INTRODUCTION: Our Link to the Theme

The capacities people have to transform as part of the “new economy” using energy forms such as wealth creation provide the theme for this volume. However, to adapt skill bases, to reidentify and regenerate in macro terms as we seek genuinely fulsome participation in community are potentials that stretch beyond narrow concepts of “new economy”. After events in New York, Washington and Pennsylvania of 11 September 2001, “world community” and “global safety” seem at least as worthy as “wealth creation”.

Accordingly, our link to the theme is a view that capabilities to transform on a macro scale have their origins in first learning that we are able to transform, and then thinking and generalising beyond immediate contexts. We consider that this happens at levels much more micro, such as in the opportunistic events of schooling. Realising and responding as a High School student to connections between academic performance and the deliberate attention given to being strategic as a learner seems to us to provide opportunity for an individual to adapt behaviours constructively. It is an opportunity for the individual to transform, to know that he/she has done so, to know how it has been done and, to evaluate the worthiness of doing it again. We report here on one such opportunity that presented to students and teachers at a Brisbane metropolitan high school.

WHAT MAKES AN INTEGRATED APPROACH?

Science Teachers Originated the Project

The impetus for this project was a desire on the part of Science teachers to help their students derive greater benefits from science textbooks used at their school. They sought assistance in professional development under a grant from the Quality Teacher Program of the Department of Education, Queensland. The Science teachers wanted to teach their subject in ways that prioritised an attention to students’ literacy and strategic learning.

A working party at the school had decided to focus their efforts in this regard initially on Year 9 classes and then to move to other year levels as their confidence and competence grew. This sequence proved to be impractical as not all in the group that participated in the project’s professional development component taught Year 9 Science classes. In practice, individuals made applications wherever their work was.

The Project Group consisted of four Science teachers, three Support teachers, two teachers from an adjoining primary school and the first author. Visitors such as the Principal dropped in to sessions from time to time. One of the Science teachers missed a session through being on long-service leave. One of the Support teachers missed the first two sessions.

Participants named the professional development program “SELL” (Science Education through Literacy and Language). It consisted of five, half-day sessions with the combined group, and nine half-days of voluntary, “critical friend” sessions with each participant. Booklets for staff and students were produced to outline the design and outcomes, and to facilitate generalisation of the project to other sections of the school’s teaching staff. For three teachers, the critical friend sessions became demonstration lessons with
their classes. In two of these cases, teachers first submitted a draft lesson plan for interaction with the first author, one immediately prior to the lesson, the other two days beforehand. Then, they implemented the lesson with all or part of the Program Group in attendance. This was followed by a plenary on the experience, where the teacher led group review and critique. Others chose to speak with the first author, independently of students and peers. We spoke about epistemology, perceptions of normal and preferred pedagogy and of the current state of their knowledge and confidence associated with the program. One of the primary school teachers could not be scheduled to demonstrate her teaching, but felt that her teaching partner (the other primary teacher) had given much the same lesson in much the same way as herself. The support teachers met together with me as a small group; the Coordinating Support teacher then met again with me separately.

In the first three sessions we worked collaboratively toward a framework from which to choose and focus key strategies. Teachers decided to concentrate on raising students’ awareness of attending to information sources, selecting appropriate and essential information, processing selected information from comprehension and memory standpoints, retrieving information in response to typical classroom tasks, and adopting a reflective stance. Later, we included using top-level structuring to assist writing. In settling on this frame, we workshopped a number of strategies that some teachers had previously experienced and other strategies that were relatively new. The framework provided an integrating device. Session 2 and some of Session 3 were spent specifically on top-level structure and top-level structuring. This involved exploring top-level structuring as concept, strategy and working approach to use with the Year 9 textbook.

The “critical friend” sessions occurred between Sessions 3 and 5. The fourth session constituted the “review” in the first of these planning-demonstration-review experiences, and provided a preview of the form and content of the Project Booklet for Teachers, the Project Booklet for Students, and, the Project Report. The fifth session was a review of each individual’s experiences and aimed at consolidation of what had been learned from the workshops and in-class trials. It included also an account of pretest data. These were (a) information collected by an independent observer of teachers and students in Science classes, (b) survey data about views of learning and literacy from students (c) and teachers, (d) performance indicators on students’ knowledge of top-level structuring, (e) students’ accounts of how they identified main ideas in their classroom text, and (f) students’ performances in locating a main idea.

An Understandable and Workable Framework
Science educators traditionally have sought to promote methods of scientific inquiry that are readily appreciated and adopted by students. This is an issue additional to concerns for the appropriateness of curricula and ideational content, and is one that has attracted wide, and sometimes bitter, debate. Identifying processes involved in scientific inquiry does not seem to be a problematic issue. For example, the International Education Assessment Study of Science asserted that, “Processing skills such as those associated with basic laboratory experiences such as classification, observation, and measurement of phenomena, are commonly considered essential elements of instruction” (Rosier & Keeves 1991, p.264). Metz (1995) observed a common trend reflecting such aspects of scientific inquiry that had been targeted for young USA children in her analysis of major commercial materials, and by the influential Science Framework for California Public Schools (California Department of Education, 1990). Locally, these elements are included amongst core skills associated with Science by the Queensland Board of Senior Secondary School Studies and conceivably are nurtured by the process of learning itself as Queensland students such as those participating in this project move through their studies.

Unlike the consensual view of what processes are important, there have been serious concerns about how such processing skills are conceptualized and activated. Metz (1995) observed that theorists and teachers have struggled with Piagetian and non-Piagetian interpretations of just what it is that students can and should do. She concluded that there was high risk that educators and students alike would have “a vision of science without a robust sense of meaning or purpose” (p.95) when potentially rich ways of thinking were excluded from the scaffolds that teaching provides. Any attempt to guide students to thoughtful approaches about thinking itself may have some merit (Bartlett, 1991). However, there are some (deBono, 1999; McGrath, 1998) who consider that schools (and perhaps science teachers particularly) that have “thinking” as part of an instructional agenda may be overly attentive to logico-analytic methods at the expense of more
generative, reflective and lateral forms of thinking and discovery. In essence, these concerns have two elements. First, teaching students how to be smart in their thinking about science needs a set of thinking outcomes comprehensive enough to enhance both mastery of essential content and exploration of what such mastery means. Second, there needs to be some systematic framework from which to organise the planning, implementation and evaluation of such teaching and learning.

One means that combines different styles of thinking under a collective and purposeful umbrella is to centre opportunities for gathering information about process, self and subject as the key element of any engagement between students and teacher (Bartlett, Lapc, Wilson & Fell, 1998). Bartlett et al reported a cross-curriculum learning enhancement that resulted in wide-ranging outcomes for students. These included improved academic performance, self-confidence and appreciation of schooling and teachers. Teachers in this program also reported positive outcomes, notably with their own professional satisfaction. The process had three components. The first was to have teachers identify how language worked in their content field – e.g. what “common” words have particular meaning, how propositions of content build as chunks of language, what structures and expressions are preferred. The second was to help teachers search for what they believed were shared elements critical to a learner’s success across subject fields. The third was to incorporate into lessons an ongoing series of checks with students on the accuracy of these perceptions and on strategies used or needed by them to be effective in that element. Bartlett et al had provided teachers with a set of common strategies to which teachers and students could default in the event that their own strategies were ineffective. Clark (2000) designed a similar program where teachers and students collaboratively constructed a repertoire of thinking and operating skills that informed learning.

Teachers at Camp Hill State High School previously had used a number of strategies in an attempt to reach their objective. These included concept mapping, SQ3Rs, 3 Level Guides, PReP and Cloze – strategies that in independent application had proven effective in various ways (O’Donnell, 1993; Scevak, Moore & Kirby, 1993). This exploratory stage had prompted greater interest at the school in a more systematic, strategically based approach. Accordingly, in this project we constructed a “Literacy Strategies” framework from which to select strategies appropriate to what we considered critical elements of engagement. Our purpose was to offset student passivity in relation to literacy aspects of their engagement with science. Teachers considered many of their students were underskilled or disorganised in gathering ideas and information from reading the assigned text. They believed this was particularly apparent in the students’ search for main idea information and, in presenting what they knew.

The framework made specific provision for students to self-regulate and focus their attention, their working knowledge that ideas in text are interrelated, their mapping of content, and their reconstruction and construction of information following reading. Collectively, this framework made for a bag of strategic tricks that would be accessible to teachers and students, and for which the team used the working title, “HiSCI” (Help in Science).

Selecting Strategies
Prior to SELL, teachers at the school had trialled several strategies that had support from the research literature. In filling the framework we selected concept mapping from these, along with top-level structuring (Bartlett 1978; Bartlett, Barton & Turner, 1989; Meyer, Young & Bartlett, 1993), word-in-the margin (Bartlett et al, 1998) and stay-alert (Bartlett et al, 1998). The nature and operation of these were workedshopped in early sessions of SELL. Particular attention was paid to top-level structuring, a procedure through which a strategist applies what is known about the hierarchical organisation of content in order to achieve memory, comprehension and expression outcomes. This procedure applies to both encoding and retrieval features of learning. It allows the strategic reader, listener or viewer to form an opinion on what a writer, speaker or performer considers as essential content and if necessary, then to move on to critical or inferential analysis. Conversely, it allows a strategist as writer, speaker or performer to produce coherent text and to signal what he/she wants to be seen as essential content. It is a dominant strategy for teaching students how to appreciate organisational features in their language, and to convert such appreciation into literacy enhancement (Bartlett, 1978; Meyer, Brandt & Bluth, 1980; Meyer, Middlemiss, Theodorou, Brezinski, McDougall and Bartlett, 2001).
After experiencing effects of top-level structuring as part of the workshop in SELL, participants took the decision to use it as the central strategy in HiSCI.

**Top-level Structuring and Its Teaching**

As top-level structurers, learners approach the tasks of gathering information from text with strategic knowledge that the text has been organised in one of five particular ways. This knowledge helps them to select one structural plan that best matches the author’s pattern of interrelations among content elements at its macrolevel – hence the term, “top-level structure”. Having made the match, the learner then is able to construct main idea by dressing the selected plan with content that may occur at different points throughout the text, but which explains how the plan “works”. For example, if a comparison organisation is identified, the main idea will be a statement of what is being compared. If the organisation is causal, the main idea will be a statement of what is causing and with what effects. Similarly, a problem and solution organisation will generate a description of what is problematic and what solution is found, and a list structure will build into a statement that the main idea is a list of a particular number of features of a topic. The fifth possibility is a messy or disjointed organisation, where the lack of any definable cohesion in the writer’s text requires readers to impose one of their own; one of the four mentioned here.

Instruction about top-level structuring is likely to be successful if it is deliberate, explicit and well planned. It has provided a strategic approach for students from 5th grade level (Meyer, Young & Bartlett, 1989) through secondary school (Bartlett, 1978) to senior adults (Meyer et al., 2001; Meyer, Middlemiss, Theodorou, Brezinski, McDougall and Bartlett, 2001; Meyer & Poon, 2001). The significance of the approach is that it is accompanied by increased proficiency in remembering and comprehending what has been read (Meyer et al., 2001). The major effect of a successful take-up of top-level structuring as a learning strategy is that it improves students’ abilities to “[analyse and use] text structure to abstract main ideas” (Pressley & McCormick 1995, p.480). Improvement in writing skills for those taught to be top-level structurers has been recorded by a number of theorists (Bartlett & Fletcher, 2000, 1999; Gordon, 1990; Hammann & Stevens, 2001; Meyer, 1982; Raphael & Kirschner, 1985).

In this project we introduced top-level structuring as the basis for an integrated approach to instructing students to learn Science through literacy and vice versa at a metropolitan state high school in Brisbane, Australia. Goals of the project were to affect positive changes in Science teachers’ and students’ capacities (a) to talk about learning science in conceptual and operational terms, and, (b) to incorporate literacy strategies when working with their Science textbook.

Specifically, we sought to increase:
1. teachers’ and students’ knowledge and use of strategic top-level structuring and supporting strategies to organise encoding and retrieval of textbook material,
2. students’ performances in identifying main idea information in textbook content,
3. students’ content knowledge, and,
4. students’ literacy.

**WHAT WE HAVE DONE**

In a typical proactive design, data were obtained from participants before, immediately after, and one term after SELL to research the effectiveness of the project. On each occasion, teachers were asked to complete “State of Play” analyses on the extent to which their teaching typically incorporated intentions, activities and strategies to promote awareness of language and learning issues involved in mastering the science content under address. They were asked also to indicate the evidence upon which they responded. Additionally, an independent observer sat in classes given by each teacher to note instances of teacher and student behaviours thought to align with objectives of the project. A checklist constructed jointly by the first author and the Head of Science guided these observations.

Students were also surveyed on how they read their science textbook. Three text passages were selected on topics about nuclear power that the Year 9 classes were to encounter over the following term. The passages were of equivalent length and presentation was counterbalanced across pretest, and immediate and delayed posttests. On each occasion, students read the test passage as a point of reference for describing how they
got started as readers, and what let them know they had finished. They were asked also what they did to focus and maintain concentration, what memory strategies they used, what knowledge they had of organisation in the text, and, what they did to identify and track important information, including the writer’s main idea. Finally, they were asked how the main idea they had identified fitted into their own understandings of Science.

WHERE WE ARE GOING
At the time of writing, we have collected all pretest data. Teachers have introduced HiSCI into their classes and its underpinning principles into their lessons. The final session of SELL will be conducted two weeks into Term 4 and the immediate posttest a week later. At this point, our efforts are a work in progress. Certainly, teachers have taken a reflective position on their work, incorporating in their lessons deliberate and explicit strategic training for students to encode and retrieve information from textual content. They consider they are accumulating a competence in improving students’ literacy for learning skills and that students are responding positively to their teaching. They report that students appear to be more alert and engaged with their texts. Test data will reveal the extent to which these early observations are validated. Analysed across the three times of testing, they will provide statistical reference to whether teachers and students in this project transformed their capabilities in pursuit of educational objectives, and perhaps as a basis enabling more macro levels of regeneration at some future time.

REFERENCES
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