# TfEL and primary connections 5Es

## TfEL and Primary Connections 5Es

### Introduction

The Teaching for Effective Learning Framework is based on constructivist learning theory. Students making sense of what they are learning and taking increased responsibility for their learning when making choices about learning, which fosters deep understanding. The TfEL framework is an holistic framework which focuses on student wellbeing for learning as well as high achievement. A teacher will demonstrate different elements of the framework depending on the context –e.g. time of the year /lesson/unit of work, class composition, age of students, community knowledge etc.

Teaching for Effective Learning is based on teacher responsiveness to the students and their learning needs.

### What do teachers do when they are implementing aspects of TfEL?

For each element of Teaching for Effective Learning there are a set of signs or behavioural, teaching indicators which demonstrate what that element looks like in practice in a classroom. These signs are not exhaustive or prescriptive, but provide examples of behaviours which indicate that the teacher is working effectively in this element. See attachment for full example of the TfEL signs.

Is TfEL congruent with the 5Es teaching and learning model? [i]

| *The 5 Es* | *Purpose* | *TfEL signs* |
|---|---|---|
| *Engage* | Create interest and stimulate curiosity. | • find hooks for students' meaning making by connecting to what they already know |
| | Set learning within a meaningful context. | • design learning experiences that are of personal, local or national significance |
| | Raise questions for inquiry. | • ask and elicit leading questions to stimulate new connections, test for understanding and develop precision in language<br>• design learning challenges which are open and stimulate further questions |
| | Reveal students' ideas and beliefs, compare students' ideas | • actively seek out what students know, can do and understand<br>• proved opportunities for students to compare beliefs and / or assumptions with other learners, wider society and experts |

| | | |
|---|---|---|
| *Explore* | Provide experience of the phenomenon or concept. | • help learners identify what they know and don't know by exposing them to new ideas and new areas<br>• explore the ways of knowing the disciplines |
| | Explore and inquire into students' questions and test their ideas. | • pose questions that elicit inferences<br>• encourage risk taking and discovery<br>• raise students' awareness of what they know and want to know<br>• provide opportunities for self direction and initiative with regard to what is learned and how it is learned |
| | Investigate and solve problems. | • support learner initiated inquiry and problem solving |
| *Explain* | Introduce conceptual tools that can be used to interpret the evidence and construct explanations of the phenomenon. | • stimulate rethinking and re-construction of knowledge by introducing contentious of ambiguous concepts to create intellectual conflict<br>• explore the ways of knowing in the disciplines |
| | Construct multi-modal explanations and justify claims in terms of the evidence gathered. | • encourage students to make sense of their learning by talking it through with others<br>• use a range of media for communication learning according to audience and purpose<br>• guide learners to see patterns and relationships in direct experience, information and data<br>• help learners understand how implicit cultural assumptions and perspectives can create bias and influence the way knowledge is constricted |
| | Compare explanations generated by different students/groups. | • deliberately design conversational activities through which shared meaning can emerge<br>• encourage students to make sense of their learning by talking it through<br>• exposing learners to new knowledge |
| | Consider current scientific explanations. | • develop and use explicit language for understanding<br>• build rich conceptual knowledge |
| *Elaborate* | Use and apply concepts and explanations in new contexts to test their general applicability. | • apply abstract concepts to real life contexts<br>• use community contexts and issues as a basis for learning<br>• use examples that students can relate to |
| | Reconstruct and extend explanations and understanding using and integrating different modes, such as written language, diagrammatic and graphic modes, and mathematics. | • ensure students access a diverse range of meaning making and communication modes<br>• employ contemporary technologies – ICT<br>• use a range of media for communication of learning according to audience and purpose<br>• encourage learners to exhibit their learning through performances of understanding in different modes |

| | | |
|---|---|---|
| *Evaluate* | Provide an opportunity for students to review and reflect on their own learning and new understanding and skills. and skills. | • create opportunities for self assessment of performance in real contexts<br>• help learners recognise that mastery is achieved through persistence and practice and deep insight comes through continued application and reflection<br>• encourage metacogntive reflection to develop learner self awareness |
| | Provide evidence for changes to students' understanding, beliefs | • encourage learners to exhibit their learning through performances of understanding in different modes<br>• use assessment for, of and as learning strategies<br>• provide opportunities for consolidation of mastery |

PrimaryConnections
Linking science with literacy

# Primary Connections



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SA TfEL

Learning for effective teaching

*design, plan and organise for teaching and learning*

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Linking science with literacy

# An Australian Innovation in Inquiry-based Primary Science Education

Mark W Hackling

Edith Cowan University

Perth, Western Australia

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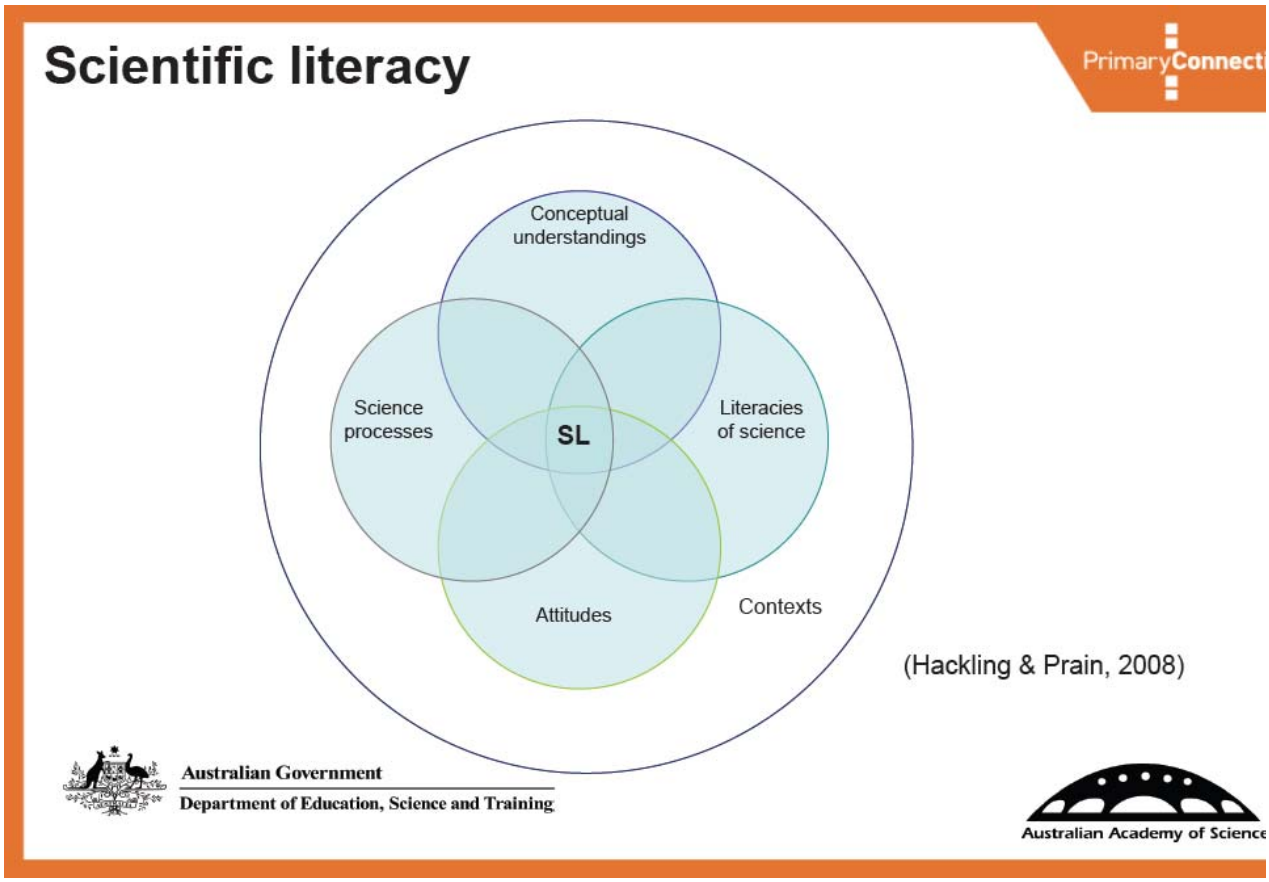
To explore the most recent South Australian Teaching for Effective Learning Resource work >
www.learningtolearn.sa.edu.au/tfel/

Published by the Teaching for Effective Learning Team, Curriculum Services


Scientific literacy
PrimaryConnect
Conceptual understandings
Science processes
SL
Literacies of science
Attitudes
Contexts
(Hackling & Prain, 2008)
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## Concerns about primary science

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- Teacher confidence and self-efficacy
- Time given to teaching science
- Student achievement

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## The chain reaction

Low science PCK → Low confidence and self-efficacy → Low science teaching time → Little opportunity for learning → Low science achievement

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## *Primary Connections*

PrimaryConnections

*Primary Connections*:

- an initiative of the Australian Academy of Science funded by the Australian Government
- aims to improve learning outcomes in science and literacy by developing teachers PCK
- through a professional learning program supported with curriculum resources

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# Professional learning

| | |
|---|---|
| University science educators | Pre-service teacher education |
| Professional learning facilitators | In-service teacher education |
| Curriculum leaders | Coordination of science within their schools |

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## Teaching and learning approach

1. Links science and literacy teaching – explicit teaching of science literacies
2. Inquiry oriented and includes student planned investigations
3. Assessment is used to support learning
4. 5Es teaching and learning model
5. Cooperative learning strategies
6. Teacher background information

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## Linking science with literacy

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- Students must learn the social language, representational forms and vocabulary of the discipline (Norris & Phillips, 2003; Gee, 2004; Unsworth, 2001; Mortimer & Scott, 2003)
- Use "everyday literacies" to develop the "literacies of science" needed to learn science (Gee, 2004; Street, 1995)

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## Linking science with literacy

- Literacies of science are the literacy practices associated with the interpretation, construction and communication with multimodal science texts
- Science provides a meaningful context and a purpose for literacy learning

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## Inquiry and investigative approach

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- Starts with questions
- Explanations and understandings emerge from experience through discourse
- Teacher scaffolded and student planned investigations
- Provides an opportunity to learn the science process skills for investigating
- Helps students develop an understanding of the nature of science

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## *Primary Connections* 5Es teaching and learning model (AAS, 2005)

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| Phase | Focus |
|---|---|
| ENGAGE | Engage students and elicit prior knowledge<br>*Diagnostic assessment* |
| EXPLORE | Provide hands-on experience of the phenomenon<br>*Formative assessment* |
| EXPLAIN | Develop science explanations for experiences and representations of developing conceptual understanding<br>*Formative assessment* |
| ELABORATE | Extend understandings to a new context or make connections to additional concepts through a student-planned investigation<br>*Summative assessment of the investigating outcome* |
| EVALUATE | Students re-represent understandings and reflect on their learning journey<br>*Summative assessment of the conceptual outcomes* |

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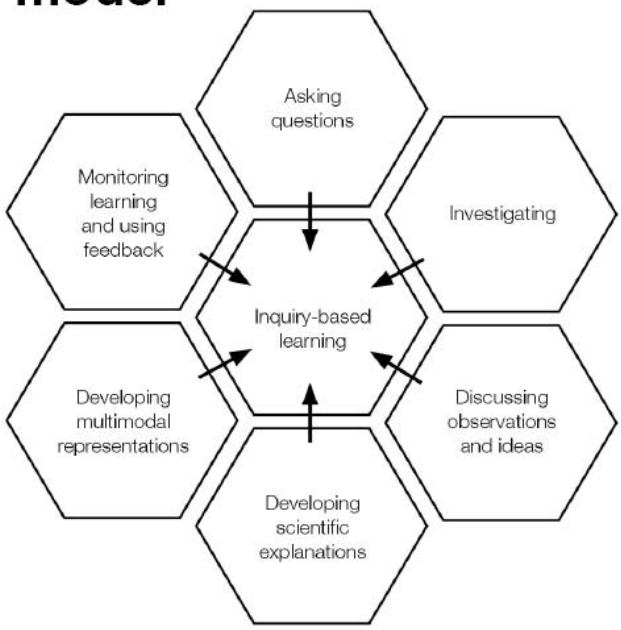
# Inquiry model

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## 2005 Trial of *Primary Connections*

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To determine the impact of *Primary Connections* on teachers, students and schools

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## Method

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- 56 schools, 106 teachers and >3000 students
- teachers completed 5 + 1 + 1 + 1 days PD
- taught supplied units in Terms 1 and 3
- taught teacher developed units in Term 2
- data gathered by teacher and student questionnaires, case studies, analysis of students' work samples

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## Teachers' confidence

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Teachers' confidence with nine science and literacy teaching strategies was assessed on a five point scale.

Mean confidence scores increased significantly ($p < .05$) from 3.34 /5 at the beginning of the program to 4.04 /5 at the end of Term 2.

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## Teachers' self-efficacy (n = 89)

PrimaryConnect

| Total self-efficacy score | Initial survey | End of summer school | Mid Term 1 | End Term 1 | End Term 2 |
|---|---|---|---|---|---|
| 1-10 | 0 | 0 | 0 | 0 | 0 |
| 11-20 | 2 | 0 | 0 | 0 | 0 |
| 21-30 | 20 | 10 | 4 | 3 | 1 |
| 31-40 | 50 | 49 | 52 | 54 | 49 |
| 41-50 | 17 | 30 | 33 | 32 | 39 |
| Mean total self efficacy score | 35* | 38 | 39 | 40 | 41* |
| S.D. | 6.8 | 5.4 | 4.5 | 4.6 | 4.5 |

A 10 item self-efficacy scale was assembled using items selected from Riggs and Enochs (1990) Science Teaching Efficacy Belief Instrument * (p.<.05).

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## Science teaching time (n = 89)

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| Minutes of science taught per week | Per cent of teachers | |
|---|---|---|
| | Before (2004) | Using PC (2005) |
| 60 minutes or more | 33.0 | 72.7 |
| Between 30 and 60 minutes | 39.8 | 26.1 |
| Less than 30 minutes | 23.9 | 1.4 |
| Rarely taught science | 3.4 | 0 |

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## Teaching practice

96 of 97 teachers said their teaching had improved

Greater focus on learning sequences and developing learning outcomes

Teachers reported an increase in:

- teaching literacies of science
- hands-on activities
- use of diagnostic assessment

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## Students' perceptions of PC (n = 538)

PrimaryConnect

| Per cent of cohort with this response | | | | |
|---|---|---|---|---|
| Unit studied | Weather N = 132 | Push, Pull PowerN = 108 | Plants in Action N = 160 | Build it Better N = 138 |
| **Have you enjoyed science this term?** | | | | |
| Yes | 82 | 63 | 77 | 49 |
| OK | 11 | 27 | 21 | 41 |
| No | 8 | 10 | 2 | 10 |
| **How much have you learned in science this term?** | | | | |
| Lots | 71 | 70 | 68 | 38 |
| Some | 15 | 23 | 30 | 50 |
| Little | 14 | 6 | 3 | 12 |

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## Achievement gains (n = 72)

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| Achievement level and score | Frequency | |
|---|---|---|
| | Engage lesson | Evaluate lesson |
| 1a (1) | 11 | 0 |
| 2d (2) | 16 | 3 |
| 2c (3) | 41 | 5 |
| 2a (4) | 3 | 8 |
| 3d (5) | 1 | 15 |
| 3c (6) | 0 | 22 |
| 3a (7) | 0 | 15 |
| 4d (8) | 0 | 4 |
| Mean score | 2.54 * | 5.51 * |

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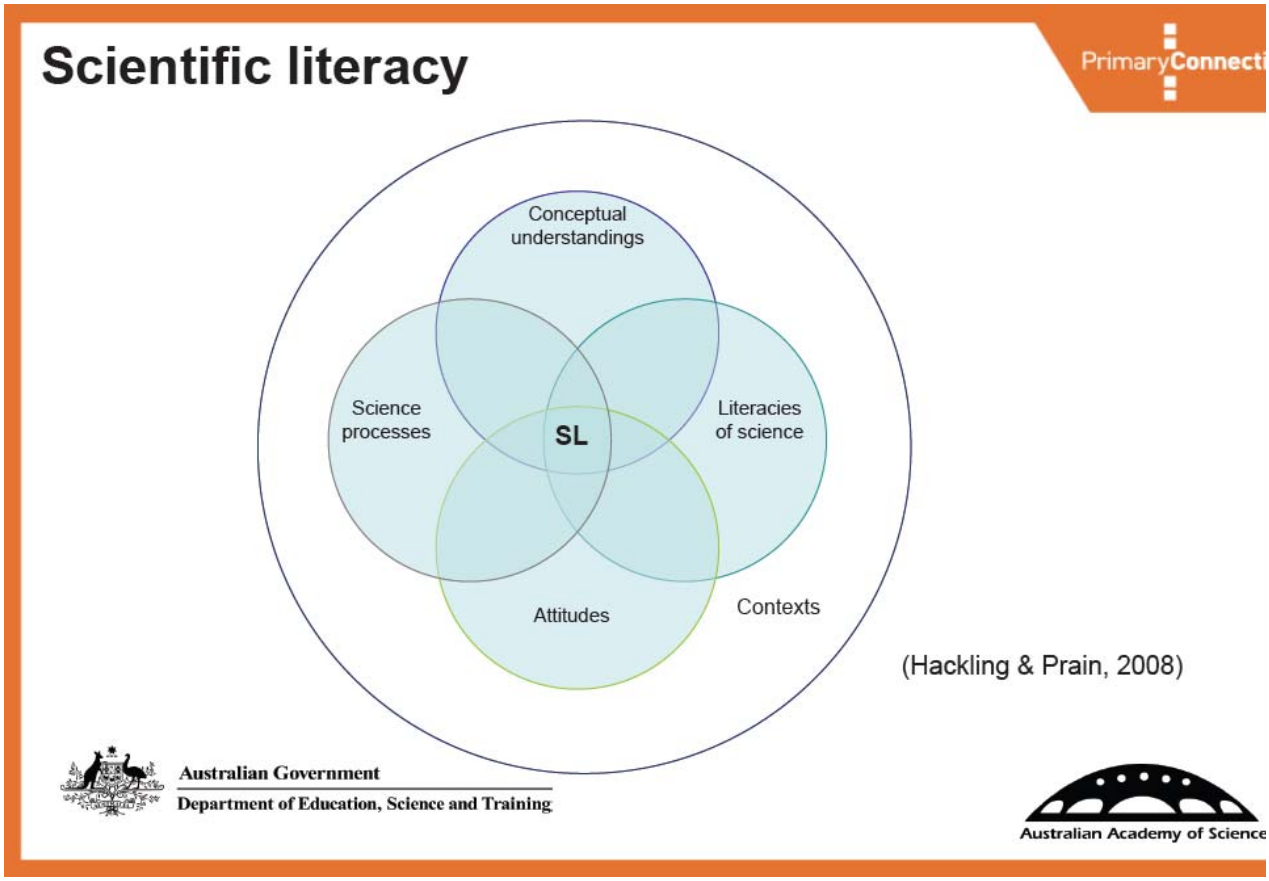
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## 2007 Evaluation Study

To evaluate the impact of *Primary Connections* on students' development of literacies of science, science processes and attitudes towards science

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Published by the Teaching for Effective Learning Team, Curriculum Services

## Method

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Pencil and paper test and attitude scale

- literacies of science
- science processes
- attitudes to and experience of school science

PC and non-PC classes matched on SEI

A total of 1467 students drawn from 26 schools

Tests conducted at end of 2007 academic year

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## Assessment tasks

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| Task | Yr 3 | Yr 4 | Yrs 5-7 |
|---|---|---|---|
| Observe, draw a labelled diagram, make comparisons | X | X | X |
| Measure, tabulate, graph, interpret, identify relationships | | X | X |
| Identify variable to investigate, formulate a question, predict, plan the design, draw table for results | | | X |
| Attitude scale | | X | X |

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## Grade 3 literacies and processes of science

| Year 3 | Groups | n | Scores /11 | |
|---|---|---|---|---|
| | | | Mean | sd |
| | PC | 189 | 4.46* | 1.849 |
| | Not PC | 62 | 3.39* | 1.251 |

Note. * $p<.05$; Cohen's $d = 0.68$

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## Grade 4 literacies and processes of science

| Year 4 | Group | n | Literacies of science /15 | | Processes of science /11 | |
|---|---|---|---|---|---|---|
| | | | Mean | sd | Mean | sd |
| | PC | 176 | 5.23** | 2.370 | 6.72** | 2.135 |
| | Not | 137 | 3.93** | 2.251 | 5.79** | 2.522 |

Note. ** p<.01; Cohen's *d* literacies = 0.56, processes = 0.40

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## Grade 5-7 literacies and processes of science

| Years 5- 7 | Group | n | Literacies of science /25 | | Processes of science /24 | |
|---|---|---|---|---|---|---|
| | | | Mean | sd | Mean | sd |
| | PC | 540 | 11.18** | 4.66 | 13.42** | 4.87 |
| | Not PC | 363 | 9.15** | 3.96 | 12.48** | 4.87 |

Note. ** p<.01; Cohen's *d* literacies = 0.47, processes = 0.19

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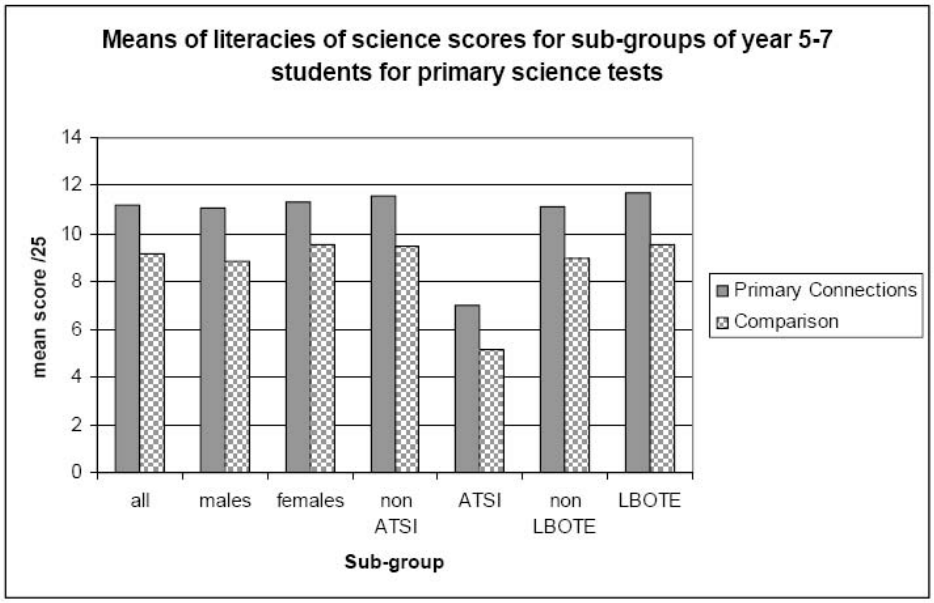


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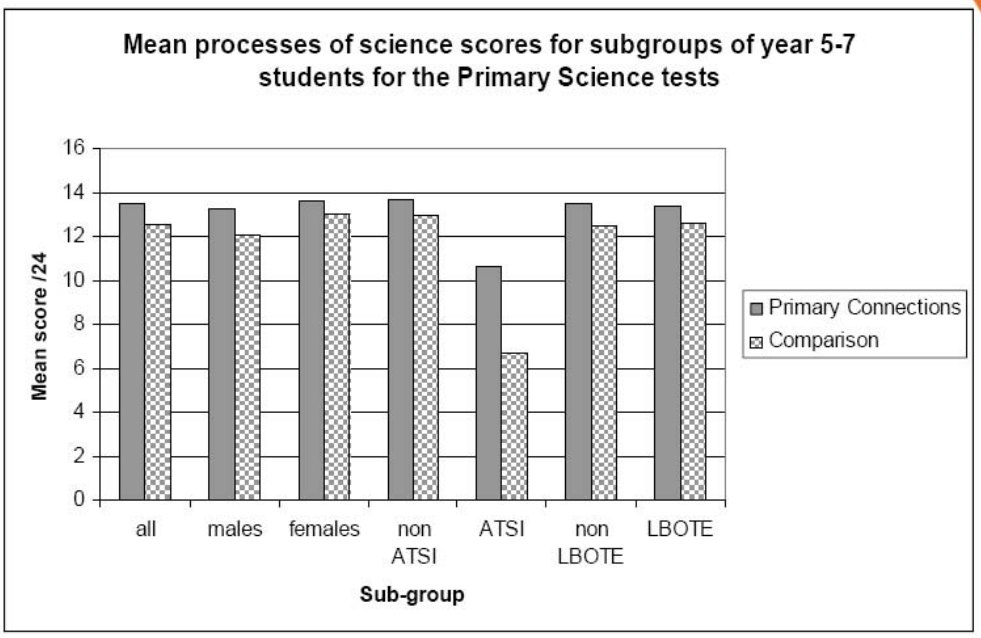


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## Attitudes towards school science

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No sig diffs for mean scale score on attitudes to science but two items showed sig diffs in favour of PC:

*I am curious during science lessons* (p<.05)

*I learn interesting things in science lessons* (p.<.01)

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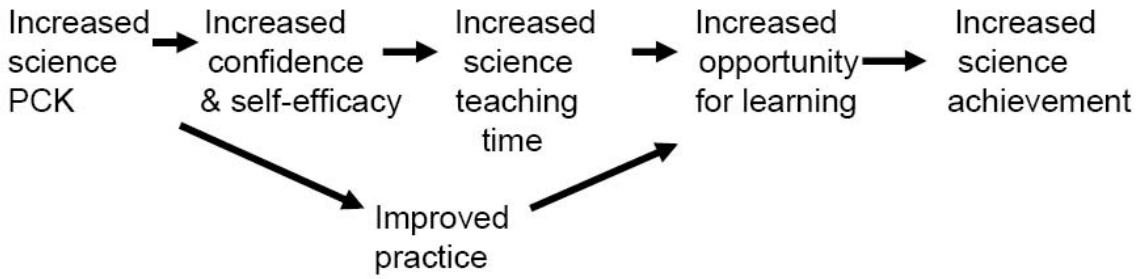
## The chain reaction

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## Further information

PrimaryConnect

www.science.org.au/primaryconnections

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[i] Department of Education, Employment and Workplace Relations, Primary Connections, Linking Science with Literacy