Exploring cross-curricular strategies to address the literacy demand within the science curriculum – with a focus on adapting teaching for the needs of SEN pupils.

By Holly Stuart

1. Introduction

According to Wellington and Osborne (2001), "Learning to use the language of science is fundamental to learning science." This can present a barrier for students who struggle with literacy. Key words in science can often seem like a foreign language – especially for SEN pupils. Wellington and Osborne further state "science teachers are (amongst other things) language teachers, so it seems plausible to utilise MFL strategies and apply them to science. Interdisciplinary approaches that blend literacy techniques with science have proven to be successful previously. (Wellington and Ireson, 2017)

Importance of literacy within the science curriculum:

There is a high literacy demand within the science curriculum,

> "Pupils should be able to describe associated processes and key characteristics in common language, but they should also be familiar with, and use, technical terminology accurately and precisely. They should build up an extended specialist vocabulary."

The national curriculum for science also reflects the importance of spoken language in pupils' development across the curriculum – cognitively, socially and linguistically. "The quality and variety of language that pupils hear and speak are key factors in developing their scientific vocabulary and articulating scientific concepts clearly and precisely."

In addition, the importance of scientific language in assessment is apparent (Figure 1). Often in biology exam mark schemes there is an emphasis on using scientific language (Figure 2). Therefore students need to be familiar with using scientific language as early as possible. Effective strategies for teaching science vocabulary are essential for students to learn to communicate within science lessons and succeed in exams.

3 (b)	**In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Figure 1

Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5 and apply a 'best-fit' approach to the marking.

Figure 2

2. Differentiation

Differentiation is commonly used within science education. There are several interpretations of what differentiation is and what successful differentiation looks like in the classroom.

- According to Lindner and Schwab (2020), the differentiated and individualised design of teaching and learning processes is a moralistic approach that attempts to ensure educational justice in the sense of a participatory fairness and is linked to an inclusive teacher practice.
- There has been a methodological shift from the traditional 'one-size-fits-all' model to individualised teaching and learning in response to heterogeneity which offers a starting point for educational equity in the school context (Bondie, Dahnke, and Zusho, 2019).
- Differentiation and individualisation are designed to motivate all students to master individual tasks and achieve goals. (Tomlinson, 2014). Furthermore, differentiation and individualisation are said to be key features of inclusive education (Kratochvilova and Havel, 2013).

When teaching a year 9 nurture group, it was important for me to consider how I was going to adapt my teaching and differentiate for the specific learning needs of the class using differentiation models (Figure 3).

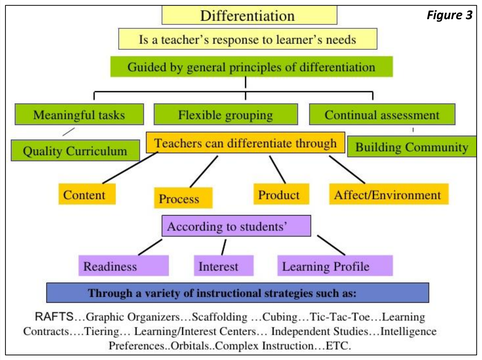


Figure 3

3. Application to Classroom Practice

- Modelling the use of scientific vocabulary throughout instruction reinforces students' comprehension whilst also maximising teachers' instructional time. Vocabulary instruction is effective when it includes visual, verbal, and physical support; therefore, physical scaffolding is essential in content-area teaching. (Quigley, 2018)
- Science is a content heavy curriculum, and time in lessons is often restrictive. As a result teachers struggle to include science vocabulary instruction. In addition, teachers often prioritise content over vocabulary, providing only a brief introduction of science terms. (Yacoubian, 2017)
- This can potentially lead to a limited vocabulary, especially for SEN students who typically can struggle with literacy and recall. Meaningful techniques for teaching vocabulary need to be explored which can effectively improve scientific literacy.
- Research suggests many variations on the theme of grouping and categorising words as a strategy for teaching vocabulary. This may be a successful strategy for children with a wealth of words, but for children with a limited academic vocabulary, it can be more of a challenge that requires further support.

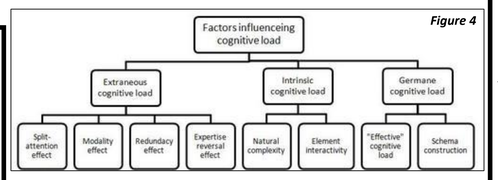


Figure 4

4. Classroom Strategies for Improving Science Literacy

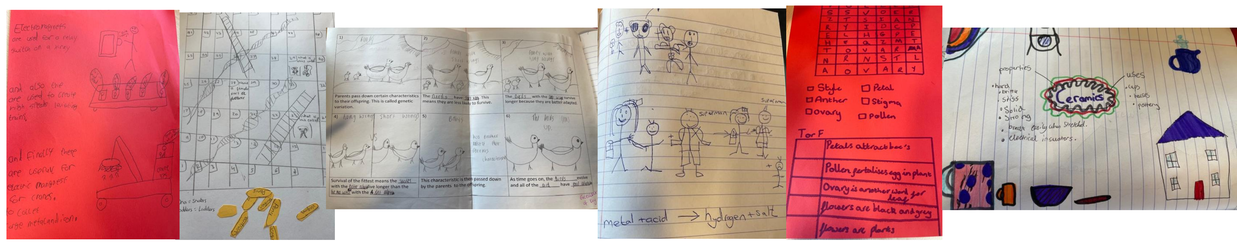
When exploring cross-curricular techniques for teaching vocabulary, some strategies used in MFL and English cannot be applied. Repetition drills would not be useful, as science is meant to be understood not memorised. Consequently, strategies need to be employed that simplify and break down complex theories and vocabulary to foster word consciousness.

Game-based learning

- Games are a brain-compatible strategy for reinforcing learning. Actively processing words in multiple ways allows the brain to store information in multiple memory systems, therefore making that information easier to access with multiple triggers or cues (Sprenger, 2010).
- Traditional games can be adapted to help students experience the language of science. For advanced students, making their own games using science vocabulary promotes in-depth understanding of words and their meanings.
- Game is also an extremely effective strategy to be used in teaching vocabulary (Linse, 2005). Harmer (2001) states that game can make learners to be more enthusiastic in learning vocabulary. It combines multiple learning strategies into an effective means of gaining, practicing, and applying new knowledge.
- Games also enable students to work cooperatively, encourage participation and interaction, and promote active learning. (Egounlete, P.M. 2018)

Multi-sensory Techniques

Another strategy of supporting students' information processing, is to supplement auditory information with visual signs. Multi-sensory experiences observing and communicating, benefit all students, especially those who struggle with literacy. Research has shown that words and text which enable the formation of images facilitate recall. (Jagger and Yore, 2012).



5. Conclusion & Evaluation

- These strategies improved engagement within the lesson, whilst supporting scientific discussion. It is important for students to recognise the value of science vocabulary used in discourse. (Quigley, 2018) Furthermore, with an emphasis on scientific language in Key Stage 4 science exams – it is important that scientific vocabulary is fostered from an early age. Using strategies which are based on experience, rather than memorisation had a positive effect on the students learning.
- Game based learning worked especially well with younger years and SEN children – where concentration and focus is more challenging. Some SEN students did struggle with the more creative tasks, but once given examples they were successful in completing the work. Games have proven to be an effective means for language learning and can be used at all stages of language learning development (Tuan and Doan, 2010) Learning strategies which use game-based strategies to engage learners, motivate action and interaction, and promote problem solving (Kapp, 2012).
- A potential limitation of these strategies is unnecessary extraneous cognitive load. Sometimes games can distract students and for some SEN pupils, certain games can result in sensory overload. Busy classroom environments can lead to the split-attention effect and add to extraneous cognitive load as shown in Figure 4 (Sweller, 2005). A balance needs to be found to ensure cognitive overload does not happen. Strategies could be incorporated to overcome this such as the 'chunking' method whereby information is condensed.
- Another possible critique of these strategies is teacher workload, and insufficiency of time. Differentiation strategies can be time consuming to create. Mifsud, Vella, and Camilleri (2013) conducted a study with a variety of stakeholders in education and found the majority support game-based learning, yet found that less than 10% of teachers implemented game-based learning into their instruction due to time constraint. Additional resources may add to existing workload – however by focusing on adapting lessons to allow higher student contribution and encourage independent learning, this could reduce workload in other areas. This may benefit teachers who list workload and lack of time as a barrier to teaching (Buchanan, 2015).

7. References

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6. Reflection & Next Steps

- Explore game-based strategies with KS4 pupils and classes of varying academic abilities.
- Further develop strategies for teaching vocabulary with a focus on EFL students.
- Refine resources to reduce extraneous cognitive load – explore 'chunking' strategies.
- Explore alternative inclusive strategies for SEN pupils.
- Expose students to various forms of reading and listening to text to promote use of scientific vocabulary in speaking and writing