress Good Progress Embedded		
Inspection Area 4: Care, Support and Guidance										
Tracking and monitoring Learning Support; 4.2. Personal Development; 4.3. Safeguarding										
4.1	Continue to develop attainment and tracking for example of FSM pupils and to continue to develop a data entry system for teaching staff to avoid multiple entry particularly with regard to KS3 reports (possible new format).	- To continue with KS3 centralised assessment sheets - To continue with KS4 centralised report/tracking sheets - To discuss all staff using identical electronic mark sheets (feeding into KS3 and KS4 tracking sheets) in turn feeding into SIMS report sheets. - Continue yearly tracking of results (September) - To use data to check progress of groups of pupils for discussion in meetings/put on agenda. - SIMS open early	Pupils sitting correct tier of entry. Pupils receiving appropriate level of challenge and support.	LPR/SAF	NA	Jul 19	- Staff drive - Minutes - Pupil reports - Results/	Dec 18	Apr 19	Jul 19
4.1 *	To complete exam and re-sit entries for Y11 in Autumn term/Y10 in January	- To complete exam and re-sit entries for Y11 in Autumn term - Base Y11 resit advice and exam entries on Y10 exam results – input data onto KS4 report tracking sheets. - Inform pupils and parents in autumn via planner slips (with place for parental signature). - Base Y10 entries on set check results. Inform pupils and parents in January via planner slips (with place for parental signature).	Pupils can prepare for relevant entry/re-sit in advance. Early dialogue with parents and pupils to check correct entry and re-sit.	LPR	Photocopying planner slips. Glue.	Autumn term (Y11) End January (Y10)	SIMS sheets Feb/March	Dec 18	Apr 19	Jul 19
4.1	Continued differentiation of KS3 resources for STF pupils; development of electronic materials in support of new KS4 course	- Continued liaison with STF staff and support assistants. - Continue to make support assistants aware of mark schemes available. - Continued development of Moodle/google classrooms to	KS3 and KS4 courses made further accessible to pupils and support staff.	LT/All	N/A	Ongoing	- Discussion with STF/LSA staff - Book monitoring - Booklets	Dec 18	Apr 19	Jul 19

	(Y11)	support home study at both key stages.								
4.1	To audit the gender balance of A' Level uptake (LPR) to inform provision and develop sixth form links to support development of teaching and learning.	4. To contact sixth form establishments (Olchfa and Gower College) to determine results of leavers 2016.	To establish uptake and success rate of KS5 science.	LPR	N/A	Dec 18	- Minutes of meetings 2017/18 Y13 results.	Dec 18	Apr 19	Jul 19
4.3 *	To continue with ongoing cluster project (ERW) and with cross phase moderation KS2/3.	1. To attend ERW cluster meetings 2. To attend moderation meetings 3. Send Y7 booklets and mark schemes to cluster schools.	- Consistency in terms of delivery of knowledge and investigations. - Consistency in attributing levels to investigations.	RMC	Photocopying costs	Jul 19	- Minutes of cluster meetings - KS2/3 results	Dec 18	Apr 19	Jul 19
4.3	Continued use of Cleapps to enable teaching staff to risk assess before teaching practical activities.	1. All staff to be aware of CLEAPPS 2. All staff to liaise with technical staff to check risk in practical activities.	Pupils and staff continuing to work in a safe and secure environment.	All	Cleapps cards/access to Cleapps advice line.	Ongoing	- Accident book - Liaison with school nurse.	Dec 18	Apr 19	Jul 19

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CIF Reference	Focus for Improvement	Action(s)	Expected Impact/Success Evidence	Lead Staff	Resources / Cost/PLD	Timescale	Monitoring Evidence	No Action Some Progress Good Progress Embedded		
Inspection Area 5: Leadership and Management										
5.1 Quality and Effectiveness of Leaders; 5.2. Self-evaluation and Improvement Planning; 5.3. Professional Learning; 5.4. Resources										
5.1 (a + b)	To effectively strategically lead science Curriculum change, in line with WG changes to Qualifications and Donaldson Report recommendations	1. Continued checking of SOW 2. Evaluate and revise resources 3. CAL attend any necessary WJEC training on new specification/HOS meetings	- Successful embedding of new Curriculum in KS4. - Revised SOW in line with new WJEC specifications. - Resources to support SOW - INSET Evaluations - Department Minutes	CAL All Staff	CAL Attendance at WJEC Training £300 Staff Cover for training. Department Meeting time to share information/develop SOW INSET time	July 2019	- INSET records - Department Minutes - INSET Evaluations - Termly RAYG rating of progress	Dec 18	Apr 19	Jul 19
5.1	To fully induct and support development of new science/supply teacher/sl.	1. PM 2. Regular meetings 3. Lesson observations 4. Triad observations 5. Support with timetable (same classroom per day) 6. SOW/Booklets available 7. Chemistry, physics and biology maps of KS3 and 4 in school calendar.	- Continued excellent teaching and learning in the classroom - Consistency of experience for all pupils - Positive induction experience of new staff members	LPR (NQT) All	Induction programmes costs?	July 19	- PM - Lesson obs - Book monitoring - Discussion with new staff members - Pupil results	Dec 18	Apr 19	Jul 19
5.2.	Refine improvement planning processes to focus more precisely on specific areas for development	1. Whole department to be involved in writing of development plan during whole school INSET 2. Agenda item of development plan for every meeting 3. RAYG rate development plan every term 4. Robust analysis and reference to book scrutiny and lesson observation areas for development in improvement planning	- Whole department involvement, shared ownership and consistency in improvement and evaluation - Clear links between self- evaluation, development plans and performance management - Regular monitoring of plan in department meetings - Termly RAYG	AS LM's CAL's All Staff	Whole school INSET Department Meeting time	July 2018	- Minutes of department and year team meetings - Link SLT meeting minutes with CAL's - Termly RAYG rating of progress	Dec 18	Apr 19	Jul 19

			monitoring of progress							
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CIF Reference	Focus for Improvement	Action(s)	Expected Impact/Success Evidence	Lead Staff	Resources / Cost/PLD	Timescale	Monitoring Evidence	No Action		
								Some Progress		
								Good Progress		
								Embedded		
Inspection Area 5: Leadership										
5.1 Quality and Effectiveness of Leaders; 5.2. Self-evaluation and Improvement Planning; 5.3. Professional Learning; 5.4. Resources										
5.3	To develop a whole school approach to meet the requirements of GDPR	1. Provide training for all staff to understand and meet requirements of GDPR 2. To shred previous pupil names of for example coursework. 3. To ensure that any pupil information on paper is securely stored.		JAB IDE AS MD CRR	INSET time for training	June 2019	- GDPR records - IT records - Termly RAYG rating of progress	Dec 18	Apr 19	Jul 19
5.4	More displays of female scientists	1. To put together a corridor display of female scientists. 2. To include a female scientist on the home physics Moodle page.	Encourage girls – science uptake and careers.	SAF?	Photocopying/posters	June 2019	- Display - Moodle	Dec 18	Apr 19	Jul 19
5.4	To further develop support of ESDGC via SOW where appropriate. Ongoing/sustainability booklet Y8	1. Ongoing attention to environment in for example in sustainability and skills week booklets.	- Continued development of pupil understanding of challenges facing the environment. - Support of EDDGC - Give pupil a sense of ownership of what they can do to help the environment.	All	Photocopying cost	Ongoing	- Booklets - Book monitoring	Dec 18	Apr 19	Jul 19

Our Targets for 2018-2019				
KS3 Year 9 % achieving expected Level				
	L5+	L6+	L7+	
	98.2%	79.5%	39%	

Target Setting: Key Stage 4 Targets

Subject	Level 1 or equivalent: %A-G	Level 2: %A-C (FFT Rank 5)	%A/A
Biology	100	100 (FFT 89)	62
Chemistry	100	100 (FFT 91)	62
Physics	100	100 (FFT 91)	62
Double Science	100	80 (FFT 75)	20
Applied Science	100	40	0

