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Jim Sturgiss

Jim Sturgiss helps to improve writing in Science classrooms…

Writing is subject-specific. Writing is not speech written down. Writing has the capacity to facilitate the abstraction of concepts and promote higher-order critical thinking. The Science classroom provides excellent opportunities to improve literacy skills and in turn, improve overall student learning outcomes. Over the past few years, analyses of external national and state assessments have suggested high school student writing performance has been undergoing a slight but discernable decline (See Appendix attachment for more detail about NSW external Science assessments and results).

This paper provides some explanation and examples using NSW 7-12 Science syllabus outcomes to demonstrate how teachers can improve writing in their Science classroom.

Literacy is subject-specific

> *Three custom DiMarzio pickups in hum/single/single configuration are mounted on Parker's newly designed pick guard, while the ever-cool Fishman passive-piezo-transducer system is located in the bridge.*

Science is a technical subject. Its language reflects its technicality. The quote above is from Guitar Magazine. It serves to show how alienating technical language can be for the uninitiated.

The technical vocabulary of science is the most obvious subject-specific language issue. But it is deeper than that. Peter Freebody (2009) asserts that there is a common sense myth that literacy is a fixed, bounded set of skills related to code-breaking and that once the student can break the codes of English, the rest of the school years simply become a matter of reading and automatically understanding all the rest. Freebody claims that many mistakenly believe that specialised textual formations in Physics or Mathematics, History, English, Biology, literary criticism, and all the rest, are basically just talk written down, conceptually and linguistically transparent, commonsensical and the equivalent of a Year 3 storybook.

On the contrary, academic development is dependent on the specific ways in which content knowledge is developed through language both written and visual. Accessing those kinds of texts is the ongoing literacy challenge for schools.

Teachers can begin the process of improving student writing by pointing out to students the variety of ways in which different texts build knowledge; how language and visual information work together in different ways in various curriculum areas and more specifically within their subject discipline.

Critical literacy

Today's science students need to do more than accept information at face value; they need to be able to understand, use and critically analyse texts' validity and underpinning points of view.
Knapp (2014) asserts that teaching writing is teaching students how to think, to order and synthesise their thoughts, and gives them the skills to demonstrate what they know. Furthermore, schools that use a systematic and explicit approach to teaching writing give their students an unassailable advantage.

The example of windfarms could be used when teaching the Stage 4 outcome:

> SC4-PW4 Science and technology contribute to finding solutions to a range of contemporary issues; these solutions may impact on other areas of society and involve ethical considerations. (ACSHE120, ACSHE135)

Windy Hill Farm - Atherton Tablelands Queensland (Wikicommons)

For instance, when a politician describes a wind farm as:

> *"Up close, they're ugly, they're noisy and they may have all sorts of other impacts," Mr Abbott said.*
> *"It's right and proper that we're having an inquiry into the health impacts of these things," he said, referring to a current parliamentary inquiry initiated by crossbench senators*

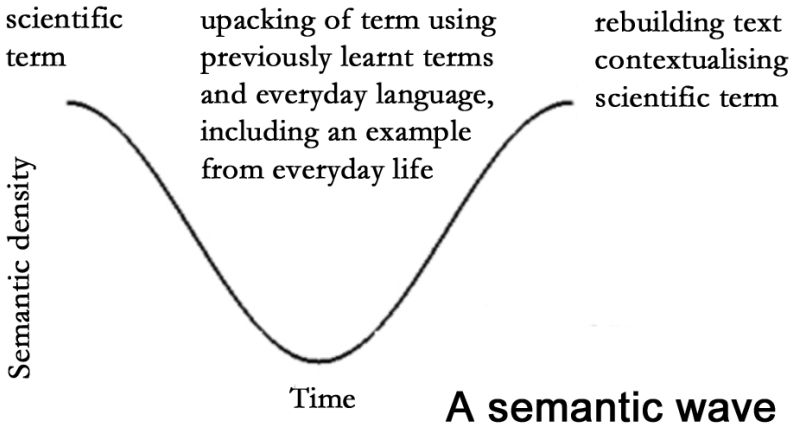
Students should be taught how to consider and write responses to questions such as:

- Is this text presenting a balanced view of the issue?
- Whose voice is represented here?
- Whose voice is missing?
- What action do I need to take?

Taking students from technical to understanding and back again - the semantic wave

Karl Maton (2011) claims that the academic/technical language of subject disciplines has semantic density built up by specialist noun groups (amongst other grammatical features). Maton acknowledges

that subject-specialist teachers are experts in breaking down the technical language of their subjects to a less semantically dense, less powerful common sense language for students. However, students require opportunities to rebuild the semantically dense texts that are characteristic of the subject disciplines if they are to master subject-specific literacy.



A semantic wave

Writing provides students opportunities to explore ideas, to have these ideas challenged and developed through the drafting and editing process.
For instance, before teaching the Stage 4 outcome:

> SC4-CW1 The properties of the different states of matter can be explained in terms of the motion and arrangement of particles. (ACSSU151)

Science teachers should ask themselves:

- Is our pedagogy didactic?
- Do we think we have so much content to get through that we must provide students with the explanation for phenomena?
- When was the last time we gave Year 8 students an opportunity to write an explanation of change of state using the particle model?
- What do we know about student understanding of such high-order abstract concepts?

Speech to writing - increasing semantic density

Science provides excellent opportunities for students to write expressively. In high school, students spend more periods in the study of Science than most other disciplines. Factual texts are the bread and butter of the discipline. Science teachers have great opportunity to develop students' writing skills.

A challenge for teachers is to move student responses from speech-like constructions of actions in science, to a more abstracted top-down mode of written scientific English that deals with concepts.

There is a common sense view that writing is speech transcribed.

However, this is not the case. Writing has evolved as a distinct mode of language (Knapp, 1992, p2). Writing is a permanent record of language. Speech tends to describe a concrete world dominated by action verbs and an action-oriented clause construction, whereas, writing has evolved to deal with the world in a more abstract way where actions become objects and concepts set in spatial and causal relationships. Writing is more compact, more abstract and more powerful than speech. It characteristically has a higher semantic density.

What a difference a word makes - nominalisation

Nominalisation is the process of making a verb or adjective into a noun. Semantic density can be increased through a nominalisation strategy performed on a draft text the students may have written. The exercise below should assist students in moving their writing away from speech transcribed to a more semantically dense and more abstract higher-order text. This process is demonstrated below using the HSC Biology outcome:

H10 describes the mechanisms of evolution and assesses the impact of human activity on evolution

1. Identify the action verbs in a text they have written (in red below)
2. Draw up a table with the verbs in one column and the nominalised form (nouns) in the next.
3. Redraft the text using some of the nominalised forms.

N.B. This strategy should be used selectively. Not all verbs need to be transformed. Indeed, if all the action verbs are nominalised the text will become dense to the extent of being impenetrable.

Evolution of single-celled organisms

1. First Draft (action verbs indicated in red)

All organisms reproduce and sometimes when they reproduce, the children vary. This is an important characteristic of life. If organisms did not reproduce, life would quickly come to an end. The earliest single-celled organisms duplicated their genetic material and then they divided in two. Two daughter cells resulted from this process; they were identical to each other and to the parent cell. But sometimes as the genes duplicated, they changed or mutated. These errors are not very common but they provide the basic material for life to evolve. So when the genetic material duplicates, they reproduce and they make errors. As a result, there is a change in what the genes are composed of. When these processes combine, life evolves.

2. Table with the verbs in one column and the nominalised form (nouns) in the next

Verb	*Nominalisation*
reproduce	reproduction
duplicated	duplication
divided	division
resulted	result
changed	change
mutated	mutation
combine	combination
compose	composition
evolve	evolution
vary	variation

3. Second draft

Replication in simple single cells is achieved through the duplication of DNA before cell division. Mutations occur rarely but provide the necessary variation in individuals that is required for the evolution of species.

Comment on first and second draft

The second draft is more concise. Much of the spoken rumination has gone. The first draft text has short sentences. It is longer. It contains many action verbs. All these features are typical of spoken language. The second draft is more abstract and more compact. This increased semantic density is achieved through the nominalisation of actions into processes (nouns).

The good and great scientists of the future will quite often also be skilled communicators. We as Science teachers can help them along this path.

Jim Sturgiss has held a wide variety of educational positions. These include: Lead analyst, Senior test designer for the English Language and Literacy Assessment (ELLA) and Essential Secondary Science Assessment (ESSA), as well as a HSC Chemistry Senior Marker and Judge. He has been Head Teacher: Science, at two high schools. He was a Director of the NSW Science Teachers Association (STANSW) for 7 years and is currently a director of the NSW Professional Teachers Council and chair of its Professional Learning Committee. His M.Ed (Hons) thesis used an experimental design to evaluate the effectiveness of a literacy and learning program (1997). He is currently teaching Science and Mathematics at Concord High School.

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