Secondary Student Achievement PLD

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National Newsletter: All Sciences including Agricultural and Horticultural Science

Information and resources for middle leaders in secondary schools | Term 3 2016

Kia ora, Talofa lava, Mālō e lelei, Kia orana, Talofa ni, Faka'alofa atu, Ni sa bula, greetings.

The science team welcomes you to our third national newsletter for 2016. We trust that you have had a refreshing break and feel ready for yet another busy term.

In this issue:

Science capabilities

An article highlighting teacher success when they engage with science capabilities has recently been published in SET. This journal is published by NZCER to make research information available for teachers and as most schools subscribe you should be able to access the article either online or in hard copy.

This article stems from a professional inquiry carried out by two secondary science facilitators, as part of a continual strengthening of their facilitating practice. The article describes the reflections of several secondary science teachers as they progress their understanding of the science capabilities, and make changes in their classroom practices so that they develop these capabilities in their students. The teachers' experiences highlight some key factors that have made a difference to the development of successful lessons, units and programs leading to significant changes in outcomes for their students.

Cleary, S. & Bennetts, J. (2016). Moving ahead with the idea of science capabilities - what are teachers doing, seeing, and saying? SET 1, 2016. http://www.nzcer.org.nz/nzcerpress/set/articles/moving-ahead-idea-science-capabilities-what-are-teachers-doing-seeing-and-saying

Engaging students

Two Wellington schools **used a context located in Māori and Pasifika cultures to engage students**. Year 11 students were keen to research the waka as part of their physics 1.1 internal assessment. They have been investigating the linear relationship between the mass of the paddlers in the waka and the time taken to travel a fixed distance under a constant force.

Students made model catamarans and tested them with different loads using two modified gutters filled with water placed under each hull. A constant force was provided using a pulley and a mass attached to one end of a fishing line. These investigations engaged the students because the tasks were challenging and students valued their outcomes.

Another school **used the science capabilities to engage students**, focusing on one capability at a time. The Year 10 students are currently doing a series of activities based on the movie *The Martian*. They watch it, a scene at a time, looking at the science in each chapter and focusing on science capability 1 gathering data - observation. (Continued next page.)

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The science department in this Central North Island school has also combined with the mathematics department for this activity – some cross-curricular links. The students are enjoying the unit and are fully engaged.

Research in science – the process

Many science departments include research tasks in their internal assessment program. For a practical investigation task, students need to learn how to investigate and then be assessed on how well they have developed that skill. Likewise a research task requires students to learn how to research to effectively find information. Research is not the only way to 'demonstrate understanding' or 'investigate', but it can be a very useful tool.

Research is a skill that has many components. Once students have defined the topic and formulated their own question, they need to locate and select relevant information from a range of sources. This information must be processed (main ideas and keywords found; fact, opinion and bias recognized), summarised and organised into a coherent presentation. Often referencing is also wanted. All of these are skills that need to be taught and practised so beginning this process in the junior school reaps benefits for senior achievement.

Too often, though, minimal thought is given to these processes. They are complex and students need plenty of exposure to them. Yes, students will be researching in many subjects – but the sorts of websites they need, the types of text they have to read and interpret and the sort of writing that is required have many features specific to science. Many schools find students benefit from a common, school-wide approach that each subject adapts to their own specific purposes.

Recent research shows that many science teachers are not focusing enough on these information literacy skills in particular. Julien and Barker (2009) examined the information literacy skills developed in grade 11 and 12 biology students from a large multicultural urban high school who were seeking information on biomes. These Canadian researchers analysed both written responses and interview transcripts and found:

- Limited information literacy skills among the students.
- Teachers were focused on science content rather than on information literacy skills.
- Teachers acknowledged their information literacy skills deficits.
- Most students pasted the task question directly into the search box.
- Many students thought the first three or four web sites were the best so focused their attention on just those. Students scanned them for matching key words, and compared their content for consistency.
- Few students used any source other than Internet.
- Trustworthiness of information was predominantly viewed in terms of the site or resource rather than any evaluation of the content.

The authors suggested:

- Asking students to search using two or more different search engines to demonstrate just how serendipitous the process is.
- Teaching students how to search online at a more sophisticated level, including how to find, process and evaluate information.
- Drawing parallels between information seeking and science inquiry (as both elicit prior knowledge, plan the method, find evidence, explain and communicate findings).

Julien, H. & Barker, S. (2009). How high-school students find and evaluate scientific information: A basis for information literacy skills development. *Library & Information Science Research*, *31*(1), 12-17.

Links to resources to support information literacy

Choosing a search engine that matches your need
Noodle Tools

Tools to support students evaluating online resources
Eduscapes Edutopia

Information literacy - A collection of articles and links
Literacy OnLine TKI Information Literacy
http://www.searchfindknow.com/info-literacy.html

Term 3 dates

31 Jul–6 Aug	Cook Islands Māori Language week
10-14 Aug	Maths Week
31 Aug-7 Sept	NZ Asthma Awareness
1-30 Sept	Save our Sight Month
1 Sept	Annular solar eclipse (not NZ)
4 -10 Sept	Tongan Language week
5 Sept	Balloon day (asthma)
8 Sept	International Literacy Day
10-18 Sept	Conservation Week
16 Sept	Partial lunar eclipse 5.55 pm
23 Sept	Spring Equinox
25 Sept	World Rivers day
25 Sept-1 Oct	Tuvalu Language Week

This term is Science Fair time - look out for the dates for your area.

A good Science Fair will often exemplify the science capabilities. The student will be:

- Gathering data - observing and inferring.
- Using evidence - supporting explanations with evidence.
- Critiquing evidence – evaluating the validity of the method and the reliability of the data.
- Interpreting representations – explaining why the evidence is presented in a certain way.
- Engaging with science in the real world.

NZQA update Biology

Use of templates: Experience has shown that the use of templates and writing frames for assessment against standards can hinder achievement. This happens when teachers penalize students who do not fill everything in correctly. Currently there is only one standard referring to the use of templates: 90925 (B1.1 Investigation). Here, EN 4 states, "A template or suitable format for planning the investigation will be provided for the student to use." This is for planning only, and not considered as evidence for the final method in the report on the investigation.

New Tasks: Most Level 1 TKI science tasks have been refined, with a simplified structure. Teachers are encouraged to use these. The latest task for 90926 (B1.2 Research) is scaffolded and removes the need for templates. "The mode of assessment could involve a written report, a PowerPoint presentation, a 'press release' to inform the public or an article, or an oral presentation or debate." The refining of TKI tasks has focused on making them look less daunting for less able students. Teachers should look more closely at the science they teach these students as much of it is too complicated.

Vocabulary Help: Complexity of the vocabulary can be addressed by giving a key word/term list at the beginning of the topic and using a range of strategies to teach the science terms. This could mean using a different vocabulary strategy every period or two - flash cards, matching lists, clusters, dominoes, I Have Who Has, Chinese Whispers. Students need practice on using dictionaries and glossaries. For 90926, these are skills being assessed as part of the standard. To ensure the task is accessible to low literacy students, teachers could use the ESOL/literacy teacher or RTLB to read the standard and task to identify words that students at reading or writing level 2-3 may not be familiar with or may be disadvantaged by. They can often offer alternative words or phrases, which do not alter the integrity of the task and the biology level being assessed, e.g. level 6. The critical point is that assessment should not be carried out against the standard until students are ready.

Processing Information: Standards that can be used for overall literacy credits, like 90926 (B2.2 research) need a task with an appropriate language focus. While 'writing' is often the best method to display evidence for meeting the criteria (and for the teacher to authenticate the evidence), it does not mean that this is the only mode of assessment that can be used to collect evidence. Students could show evidence of research skills such as processing by developing a portfolio. Students can process info in a digital format - using cut and paste, highlighting in colour etc. If they did this they would have to make it electronically available - printed file, USB or even letting them keep a blog. From this, the student could then give a speech or seminar - but they would have to provide written supporting evidence to show where/how they collected and processed the speech information.

Refining Research Questions: With standard 90926, students need to refine a given question or purpose to guide both their research and their presentation of evidence. It is important that schools do not just give students a research question to copy - the Explanatory Notes are quite clear on this. Moderators are still finding this is an issue for some.

Standard 91155 (B2.3 Plant & Animal Adaptations): This standard may be more fairly assessed using the collection of evidence rather than a test/exam, as indicated in the updated Conditions of Assessment. Using humans as a mammal is fine, especially if the adaptations to living in an extreme environment involve known physiological adaptations of circulation or gas exchange, as with Sherpa. The key here is "way of life" - humans live on land and need to get oxygen from the air. The TKI task 2.3B has been updated to show the relationship between adaptations and how these help animals (mammals in this resource) survive in their habitat. The previous version's evidence statements had an over-focus on structure and function as the evidence, without enough links to way of life (EN 4) etc. For this reason choosing a choosing a water living mammal as well as a land dwelling is a good idea, as it gives students better opportunity to look at limitations and advantages, as well as the connectedness of the two systems.

Recent national reports from ERO

Vocational pathways: authentic and relevant learning. May 2016
http://www.ero.govt.nz/publications/vocational-pathways-authentic-and-relevant-learning/

Modern NZ learning practice: glossary. February 2016
http://www.ero.govt.nz/publications/modern-new-zealand-learning-practice-glossary/

New Code of Practice workshops from NZASE

As the Health and Safety Act has been introduced, the Code of Practice for Schools Exempt Laboratories has been refreshed to reflect the new Act. The Guidance Manual for Safety in Technology Education is also being refreshed.

Workshops will be held to discuss

- The refreshed code.
- An overview of the key parts of the Act that impact on schools.
- Ramifications particularly in the science and technology learning areas.

Each of these NZASE workshops runs from 9:30 am – 12:30 pm:

Whangarei Fri 5 Aug
Auckland North Sat 6 Aug
Auckland Central Fri 12 Aug
Auckland South Sat 13 Aug
Hamilton Fri 19 Aug
Tauranga Sat 20 Aug
New Plymouth Fri 26 Aug
Palmerston North Sat 27 Aug
Napier Fri 2 Sep
Wellington Sat 3 Sep
Invercargill Fri 9 Sep
Dunedin Sat 10 Sep
Nelson Thu 15 Sep
Greymouth Fri 16 Sep
Christchurch Sat 17 Sep

Venue and registration information is not available yet, but these workshops will be free. All high schools should ensure they send 1-2 staff members to these workshops, who then report back to all at their school who need to know. Information will be posted online at http://nzscienceteacher.co.nz

Reading in science part 2: Priming students for reading

Last term we looked at how to get struggling readers underway with developing reading skills. This term we are looking at preparing students for reading. Often as science teachers we just plunge right on in to find the science in our chosen reading. But if we take a more considered approach our students will gain a more complete understanding.

Although secondary school students may have some reading ability, science reading requires different skills than reading in English (or in other subjects) as it includes a lot of features that are peculiar to science. In contrast to other writing, science writing:-

- Often has an opening general statement and each paragraph has a topic sentence, with meaning built up step by step.
- Is concerned with facts.
- Contains language that students may not be used to:
  - academic language e.g. analyse, conclude, formula, identify
  - technical language e.g. mitosis, alkali, acceleration
  - general words that also have different scientific meanings e.g. potential, respiration, solution, table, property, weight
  - complex sentences with many phrases.
- Is usually set in no particular time, will not include characters or individuals, and will be written in an objective style.
- Uses action verbs, linking verbs, and tools such as nominalisation to condense language. (Nominalisation makes verbs into nouns e.g. nutrient depletion, desertification, fossilisation, accelerating.)
- Often includes visual images which also require interpretation skills.

As teachers we are experienced and successful readers of science but our students need support to develop the skills necessary to cope with these features of scientific language, which at the start will be unfamiliar to them. This is especially important for our ESOL and less able students.

Before students read it is important to establish a purpose for reading, to use text features to predict content and to link to what students already know (NZC p. 34). Pre-reading strategies, such as those below, are designed to meet these 3 aims:

- **Brainstorming** – collate ideas about the topic with the whole class or ask students to draw their mental image of 1 aspect or list key vocab.
- **KWLH** – this 4 column table invites students to describe what they **K**now and what they **W**ant to know before they read (and what they **L**earnt and **H**ow they learnt it afterwards).
- **Postbox** - invite students to post their questions on the topic.
- **Preview and predict** - get students to preview the text (give them headings, images, captions, bolded words; or a word cloud) and then predict what it will be about – making them more active as readers.
- **Anticipatory reading guides** – write about 6 T/F statements that catch the reader's interest and focus on the main messages of the reading. Students work independently, agreeing or disagreeing with the statements then share their choices with a partner.
- **Before and after vocab grids** – in a 3-column table, list some key science terms from the reading. Students write their own definitions for each word without using a dictionary. After the reading students confirm or revise their original definitions. A class discussion on the answers is often fruitful.

Using a selection of some of these strategies gets the students primed, reminds them of some key vocab and gives a reason to read (to answer their own questions). Developing literacy skills does take time but bears fruit in increased student understanding and achievement.

With science texts it can also be useful to explore any accompanying images – photos, diagrams, tables, graphs, flowcharts. Make sure the students understand both the component parts (what colours, relative sizes, arrows and lines mean) as well as the whole message of the image and how it might relate to the reading. Sometimes this is useful to do before the reading begins; at other times, understanding the images is dependent on understanding concepts in the text first. The science capability *Interpreting Representations* may be useful here.

Pre-reading strategies

These links explain the strategy more fully and most also have at least 1 science example.

KWLH chart
http://esolonline.tki.org.nz/ESOL-Online/Teacher-needs/Pedagogy/ESOL-teaching-strategies/Oral-language/Teaching-approaches-and-strategies/Reading/KWL-chart

Anticipatory reading guide
http://esolonline.tki.org.nz/ESOL-Online/Teacher-needs/Pedagogy/ESOL-teaching-strategies/Reading/Anticipatory-reading-guides

Before and after vocab grid
http://esolonline.tki.org.nz/ESOL-Online/Teacher-needs/Pedagogy/ESOL-teaching-strategies/Vocabulary/Before-and-after-vocabulary-grid

Word cloud
Copy and paste some text, words and headings, from the text into a program like wordle. This creates a jumbled collection of words in which the size of the word is proportional to how often it appears in the text.

Note: These do not work so well on Macs. You could do it on a PC first and email it to the Mac.

Professional reading

Fang, Z. & Wei, Y. (2010). Improving middle school students' science literacy through reading infusion. *Journal of Educational Research, 103*: 262-273.

References

- https://arbs.nzcer.org.nz/research-and-articles#language-barriers
- https://arbs.nzcer.org.nz/supportmaterials/language_of_science.php
- Literacy in the Science Classroom ppt - Aaron Wilson
- Effective Literacy Strategies in Years 9-13, A Guide for Teachers, 2004.
- Making Language and Learning Work DVD 1 – this 1st in the series of 3 DVDs focuses on literacy in Science and is a useful tool in any PLD on literacy in our subject.