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AUDITOR-GENERAL SPECIAL REPORT No.90

Science education in public high schools

July 2010

Presented to both Houses of Parliament in accordance with the provisions of Audit Act 2008

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8 July 2010

President
Legislative Council
HOBART

Speaker
House of Assembly
HOBART

Dear Madam President
Dear Mr Speaker

SPECIAL REPORT NO. 90

Science education in public high schools

This report, relating to my audit of the effectiveness of science teaching in Tasmanian public high schools, has been prepared consequent to examinations conducted under section 23 of the *Audit Act 2008*.

Yours sincerely

H M Blake
AUDITOR-GENERAL

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Foreword

My performance audit was conducted at a time when Tasmanian public high schools were experiencing, and will continue to experience, change in the delivery of science education. Change was caused by the move from the Essential Learnings framework to the current implementation of the new Tasmanian Curriculum for Science, which will at some point be replaced by a national curriculum.

This is happening at a time when the proportion of Tasmanian students continuing with science is declining and, as identified from an independent source referred to in this report, industry has reported a substantial decline in applicants for advertised vacancies thus potentially exacerbating skills shortages in Tasmania. Also of concern was a Commonwealth Department of Education, Science and Training July 2006 report titled *Audit of science, engineering & technology skills – Summary report* which highlighted a looming shortfall of 35% of the 55 000 additional science professionals required by 2011.

My Report makes a number of findings and puts forward 12 recommendations aimed at assisting better understanding these trends and addressing them.

I was particularly pleased by many aspects of the response by the Secretary of the Department of Education to my Report. In particular, I note that by 2013 all Tasmanian schools will have substantially implemented the Australian Curriculum, including science. Successful implementation will provide a sound platform for a follow up of my Report in three to four years time.

H M Blake

Auditor-General

8 July 2010

List of acronyms and abbreviations

ACDS	Australian Council of Deans of Science
BER	Building the Education Revolution
BeTTR	Beginning Science Teacher Time Release Program
DoE	Department of Education
MCEETYA	Ministerial Council on Education, Employment, Training and Youth Affairs
OECD	Organisation for Economic Co-operation and Development
PISA	Program for International Student Assessment
PY10	Post-Year 10
SARIS	Student Assessment and Reporting System
TIMSS	Trends in International Mathematics and Science
TQA	Tasmanian Qualifications Authority
UTAS	University of Tasmania

Executive summary

Executive summary

Background

Studying science stimulates students' natural curiosity and sense of wonder about their world, as they participate in experiences that enable them to explore, question, test and conduct research. Many of the skills acquired through scientific training can also be applied elsewhere in life.

However, in 2006, the Commonwealth Department of Education, Science and Training produced an audit of science, engineering and technology skills that highlighted a looming shortfall of 35% of the 55 000 additional science professionals required by 2011.[1]

Most students in Tasmania's public schools are taught science between kindergarten and Year 10. Only upon reaching their senior secondary years can students elect not to study science. The Department of Education (DoE or the Department) has responsibility for overseeing all of Tasmania's public high schools. However, whilst DoE provides some central support and direction it has also given schools a significant degree of autonomy.

DoE has recently overseen the implementation of the new Tasmanian Curriculum for Science, replacing the previous Essential Learnings framework.

This audit is concerned with whether or not Tasmanian public high schools are fulfilling their role of providing general scientific literacy and preparing students for future studies in the field of science.

Detailed audit conclusions

Are Tasmanian high school students achieving a satisfactory level of scientific literacy?

We sought objective measures of scientific literacy for comparison. Possibly suitable measures found were two international surveys of student achievement:

- Program for International Student Assessment (PISA)
- Trends in International Mathematics and Science Study (TIMSS).

[1] Commonwealth Department of Education, Science and Training, *Audit of science, engineering & technology skills – Summary report*, July 2006

However, neither of these two international measures of science performance are fully suitable to evaluate Tasmanian performance in science against other jurisdictions or previous periods. Nonetheless, on the basis of information provided in these two surveys, there are some indications that Tasmanian high schools are marginally underperforming compared to most other Australian jurisdictions. However, there were also indications of some improvement in science literacy from 2003 to 2007 and in both measures, Tasmania performed better than the international average.

There is presently a lack of internally captured comparable science result data leading to ineffective monitoring of quantitative performance.

Are sufficient numbers of students continuing on from high school to further education in science in order to meet the State's need for a skilled workforce?

Numbers of post-Year 10 (PY10) students have held up well over the past 15 years, which is an indicator of the effectiveness of science teaching at high schools. On the other hand, a substantial decline in the proportion of Tasmanian students continuing with science at Years 11 and 12 and some evidence of a national skills shortage are of concern.

Are Tasmanian high school science teachers properly qualified and trained?

In the main, Tasmanian public schools had sufficient science teachers with the necessary experience, training and qualifications to teach science effectively.

Does the Tasmanian high school science curriculum meet national requirements and is it effectively delivered?

Despite widespread consultation with stakeholders and alignment with national requirements, it appeared that the non-prescriptive nature of the curriculum was leading to inconsistency of teaching between schools and preventing Year 11 teachers from assuming that incoming students from public high schools had a reasonable level of prior knowledge.

We were also unable to conclude that the curriculum was being effectively delivered and assessed because of deficiencies in, or non-provision of, planning documentation for lessons. Neither were we persuaded that the moderation process was able to ensure that results of assessment for different schools were comparable.

Are high school science facilities well resourced throughout the State?

More than half of the schools visited had laboratories that required refurbishment, were old or in poor condition. In addition, some schools had excessively old laboratory equipment and insufficient laboratory technicians.

Is science teaching covered by departmental strategic planning?

There was little evidence of a coordinated approach to strategic management, although a number of separate documents outlined various goals, measures and strategies.

List of recommendations

The following table reproduces the recommendations contained in the body of this Report.

Rec No	Section	We recommend that…
1	1.4	… DoE works with other states and territories to ensure agreed standardised testing enables more meaningful comparison between jurisdictions.
2	3.2	… DoE maintains and regularly reviews centralised information about the qualifications of its teachers.
3	3.3	… DoE periodically reviews the age profile of science teachers for purposes of long-range planning.
4	3.5	… DoE develops a more coordinated approach to professional development and ensures that teachers keep up to date with their subject knowledge.
5	4.4	▪ DoE coordinates development of an agreed mandatory subset of skills and knowledge ▪ DoE further develops moderated assessment for the mandatory subset of skills and knowledge.
6	4.5	… schools prepare detailed plans to provide for and document coverage of the curriculum, as well as an assessment approach and professional development needs.
7	4.6.2	… clear and detailed assessment intentions be documented in school curriculum documents as well as lesson planning documents.
8	4.6.3	… DoE investigates why a large proportion of students are under-performing in science.

Rec No	Section	We recommend that…
9	4.6.4	… the moderation process be reviewed to ensure all classes are subject to effective moderation and that DoE maintains supervisory control of the process to ensure consistency of assessment between schools.
10	5.2	… DoE develops a plan for review and upgrade of high school laboratories.
11	5.3	… DoE gives high priority to ensuring schools having sufficient laboratory technicians to support teaching staff and to ensure health and safety standards are maintained.
12	6.2	… DoE develops a strategic plan covering science teaching.

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Audit Act 2008 section 30 — Submissions and comments received

Audit Act 2008 section 30 — Submissions and comments received

Introduction

In accordance with section 30(2) of the *Audit Act 2008*, a copy of this Report was provided to the Department of Education with a request for comment. A summary of findings was also provided to the Treasurer and Minister for Education with a request for comment or submissions.

The comments and submissions provided are not subject to the audit nor the evidentiary standards required in reaching an audit conclusion. Responsibility for the accuracy, fairness and balance of those comments rests solely with those who provided a response or comment.

Submissions and comments received

Department of Education

In order to excite and motivate young Tasmanians about Science learning and careers in Science we are creating an educational environment that is not just about traditional methods but more in tune with current and topical scientific endeavour. For example, Tasmania is leading the nation in its collaboration on the innovative approach to Science education through the recently announced Sustainability Learning Centre, which will stimulate Tasmanian students' scientific curiosity with information and knowledge about sustainability and climate change and encourage them to seek pathways and careers in science and technology.

The Department has over the past five years intentionally moved resources and decision-making away from the Centre to schools because previous input driven management and controls did not take enough account of the local context of each school and thereby provide schools with the flexibility necessary to tailor improvement strategies specifically to the needs of their students and teachers. Instead, the Department has taken an outcomes approach, which sets high level outcomes, requires schools to develop annual improvement plans to meet them and actively supports schools through four regional Learning Services. Improvement measures are reported annually both at school, regional and system level.

While the Department values feedback on its operations, this audit would have been of more benefit had it been conducted following full implementation of the Tasmanian curriculum in 2011. All schools have been implementing core subjects such as

English/literacy and Maths/numeracy since 2007 and so it has been reasonable to set targets for student achievement in those subjects. In relation to Science, previous to the development of the Tasmanian curriculum in 2007, schools alone determined the extent of the provision and the nature of Science teaching. The clearly documented outcome for Tasmanian schools in Science is to have implemented the curriculum before the end of 2010. Only when all schools have done this is it reasonable to set targets for achievement and improvement.

Because Tasmanian government schools are in the final year of implementing the Tasmanian science curriculum, the impact of the new curriculum on student outcomes and preparedness for Science studies in Years 11 and 12 is unlikely to be evident until at least the end of 2012. An evaluation undertaken now is against an old curriculum.

Tasmanian teachers and educators in collaboration with the Australian Curriculum and Assessment Authority (ACARA) and all other states and territories are already contributing to the development of an agreed mandatory set of skills and knowledge for science learning in the Australian curriculum. Our new curriculum is right on track for the future. A recent alignment study conducted by ACARA compared the topic coverage of the Tasmanian curriculum with that proposed in the Australian curriculum and the results were that the level of correspondence in science between the two is high.

By the end of 2013 all Tasmanian schools will have substantially implemented the Australian Curriculum, including science.

Tasmania is currently bound by national agreements in relation to national standardised testing and will be involved in determining any future assessments following the implementation of the Australian Curriculum.

We respect and support the school principal's leadership role in each school and leading educational researchers Michael Fullan (2007) and Richard Elmore (2004) also support the model of professional learning being delivered in Tasmania. Elmore particularly states that improvement above all entails 'learning to do the right things in the setting where you work'. The responsibility for identifying professional learning needs of science teachers lies primarily with the principal of each school and is coordinated in negotiation with each of the four regional Learning Services units. In addition, the Department centrally co-ordinates professional learning offerings in collaboration with the University of Tasmania, in the form of post-graduate HECS scholarships to DoE teachers. This has resulted in the University offering a Graduate Certificate in Science Education

which is designed to provide a structured professional development program specifically for the needs of science teachers which recognises that professional development is a continuous and life long process and assists teachers to upgrade their disciplinary and pedagogical knowledge and improve their qualifications for teaching science.

We agree that strategic planning is vital to ensure improvement in all aspects of education. We believe that planning needs to reflect the nature of the education 'business', which is complex and multifaceted. While it can always be improved, Tasmania's planning is consistent with that in all other states and territories education systems. Because of its size and the resources available Tasmania's planning must also balance appropriately the amount of specificity and detail for each facet of the business with the level of professionalism of principals to interpret and implement overarching plans. The eight strategic planning documents provided to the Tasmanian Audit Office which guide all teaching in Tasmanian government schools, including science teaching, are high level and set the policy direction for Tasmanian schools and support for schools including timeframes for implementation of curriculum and reporting; process, content and achievement standards for each subject; school accountabilities; a strategic plan for support to schools in each subject; performance management and teaching standards.

Introduction

Introduction

Background

Science provides a way of answering interesting questions about the world in which we live. The knowledge science produces has proved to be a dependable basis for action in our personal, social and economic lives. Without science there would be no Internet, electricity or antibiotics. High levels of scientific endeavour can provide significant economic and competitive benefits to a nation that encourages science.

Scientific literacy is the knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity[2].

Studying science stimulates students' natural curiosity and sense of wonder about their world, as they participate in experiences that enable them to explore, question, test and conduct research. Many of the skills acquired through a scientific training can also be applied elsewhere in life.

However, in 2006, the Commonwealth Department of Education, Science and Training produced an audit of science, engineering and technology skills that highlighted a looming shortfall of 35% of the 55 000 additional science professionals required by 2011[3]. There are indications that a national decline in tertiary science enrolments may be having a serious impact on the skill levels of the Australian workforce and the nation's competitiveness in the international labour market.

Most students in Tasmania's public schools are taught science between kindergarten and Year 10. Only upon reaching their senior secondary years can students elect not to study science. The Department of Education (DoE or the Department) has responsibility for overseeing all of Tasmania's public high schools. However, whilst DoE provides some central support and direction it has also given schools a significant degree of autonomy.

Since 2008, DoE has been overseeing the implementation of the new Tasmanian Curriculum for Science, replacing the previous

[2] United States National Center for Education Statistics

[3] Commonwealth Department of Education, Science and Training, *Audit of science, engineering & technology skills –*

Summary report, July 2006

Essential Learnings framework. By 2011 all high schools will be expected to be delivering the new curriculum.

This audit is concerned with whether or not Tasmanian schools are fulfilling their role of providing general scientific literacy and preparing students for future studies in the field of science.

Audit objective

The audit objectives were to:

- assess the effectiveness of secondary science education in Tasmania
- review the strategic management of secondary science education.

Audit scope

The scope of the audit encompassed teaching of science provided by DoE in public high schools in 2009. The audit included a review of science teaching at eight schools selected to provide coverage of large and small, rural and urban schools across the state.

Audit criteria

The following criteria were used to form an opinion about the audit objectives:

- Effectiveness:
  - Tasmanian high school students are achieving a satisfactory level of scientific literacy.
  - Sufficient numbers of students are continuing with science at senior secondary and university level to meet the State's need for a skilled workforce.
  - Tasmanian high school science teachers are properly qualified and adequately trained.
  - The Tasmanian high school science curriculum meets national requirements and is effectively delivered.
  - Tasmanian high school science facilities are well resourced throughout the State.
- Management:
  - Science teaching is subject to departmental strategic planning.

Audit approach

The audit approach included:

- examination of documentation
- interview of students, teachers, principals, DoE administrative staff and academics
- analysis of relevant data
- observation of laboratories and classrooms.

Our evaluation did not include observation of classroom teaching by individual teachers or student surveys. Instead, the focus was on examination of objective measures, review of lesson plans and analysis of retention rates.

Format of the report

The structure of our report does not mirror the audit criteria listed above. However, the substance of those criteria is covered in detail in successive chapters.

Timing

Planning for this audit began in July 2009. Fieldwork was completed in March 2010 and the report was finalised in June 2010.

Resources

The total cost of the audit excluding production costs was $172 000.

1 Measuring results

1 Measuring results

Are Tasmanian high school students achieving a satisfactory level of scientific literacy?

1.1 Background

We wanted objective measures of scientific literacy for comparison with other jurisdictions and previous periods. The only suitable measures found were international surveys of student achievement:

- Program for International Student Assessment (PISA)
- Trends in International Mathematics and Science Study (TIMSS). TIMSS reflects what Year 4 and Year 8 students cover in the classroom.

1.2 Program for International Student Assessment (PISA)

Every three years, PISA assesses skills and competencies of 15-year-olds, regardless of grade year. It conducts its surveys within 30 Organisation for Economic Co-operation and Development (OECD) member countries and an additional 27 non-OECD countries. In Australia, 14 000 students across 356 schools from all states and territories participated in the 2006 PISA survey.

With a score of 527, Australia ranked seventh out of 57 in the 2006 PISA survey, above the OECD average of 500[4]. Figure 1 compares Tasmania's performance in the survey against other jurisdictions.

[4] For both PISA and TIMSS the average score is indexed at 500.

Figure 1: PISA 2006 interstate comparison[5]

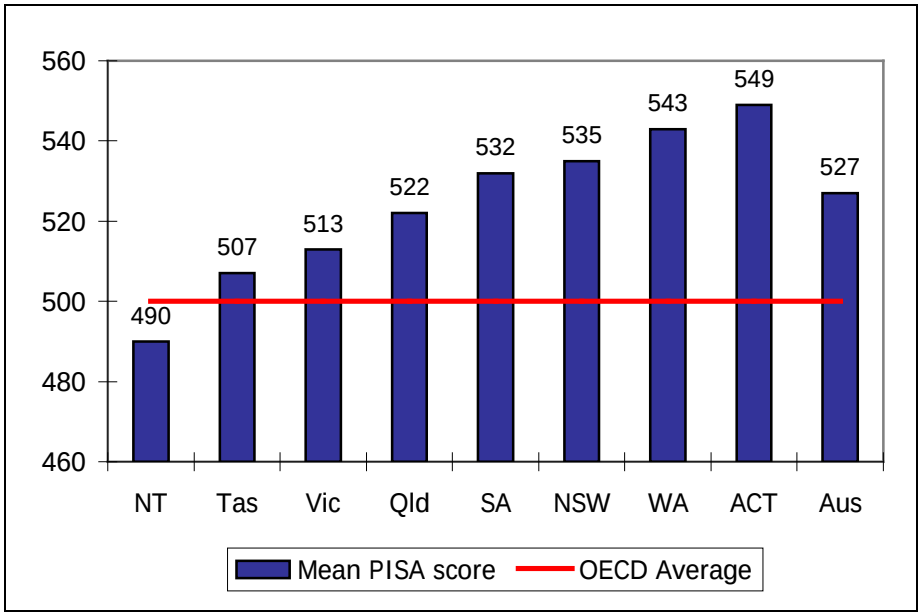
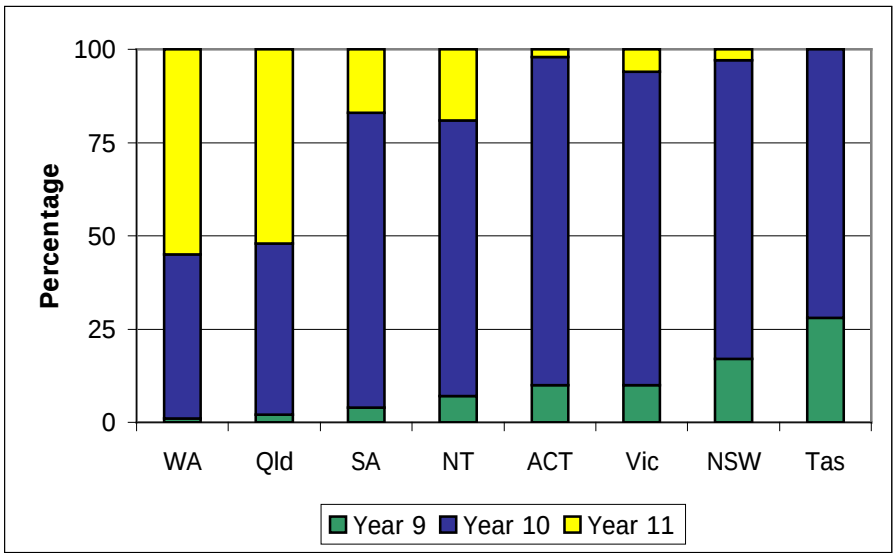


Figure 1 shows that Tasmania scored above the OECD average and similar to Victoria, but was significantly lower than South Australia, New South Wales, Western Australia and Australian Capital Territory. Tasmania also scored lower than the Australian average.

In any event, the comparison with other jurisdictions is, to some extent, misleading because it compares the performance of 15-year-olds without regard to grade year. Figure 2 illustrates this problem by showing the distribution of 15-year-old science students from each state and territory across Years 9 to 11.

[5] Thomson, S. and De Bortoli, L., Australian Council for Educational Research, *Exploring scientific literacy: how Australia measures up: the PISA 2006 survey of students' scientific, reading and mathematical literacy skills*, 2008.

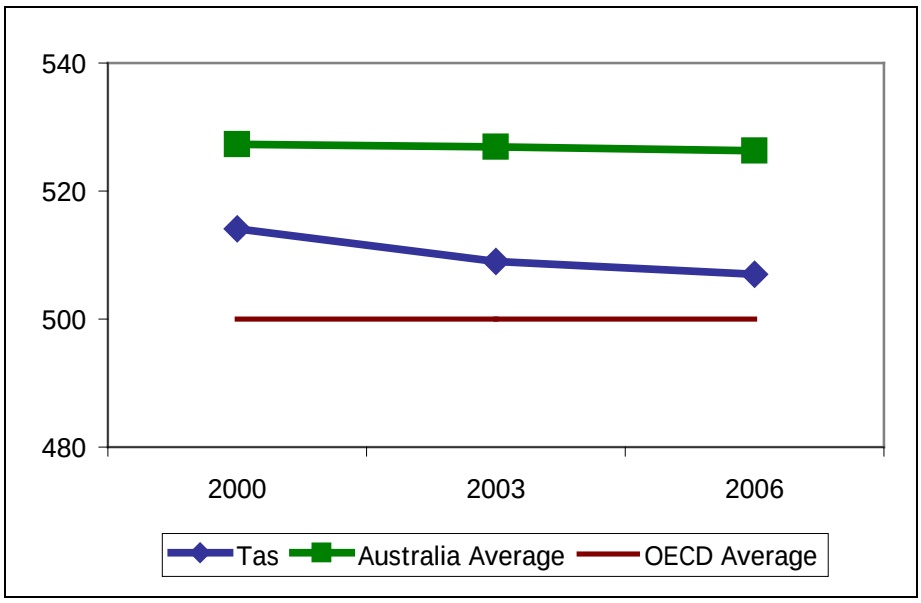
Figure 2: Distribution of 15-year-old science students[6]



There are significant differences in the grade year distribution of 15-year-olds nationally. For example, more than half of Western Australia's 15-year-olds are in Year 11, whereas Tasmania had virtually no 15-year-olds in Year 11.

On the other hand, NSW and ACT, with similarly low numbers of 15-year-olds in Year 11, out-performed Tasmania by three and four percent, respectively. Figure 2 also shows that Tasmania had the highest percentage of 15-year-olds in Year 9. Figure 3 shows a slight drop in Tasmania's PISA score (only one percent), between 2000 and 2006.

Figure 3: PISA 2000–06 Tasmania and the rest of Australia



[6] Educational Performance Services, *Performance of Tasmanian Students in International and National Science Testing*, 2009

Figure 3 makes no allowance for possible drift in the dispersion of 15-year-olds between grade years over the six-year period. Overall, it is difficult to draw a meaningful conclusion other than that there has been little change.

We also noted that PISA had reviewed the impact of socio-economic factors, taking into consideration factors such as parents' occupational status and educational attainment, number of books and educational resources in the house and family wealth. An ABS index had Tasmania last of all Australian states and territories with a score of 931 against an Australian average of 977. PISA's analysis of states and territories found that lower socio-economic levels did have an impact on performance.

1.3 Trends in International Mathematics and Science Study (TIMSS)

The second measure we looked at was TIMSS data. The International Association for the Evaluation of Educational Achievement conducts TIMSS every four years, in 59 countries. TIMSS measures science performance of Years 4 and 8 students (regardless of student age).

Australia was above the international average at both the Year 4 and Year 8 levels for science literacy.

TIMSS also enabled us to compare the performance of Tasmanian Year 4 and Year 8 science students against the rest of Australia (see Figure 4).

Figure 4: 2007 TIMSS comparison of Tasmania with rest of Australia

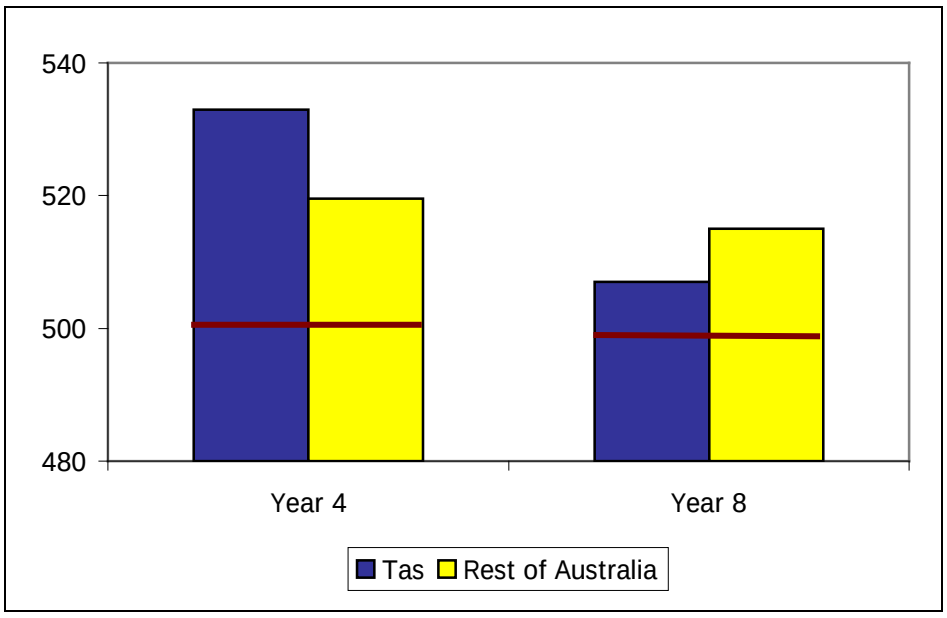


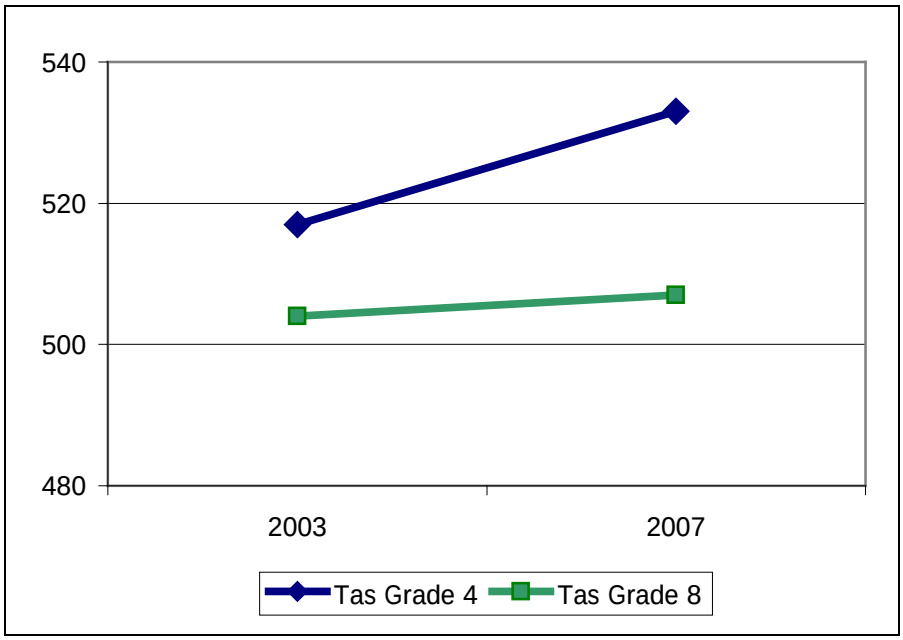
Figure 4 shows that:

- Tasmania ranked well above the international average
- Tasmania's score compared favourably with the Australian average at Year 4, but was marginally lower than for Year 8.

It is difficult to draw conclusions about the quality of high school science teaching in Tasmania from a survey taken during the second year of high school, but there is at least a small indication that science teaching from Year 4 to Year 8 may be more effective in other Australian jurisdictions.

We also compared 2007 Tasmanian TIMSS results with 2003.

Figure 5: Tasmanian TIMSS 2003 and 2007 science results



Tasmania's Year 4 science score improved by three percent and that Year 8 performance marginally improved. In that period, the Australian Grade 8 average score decreased by two percent.

We noted that it has been government policy to focus on literacy and numeracy in recent years. It is possible that to a small extent the improvement reflects improvements in numeracy and literacy, but also that greater improvements in science literacy might flow from a similar focus on science.

1.4 Tasmanian high school science results

We have seen that neither PISA nor TIMSS are ideal for our purposes in measuring high school science performance: PISA because it measures the performance of 15-year-olds rather than at levels of education and TIMSS because it does not provide a measure beyond Year 8.

We expected to be able to access high school science results either from the Department or schools to ascertain performance, but no comparable science results were available. Since 2000 the science curriculum has changed twice. Partly, that reflects changes in the way science is taught. For example, during the Essential Learnings phase, 2005–08, DoE did not collect science results because science was bundled with other subjects rather than assessed as a separate high school subject.

Whilst there remains a gap in science results, we did note that DoE was implementing a result information system whereby schools now have to report mathematics and English results. Schools are now being encouraged, on conversion to the Tasmanian curriculum, to also report science results. For 2009, we found that 82.7 percent of science results were reported. We concluded this information was not suitable for comparison purposes, because there was:

- no prior year data
- no similar data from other jurisdictions
- insufficient standardisation and moderation.

The lack of comparable science result data indicates that at present, DoE has not effectively monitored quantitative performance and is largely reliant on unsuitable external benchmarks (PISA and TIMSS).

Recommendation 1

We recommend that DoE works with other states and territories to ensure agreed standardised testing enables more meaningful comparison between jurisdictions.

1.5 Conclusion

Neither of the two international measures of science performance are fully suitable to evaluate Tasmanian performance in science against other jurisdictions or previous periods. Nonetheless, there are some indications that Tasmanian high schools are marginally underperforming compared to most other Australian jurisdictions. However, there were also indications of some improvement in science literacy from 2003 to 2007 and in both measures, Tasmania performed better than the international average.

There is presently a lack of internally captured comparable science result data leading to ineffective monitoring of quantitative performance.

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2 Students continuing with science

2 Students continuing with science

Are sufficient numbers of students continuing on from high school to further education in science in order to meet the State's need for a skilled workforce?

2.1 Background

In this Chapter, we examined:

- participation in PY10 science education
- reasons why students may not be continuing with science
- science skills shortages in the workforce.

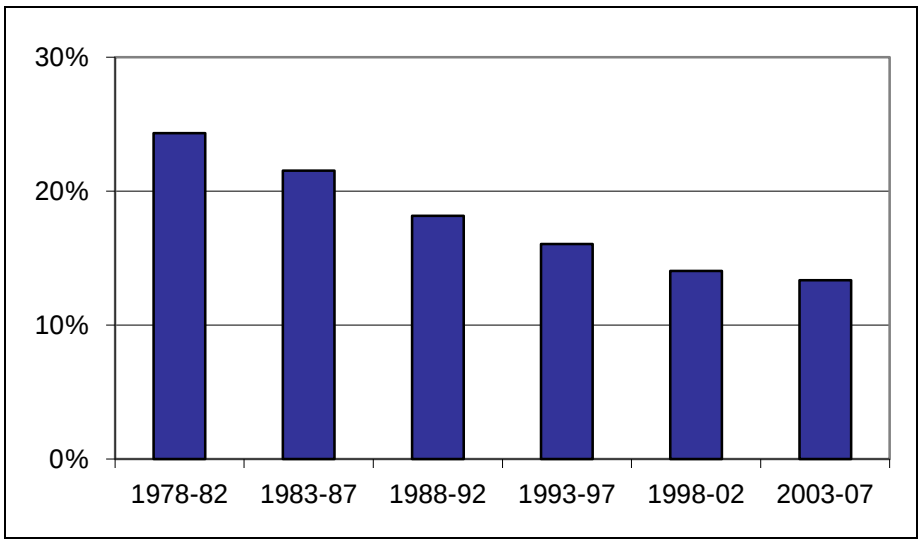
2.2 Participation in post-Year 10 science education

In this section, we examine participation in PY10 science education both nationally and within Tasmania.

2.2.1 Participation in science nationally

In 2008 a report, *Participation in Science, Mathematics and Technology in Australian Education*[7], concluded that participation in Year 12 science had declined between 1978 and 2007. Figure 6 illustrates the participation of students across a number of science subjects.

Figure 6: Australian students doing Year 12 science: 1978 to 2007[8]



[7] Ainley, J., Kos, J. and Nicholas, M., Australian Council for Educational Research, *Participation in Science, Mathematics and Technology in Australian Education*, August 2008.

[8] The data in Figure 6 is the average proportional participation across science subjects. For example, in 1978, 56% of Year 12 students chose biology, 31% chemistry, 28% physics and 5% geology. The average of these participation percentages appears in Figure 6 as an index of participation in science.

Between 1978 and 2007, there had been a significant reduction in average participation rates for science subjects. We also noted from the report that:

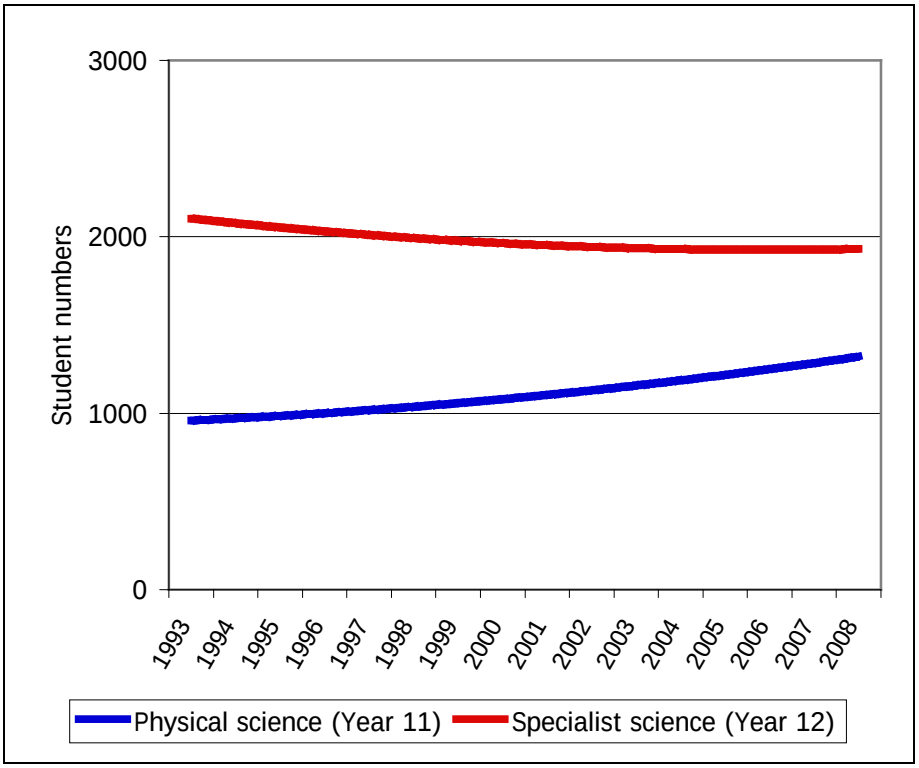
- participation in biology had declined from 55 percent to 29 percent
- chemistry and physics experienced a drop in enrolments.

Physics and chemistry are seen as enabling subjects for tertiary science. Students without physics and chemistry are unable to pursue some science-related degrees at university, including medicine and pharmacy.

2.2.2 Participation numbers in science in Tasmania

After looking at the national science data, we then wanted to relate this to Tasmania. First, we looked at actual numbers of students enrolled in science in Years 11 and 12 as shown in Figure 7[9].

Figure 7: Number of Tasmanian students[10] completing science courses: 1993 to 2008



Numbers of students enrolling in the Year 11 science subject, physical science, have increased significantly (by 46%) since 1993,

[9] Derived from data provided by the Tasmanian Qualifications Authority

[10] Based on information for public and non-public schools provided by the Tasmanian Qualifications Authority.

while there was a marginal decrease in the Year 12 specialist science subjects.

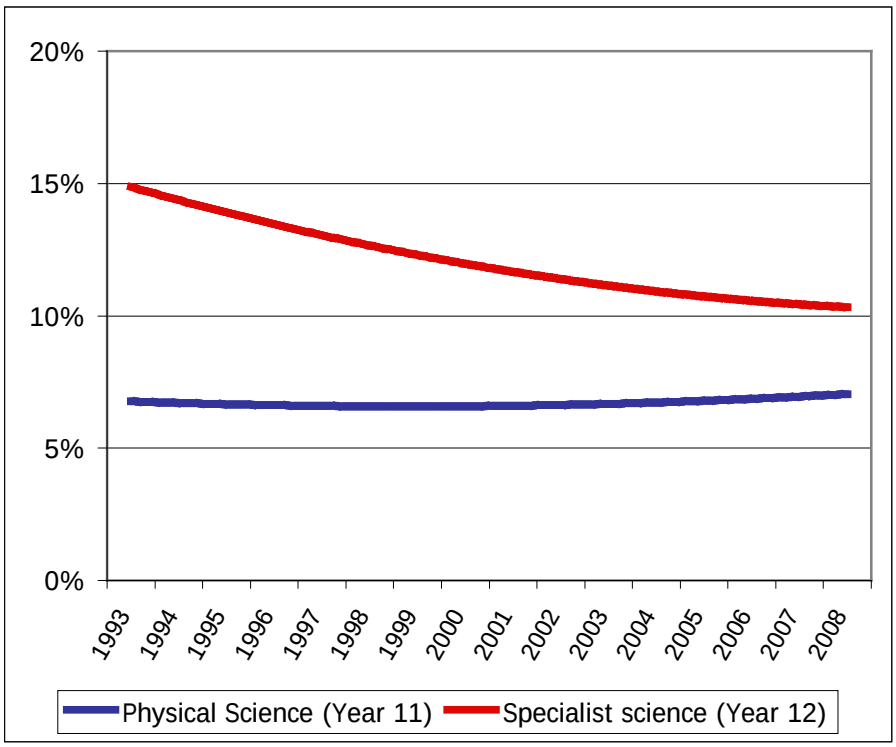
We also noted using data from the University of Tasmania (UTAS) that the number of students undertaking science-related degrees had remained steady since 2005, as has overall enrolments in undergraduate degrees.

On that basis, it would appear that high school science has been effective in providing increasing numbers of science students for PY10 studies. On the other hand, there have been substantially more students undertaking PY10 education, which makes the participation rate relevant.

2.2.3 Participation rates in science in Tasmania

Figure 8 compares Tasmania's rate of Year 11 and 12 students participating in science-related subjects from 1993 to 2008.

Figure 8: Rate of Tasmanian students doing science: 1993 to 2008



Unlike Figure 7, which looks at actual numbers, Figure 8 indicates that while the proportion of students enrolling in the entry-level Year 11 subject, physical science, has held up there is evidence of a substantial decline in the more specialised Year 12 subjects such as chemistry and physics. There may be a number of reasons for this including:

- reluctance by students to continue on to more specialised science subjects

- acceptance by students that a well-rounded education should at least include Year 11 science
- career paths that only require Year 11 science.

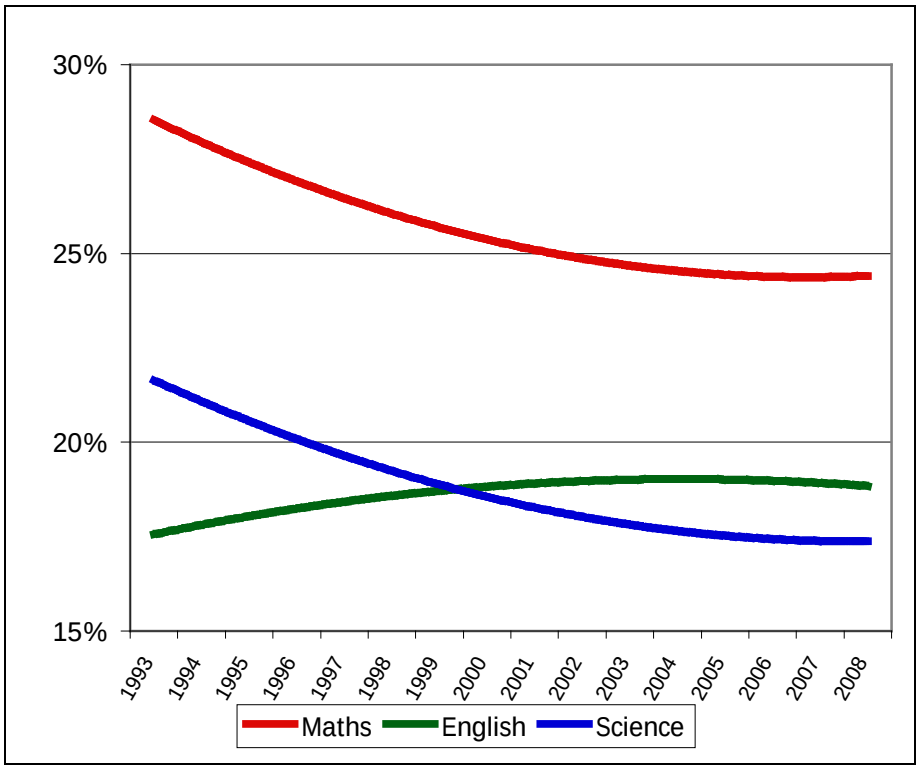
Regardless of the reason, it appeared to us that, overall, the proportion of students completing PY10 science subjects has declined.

One difficulty in looking at participation rates is that they take no account of the changing profile of students entering PY10 study. We would expect that the increased numbers of students undertaking PY10 enrolment in 2008, compared to 1993, will involve a group less likely to undertake mainstream tertiary subjects such as science. For that reason, we also compared the decline in science with movement in other key Year 10 subjects: mathematics and English.

2.2.4 Comparison with other mainstream PY10 subjects

Figure 9 shows the proportion of Year 11 and 12 students enrolled in science, English and mathematics.

Figure 9: Year 11 and 12 participation trends compared to other disciplines



Proportionally, science and mathematics enrolments have both declined relative to English. That result suggests that, despite steady enrolment numbers for Year 11, interest in science may be declining relative to other mainstream subjects.

2.3 Focus group findings on continuing with science

We conducted focus group meetings at two colleges to gauge senior secondary student views on their experiences of high school science. Some students told us of their positive experiences with high school science including, inspirational teachers, engaging guest speakers and some interesting experiments.

We asked those students who had not continued with science to give us reasons for not choosing science subjects. Reasons given included:

- poor relationship with teacher
- alternative career pathway
- other interests.

Despite a number of students turning away from science for one reason or another, we found that some students still persisted with science despite having a negative view of high school science. Conversely, some students told us that they had not continued with science after Year 10 despite having enjoyed science at high school.

2.4 Skill shortages

A report released by the Commonwealth Government in 2006 stated that Australia would have a shortage of 30 000 scientists by 2011[11]. Industries including engineering and scientific research were expected to be particularly hard hit, with the possible consequence of significant economic and competitive detriment.

In July 2008, the Taylor report identified a number of factors that created skills shortages in Tasmania[12]. Though the report did not specifically address skill shortages in science-related positions, it did make a number of general points that could be applicable to the science sector, including:

- Industry reported a substantial decline in applicants for advertised vacancies.
- Strong migration trends were likely to exacerbate the problem, particularly with professional vacancies.

Subsequent to the Taylor report, the global economic downturn occurred. However, bodies such as Skills Tasmania (a state-owned industry advisory body) indicated to us that the financial crisis had only a minimal impact on science-related vacancies in Tasmania.

[11] Commonwealth Department of Education, Science and Training, *Audit of science, engineering & technology skills – Summary report*, July 2006

[12] Taylor, L., *Occupational Skill Shortage Analysis – Tasmania Phase One*, Skills Tasmania, July 2008

There is still strong demand for scientists in sectors such as agriculture, aquaculture and forestry.

However, measuring demand factors for science-related professions is difficult, as most companies looking for science professionals advertise both nationally and internationally. Similarly, many science graduates are prepared to leave the state to find work elsewhere. It should also be noted that unlike other tertiary disciplines such as law, accounting and medicine, science does not present an obvious career path, so that to some extent it is not surprising that there would be greater shortages for science-based jobs.

Whilst it is not possible to confirm a skills shortage for science-qualified people in Tasmania there is evidence of a national shortage.

2.5 Conclusion

Numbers of PY10 students have held up well over the past 15 years, which is an indicator of the effectiveness of science teaching at high schools. On the other hand, a substantial decline in the proportion of Tasmanian students continuing with science at Years 11 and 12 and some evidence of a national skills shortage are of concern.

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3 Science teachers

3 Science teachers

Are Tasmanian high school science teachers properly qualified and trained?

3.1 Background

The success of science teaching at high schools depends on suitably qualified and experienced teachers. In addition, science teachers should be receiving adequate and accessible professional learning on a regular basis. This Chapter examines:

- science teachers' qualifications and experience
- appropriate professional development
- teacher–student ratios.

To gather data for this audit, we interviewed science teachers from eight high schools across DoE's four districts. We selected an urban and a rural high school in each district. We did not attempt to perform classroom evaluation of science teaching.

3.2 Qualifications of teachers

In a 2005 report[13], the Australian Council of Deans of Science stated:

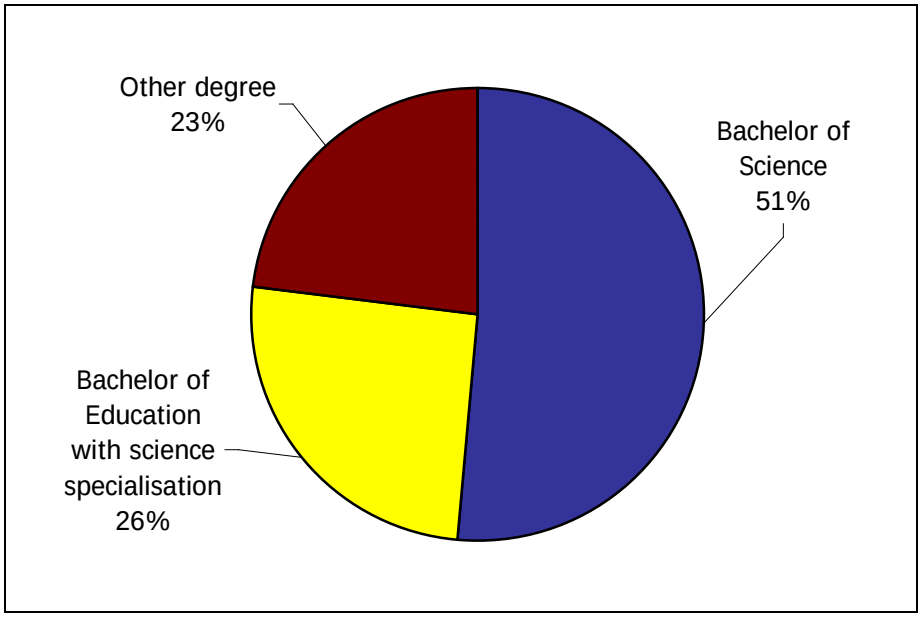
> There is a clear preference among heads of secondary school science departments for staff with a university degree in science supplemented by an education qualification, rather than a university degree in teaching with some study in science.
>
> There is agreement among heads of secondary school science departments that, in future, teachers of senior science should have at least a major in the appropriate discipline area — a view supported by the ACDS.

The report noted that 28 percent of Australian science teachers did not possess science-based degrees. Further, 22 percent of Year 7 and 8 teachers did not complete any science subjects at university.

We were unable to locate any such required qualification in DoE documentation. Neither was information about qualifications accessible at a central level. Figure 10 summarises the qualifications of the science teachers at our sampled schools.

[13] Harris, K., Jensz, F., Baldwin, G., *Who's Teaching Science?*, Australian Council of Deans of Science, January 2005, p. viii

Figure 10: Science teacher qualifications at sampled schools



We found that 51% of the sample of teachers had a science degree. Of those with neither a science degree nor Bachelor of Education with science specialisation:

- Five percent of those teachers had no science component in their qualifications but were teaching science because there was a shortage of science staff.
- Ten percent were physical education teachers with a Bachelor of Human Movement, which included some science-related content.

Of course, the absence of formal qualifications does not necessarily mean that a teacher cannot teach science effectively. During the audit, we met teachers without formal qualifications who appeared knowledgeable and enthusiastic about science.

The Department indicated that it was aware of the shortage of qualified science teachers, especially in the north and northwest. To address the shortage it has implemented the following programs:

- A graduate recruitment program that has had some success, although the Department has had difficulty filling the program in recent years.
- The Teacher Training centre at Rokeby High School.
- The DoE/UTAS student teacher scholarship program.
- A Maths/Science Higher Education Loan Payment (HELP) Scholarship Program.

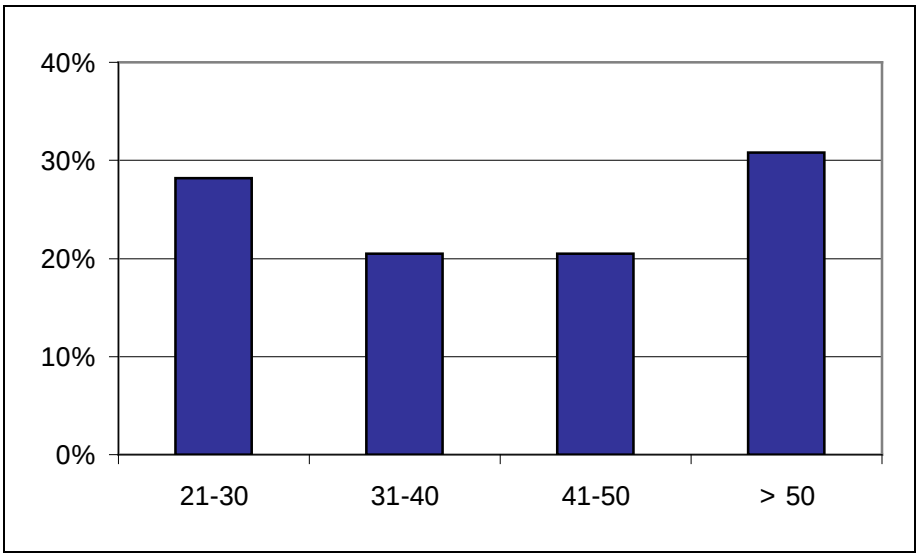
Recommendation 2

We recommend that DoE maintains and regularly reviews centralised information about the qualifications of its teachers.

3.3 Teachers' age demographic

To ensure an adequate supply of future science teachers, there needs to be an adequate number of newly trained teachers of science. A Commonwealth commissioned report found that the average age of the Australian teaching workforce was increasing[14]. Whilst DoE monitors the age profile of all its teachers, information about average science teacher age was not available from the Department. Figure 11 shows the number of teachers in various age brackets for our sampled schools.

Figure 11: Science teachers' age demographic



While our sample was small, it was consistent with national trends and suggested that a significant proportion of teachers is likely to retire in the next ten years. At the same time, the proportion of teachers under 30 is encouraging. Our main concern was that this information was not being monitored by DoE for long-range planning.

[14] Ainley, J., Kos, J., Nicholas, M., *Participation in Science, Mathematics and Technology in Australian Education*, Australian Council for Educational Research, August 2008

Recommendation 3

We recommend that DoE periodically reviews the age profile of science teachers for purposes of long-range planning.

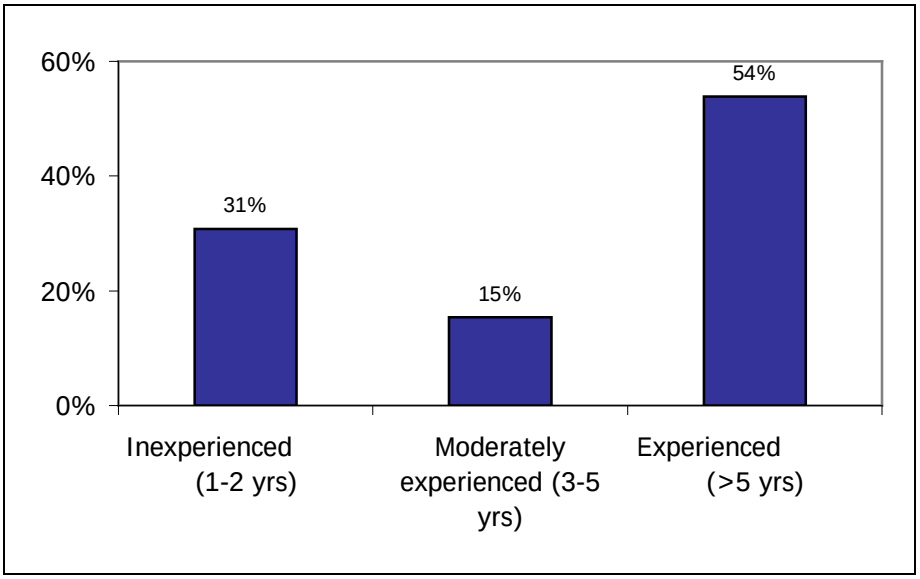
3.4 Teaching experience

A teacher's age is not necessarily a true indicator of teaching experience, as some people do not become teachers until later on in their working life. Of the teachers that we interviewed:

- Eighteen percent were first-year teachers.
- Thirty one percent were in their first two years of science teaching.
- Forty six percent were in their first five years of teaching science.
- Fifty four percent of teachers had greater than five years experience.

Figure 12 indicates the relative experience in teaching science of our sample of science teachers.

Figure 12: Science teachers' experience teaching science



There was a reasonable mix of experienced and inexperienced teachers, with more than half having at least five years teaching experience.

3.5 Professional development for science teachers

New science teachers have access to professional development time through the Department's Beginning Teacher Time Release

program (BeTTR). Generally, professional development appears to be organised on a school-by-school basis, although regional learning centres also had a role in development and promulgation of professional development.

Teachers are able to source suitable professional development from a number of sources, including DoE's intranet. Teachers can also attend seminars and conferences, including the annual Science Teachers' Association conference. In addition, the Department provided a program of organised professional development to support the introduction of the science curriculum.

Some interviewed science teachers complained that they found it difficult to make time for professional development, but others were comfortable with the current level and one complained of being "PD'd out".

Overall, we were not persuaded that a lack of professional development was affecting classroom performance. On the other hand, we noted that the Department did not appear to have a coordinated approach to professional development and this may have contributed to inconsistency between schools.

Recommendation 4

We recommend that DoE develops a more coordinated approach to professional development and ensures that teachers keep up to date with their subject knowledge.

3.6 Teacher–student ratios

We obtained student data from each school that we visited. From this information, we found that the average science class had 23 students. The maximum class size in the sample was 32. We concluded that class sizes were not contributing to any loss of engagement in science.

3.7 Conclusion

In the main, Tasmanian public schools had sufficient science teachers with the necessary experience, training and qualifications to teach science effectively.

4 Science curriculum

4 Science curriculum

Does the Tasmanian high school science curriculum meet national requirements and is it effectively delivered?

4.1 Background

In October 2007, DoE released the Tasmanian Curriculum for science, covering science teaching in public schools from kindergarten to Year 10. However, a national curriculum is also being developed that will eventually replace the Tasmanian Curriculum.

In this Chapter, we look at whether the Tasmanian Curriculum was:

- aligned with national requirements
- developed with stakeholder involvement
- successfully delivered
- appropriately assessed.

4.2 Alignment with national requirements

The Commonwealth Government announced the development of a national curriculum for science in April 2008. Until the adoption of the national curriculum, the Tasmanian Government had committed to align its curriculum with the *Statements of Learning for Science*[15].

We verified that the Tasmanian Curriculum incorporated the national statements of learning although we noted that the national statements of learning were not very prescriptive and not suited to ensuring national consistency of content.

A draft of the new national science curriculum was released for consultation on 1 March 2010 and is set for release late in 2010.

4.3 Stakeholder involvement

The Tasmanian Curriculum replaced the previous Essential Learnings Framework. The draft curriculum went out for consultation, initially to groups of teachers around the state. Public consultation then followed, allowing other teachers and professional bodies to make submissions. Year 11 and 12 science teachers became involved through moderation meetings.

[15] Curriculum Corporation, *Statements of Learning for Science*, 2006

We found that there was widespread consultation and acceptance of the curriculum.

4.4 Curriculum contents

Strands of knowledge

The Tasmanian Curriculum deals with:

- science as a human endeavour, which focuses on the relationship between science and society
- scientific inquiry, which focuses on scientific method and concepts such as formulating and testing hypotheses
- scientific communication, which looks at sources of scientific information and writing of science reports
- science as a body of knowledge, which includes principles and theories drawn from the disciplines of science.

While the curriculum is reasonably prescriptive about competencies, it is less so about content and learning activities.

Student focus groups

Some of our focus group students (see Section 2.3) were quite critical of what they saw as significant variations in content between schools and a lack of alignment of the high school curriculum with college science. Some of the comments included[16]:

- Alignment with college science was poor. We had to start from scratch at college.
- I am not doing chemistry next year, because I did not learn any chemistry at high school.
- I would have liked more consistency with the way in which science was taught, not only between schools but also between classes at the same school.
- I would have liked to have science at high school better prepare me for science at college. It is a bit of a leap at the moment.

Year 11 college teachers

We followed up with Year 11 college senior teachers to seek their views about students' prior knowledge. Comments included:

[16] By 'curriculum' we are not necessarily referring to the new Tasmanian Curriculum for science, because it was not introduced until 2008. College students in Years 12 and 13 would not have been taught this curriculum.

- There was significant variation between year 11 students from different high schools.
- I expect a reasonable level of scientific understanding and mathematical ability, but find that I need to commence the physical science course from a low base to counteract the fact that not all students have done much physics and chemistry.
- Many students arriving at College to do Physical Sciences in Year 11 cannot write simple chemical formula, or put together a simple electrical circuit.
- There needs to be more emphasis on an agreed set of skills and knowledge that should be embedded in the high school science curriculum. I would also favour standard testing of basic knowledge and skills.
- Non-government schools that have continuing year 11-12 students have the advantage of more continuity in science.

As noted in Chapter 1, PISA and TIMSS data indicates that Tasmania is competitive with other states and territories and better than the OECD average. However, it seems to us that Tasmania may be missing the opportunity to have a genuine competitive advantage through greater scientific literacy. Subjects such as mathematics build steadily on previously acquired knowledge from high school through to Years 11 and 12. By contrast, college science teachers are currently compelled to assume little knowledge from high school. To some extent, that is due to physical science only being offered at one level, unlike, for example, mathematics, which is offered at different levels.

The following recommendation may well be overtaken by events, with the prospect of a new national curriculum, but in view of the comments of students and teachers, the recommendation should still be made.

Recommendation 5

We recommend that:

- **DoE coordinates development of an agreed mandatory subset of skills and knowledge**
- **DoE further develops moderated assessment for the mandatory subset of skills and knowledge.**

4.5 Was the curriculum effectively delivered?

Although schools are not obligated to fully implement the Tasmanian Curriculum until 2010, principals advised that they were using the curriculum. In order to assess whether the curriculum was effectively delivered, we examined planning documents, looked at how it was assessed and examined science results from a sample of high schools.

The Tasmanian Curriculum states that it is important to map out the science learning that will occur at each year level to ensure coverage of the curriculum and avoid repetition. A balanced 'scope and sequence' document should be used to ensure all of the required strands are covered by teachers. We expected that the scope and sequence documents would be sufficient for us to assess whether the curriculum was being delivered.

Some schools provided us with scope and sequence documents that gave detailed blueprints addressing the curriculum. However, we found that the standard of the documentation was unsatisfactory at four of the eight sample schools, having the following failings:

- they did not exist
- they were scant in detail, e.g. merely a list of topics
- the documents failed to adequately cover the strands of the curriculum.

We also noted that only one of the scope and sequence documents covered an assessment approach and none addressed professional development needs of teachers.

Where we were unable to locate satisfactory scope and sequence documentation we requested a sample of lesson plans to enable verification that the curriculum had been delivered. Despite repeated requests, no lesson plans were forthcoming. One teacher conceded that detailed lesson plans did not exist.

We were unable to obtain documentary evidence that half of the Tasmanian schools that we sampled had delivered the curriculum.

Recommendation 6

We recommend that schools prepare detailed plans to provide for and document coverage of the curriculum, as well as an assessment approach and professional development needs.

4.6 Assessment

4.6.1 Assessment approach

The Tasmanian Curriculum is not prescriptive in what content is taught and assessment is criteria-based. Teachers assess students

using a scale of five standards, divided into 15 stages spanning kindergarten to Year 10. When a student can demonstrate achievement of a given stage he or she can then progress to the next stage. Table 1 illustrates the three relevant curriculum standards showing the expected stages of assessment for Years 7-10.

Table 1: Expected progress of assessments for Years 7–10

	Standard 3			Standard 4			Standard 5		
Year 10					11	12	13	14	15
Year 9				10	11	12	13	14	
Year 8			9	10	11	12	13		
Year 7		8*	9	10	11	12			

* Stages range from 1 to 15.

Well below minimum standard

Below minimum standard

Minimum standard

Table 1 shows that a typical Year 7 student commences high school science from either Stage 8 or Stage 9. By the time a student is in Year 10 he or she should have at least progressed past Stage 11. An advanced Year 10 student will probably complete Stage 15. The Department's *Expected Progress of Assessments* document specifies that the below minimum standard, shown in yellow, is below the average standard expected for a year group — shown in green (minimum in dark green).

4.6.2 Assessment methods

Ultimately, any curriculum needs to have an assessment process in order to:

- provide motivation for students to learn
- assess each student's achievement
- facilitate evaluation of curriculum delivery by individual schools and the Tasmanian education system
- identify poorly and strongly performing schools and teachers.

In our view, it would not be possible to conclude that curriculum delivery had been effective in the absence of evidence of objective and consistent assessment of student achievement.

Assessment is provided by a range of methods including tests, assignments, experiment reports and observation. We looked for evidence of planned assessment at the Department, school or teacher level.

We found that the Tasmanian Curriculum included general principles of assessment, but was not sufficiently prescriptive to serve as an assessment plan. Scope and sequence documents did not refer to assessment other than for one school that provided assessment details for each topic of the curriculum. No other documented assessment plan was located in our sample. On inquiry, teachers provided general comments such as:

- We use investigations, tests, assignments and observations.
- A full range of assessment is undertaken here with the top-level senior classes undertaking formal exam-type assessments.
- Assignments given for each unit, which can be in the form of an essay, poster assignment, PowerPoint presentation or a student-designed experimental investigation. There is a test each term which covers two units with a 30–45 minute test being held at the end of each unit.

The information provided by these teachers suggests that they had a reasonable idea of how they were going to assess student performance. However, in the absence of a documented and detailed assessment plan or inclusion of assessment intentions in other plans, we were unable to conclude as to whether assessment had been an effective element of curriculum delivery.

Recommendation 7

We recommend that clear and detailed assessment intentions be documented in school curriculum documents as well as in lesson planning documents.

4.6.3 Assessment results

Figure 13 summarises the proportion of students found to be below DoE's expected standard in a sample of over 2000 individual student results from the schools we visited.

Figure 13: Proportion of students below expected standard

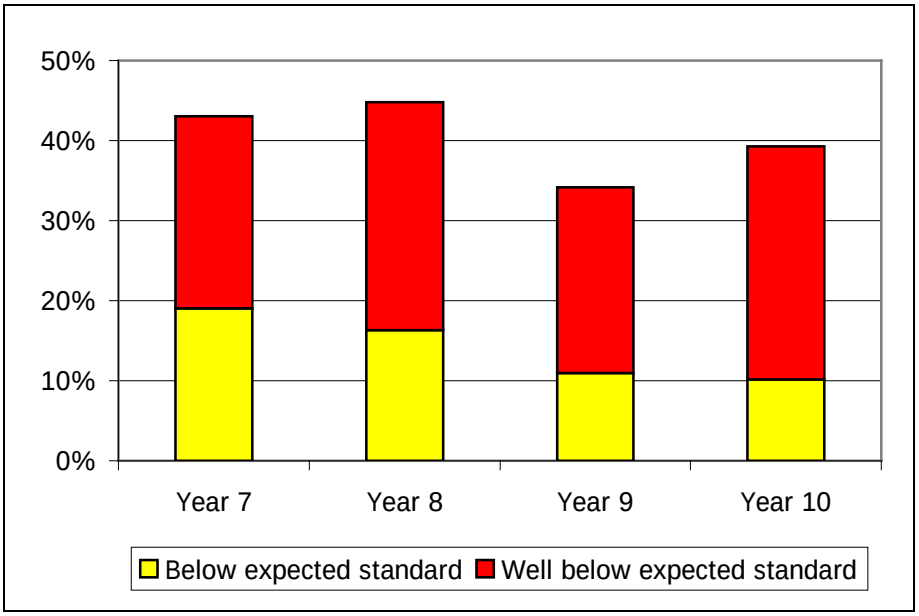


Figure 13 suggests a large proportion of students are either not interested or not progressing in high school science. Coincidently, one of our interviewed teachers commented that only a third of students appeared engaged with the class work. Other teachers also commented on high levels of disengagement. PISA tested interest in learning science and found that Australia ranked 54th of 57 countries tested and that Tasmania ranked sixth of the eight states and territories.

Recommendation 8

We recommend that DoE investigates why a large proportion of students are under-performing in science.

4.6.4 Moderation days

In the absence of standardised tests for the state, we considered it necessary that a substantial moderation process occur annually to ensure that results of individual schools are comparable.

We were advised that there was a moderation day, which involved review of graded work by individual schools and teachers. We found no formal process for standardising student results in accordance with moderation findings and it was left to individual teachers to adjust their marking standards as they deemed necessary. Our view was that some form of independent scrutiny and follow up of any inequitable grading was necessary. A concern raised by teachers and principals was that in recent years the days allocated for moderation had been insufficient following reduction from two down to one. However, the Department advised us that prior to 2006

only Years 9 and 10 received any moderation days. Since 2006, moderation has been extended to all years.

In addition to a moderation day, there is a program to assist with schools' internal moderation processes by providing summative information of a statistical nature. That information would allow Principals to compare the distribution of results for their school and classes with others. This process might assist a teacher or principal to correct inconsistencies with their assessment standards compared to other schools. However, there is also the risk that it might be used to falsely standardise results with other schools where not justified by student performance. We see it as a useful program, but not a substitute for comparison of assessed work.

There is also a program (Guided Assessment Task) which involves use of standardised testing of students and comparison with classroom assessments. We see this as a potentially effective moderation method, but at this stage, there has been low uptake by schools and year grades.

Recommendation 9

We recommend that the moderation process be reviewed to ensure all classes are subject to effective moderation and that DoE maintains supervisory control of the process to ensure consistency of assessment between schools.

4.7 Conclusion

Despite widespread consultation with stakeholders and alignment with national requirements, it appeared that the non-prescriptive nature of the curriculum was leading to inconsistency of teaching between schools and preventing Year 11 teachers from assuming that incoming students from public high schools had a reasonable level of prior knowledge.

We were also unable to conclude that the curriculum was being effectively delivered and assessed because of deficiencies in, or non-provision of, planning documentation for lessons. Neither were we persuaded that the moderation process was able to ensure that results of assessment for different schools were comparable.

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5 Resourcing

5 Resourcing

Are high school science facilities well resourced throughout the State?

5.1 Background

We sought to determine whether high school science programs were adequately resourced by looking at the standard of:

- science laboratories
- laboratory technicians
- teaching aids and materials.

5.2 Science laboratories

All high schools should have suitably equipped science laboratories that allow teachers to deliver the curriculum. We found that laboratories visited varied considerably:

- Of the eight schools, three had modern, well equipped laboratories offering no impediment to the delivery of the curriculum.
- Another two schools had spacious well equipped laboratories but required refurbishment. However, these schools had been successful in securing government funding for refurbishment in the near future.
- The remaining three schools had laboratories that were old and in poor condition. In addition, we found that they had layout and/or acoustic problems. Only one of these schools has been given subsequent approval to refurbish its laboratory.

All of the schools visited had adequate stocks of chemicals for experiments. However, some of the equipment used for experiments was old, for example some schools were finding it increasingly difficult to keep their Bunsen burners in service.

Recommendation 10

We recommend that DoE develops a plan for review and upgrade of high school laboratories.

5.3 Laboratory technicians

Science teachers rely on laboratory technicians to ensure that experiments are safe and comply with occupational health and

safety considerations. Laboratory technicians also help set up experiments and maintain equipment and supplies.

DoE uses a formula to determine laboratory technician staffing based on student enrolments with funding provided to schools accordingly. Schools determine how they apply these funds. We asked principals for student numbers so that we could confirm the adequacy of laboratory technician numbers. At two schools, we found there to be insufficient laboratory technician resourcing. At one school there was none at all — despite being funded by DoE for one day a week. We note that securing the services of a laboratory technician can be difficult in remote areas.

Recommendation 11

We recommend that DoE gives high priority to ensuring schools having sufficient laboratory technicians to support teaching staff and to ensure health and safety standards are maintained.

5.4 Teaching aids and other resources

Ideally, science teaching should be underpinned by visual materials. Traditionally, this would have been in the form of textbooks and handouts.

There is no longer a prescribed textbook for science under the Tasmanian Curriculum. Our sampled schools generally used a combination of old sets of text books supplemented by handouts. In addition, the schools used the Internet, overhead projectors, television and DVDs. In particular, schools made extensive use of the on-line resource, the *Le@rning Federation*, a joint project by states and territories.

Excursions are recognised as a valuable learning experience for science students. We found that there are a diverse number of experiences available in Tasmania for high school students, including:

- CSIRO Science Education Centre in Hobart
- Woodbridge Marine Discovery Centre
- National Forest Learning Centre in Hobart
- Grote Reber museum at Cambridge.

In addition, many of the schools that we visited had established links with local industries such as forestry and aquaculture.

5.5 Conclusion

More than half of the schools visited had laboratories that required refurbishment, were old or in poor condition. In addition, some schools had excessively old laboratory equipment and insufficient laboratory technicians.

6 Strategic planning

6 Strategic planning

Is science teaching covered by departmental strategic planning?

6.1 Background

We were looking for either a strategic plan for science teaching or for a general plan that incorporated science. Strategic plans should outline:

- goals
- standards of service delivery
- measures of goal achievement
- strategies to further the goals
- risks and risk-management strategies
- resources.

6.2 Strategic plans and goals

We were provided with a variety of documents in response to our requests for a copy of the Department's strategic plan incorporating science teaching.

One such document was the Tasmanian Curriculum for science which sets out the content and assessment criteria of the science program. It also defined the goal of science education to be development of scientific literacy in all students. However, the curriculum did not include measures of achievement of that goal. It also did not deal with practicalities of the delivery of teaching services such as:

- supply of teachers and other resources
- maintenance of teaching standards and monitoring processes
- strategies to improve goal achievement.

Other separate documents provided broad outlines of goals, strategies and measures, but no single document met our expectations of a strategic plan[17]. The documents provided also tended to be pitched at too high a level to facilitate planning.

[17] One such document was the *Learning Services Curriculum Team Strategic Plan 2008–2009*, which did contain some strategies for implementing the new Tasmanian science curriculum and engaging and supporting new science teachers.

There were also individual school plans which covered local matters such as school budgets, recruitment of teachers, and minor infrastructure matters, but obviously not statewide strategies.

Recommendation 12

We recommend that DoE develops a strategic plan covering science teaching.

6.3 Measures of goal achievement

Measures of goal achievement are needed for different reasons, namely to:

- ensure that the curriculum is being effectively delivered in schools
- compare performance with previous periods
- compare performance with other jurisdictions
- internally identify poorly performing schools and teachers, in order to take corrective action.

All of these functions serve to motivate better performance, lead to improvements and provide evidence on the effectiveness of teaching methods and new initiatives.

For literacy and numeracy there are national surveys and benchmarks which are used for measuring and comparing performance of students, schools and jurisdictions. That information has been the focus of a national impetus to lift literacy and numeracy levels.

In the case of science, there are also national or international benchmarks — PISA and TIMSS — as discussed in Sections 1.2 and 1.3. However, as noted, those measures were deficient in some respects. PISA measures the performance of 15-year-olds regardless of grade year and therefore complicates comparison between jurisdictions with a different age distribution between grade years. TIMSS only tests at Year 4 and Year 8 and therefore does not provide measurement of the last years of high school. In addition, both PISA and TIMSS are not measured annually.

The Department does have a system (SARIS) for recording and reporting statewide subject results, based on student achievement of stages of the Tasmanian Curriculum. However, at the time of our audit it was not compulsory for schools to enter science results into SARIS and some 13 percent of results were not entered. A greater problem was lack of comparability of school results. As noted in Section 4.5, inconsistencies in assessment approach and lack of

moderation of results made it difficult to make meaningful comparisons.

We refer to Recommendation 1:

> We recommend that DoE works with other states and territories to ensure agreed standardised testing enables more meaningful comparison between jurisdictions.

6.4 Strategies

One planning document listed some high-level strategies, including[18]:

- devolving planning to a school level
- implementing the new science curriculum.

We also found a listing of some strategies in the Department's Annual Report and Treasury Budget Papers, including:

- support for first-year teachers through the BeTTR program
- graduate recruitment program for science teachers
- infrastructure spending for refurbishment of science laboratories at three high schools.

However, our view is that incorporation of strategies into a strategic plan would facilitate follow up and increase the likelihood of successful implementation.

6.5 Conclusion

There was little evidence of a coordinated approach to strategic management, although a number of separate documents outlined various goals, measures and strategies.

[18] *School Improvement Framework*, Department of Education, 2009.

Independent auditor’s conclusion

Independent auditor's conclusion

This independent conclusion is addressed to the President of the Legislative Council and to the Speaker of the House of Assembly. It relates to my performance audit on science education in Tasmanian public high schools. I examined Department of Education (DoE) documentation, interviewed students, teachers and DoE staff and academics to assess the effectiveness and strategic management of secondary science education. My audit was based on the objective, audit scope and audit criteria detailed in the Introduction to this Report.

In developing the scope of this audit and completing my work, the parties interviewed provided me with all of the information that I requested. There was no effort by any party to the audit to limit the scope of my work. This Report is a public document and its use is not restricted in any way by me or by any other person or party.

Responsibility of the Secretary of the Department of Education

The Secretary is responsible for ensuring that a science education program is conducted in an effective manner in Tasmanian public high schools.

Auditor-General's responsibility

In the context of this performance audit, my responsibility was to express a conclusion on whether DoE managed an effective science education program in Tasmanian secondary schools.

I conducted my audit in accordance with Australian Auditing Standard ASAE 3500 *Performance Engagements,* which required me to comply with relevant ethical requirements elating to audit engagements. I planned and performed the audit to obtain reasonable assurance of whether DoE managed the science programs in high schools effectively.

In this circumstance, my work involved performing procedures to obtain evidence about performance of DoE's science education program based on objectives and criteria outlined in the Introduction to this Report. The criteria were established by me without influence. The audit procedures depended on my judgement, based on the criteria and the assessment of the risks of material misstatement of the information obtained by me as part of this audit.

In making this risk assessment, I considered the effectiveness, operational performance and strategic management of the science

education program. I believe the evidence I have obtained was sufficient and appropriate to provide a basis for my conclusion.

Auditor-General's conclusion

Based on the audit objectives and scope and for reasons outlined in the remainder of this Report, it is my conclusion that DoE ensures that the Tasmanian public high schools science education program is conducted in an effective manner.

However, I also concluded that:

- Students in Tasmanian public high schools are marginally underperforming in science when assessed against the Tasmanian curriculum.
- There has been a decline in the proportion of Tasmanian students continuing with science past high school.
- I was unable to conclude that the curriculum was being delivered effectively.
- More than half the schools we visited had laboratories that required refurbishment, were old or in poor condition.
- There was little evidence of a coordinated approach to strategic management at the departmental level

My findings resulted in 12 recommendations.

H M Blake

Auditor-General

8 July 2010

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Jun	2010	88	Public Trustee — management of deceased estates
Jun	2010	89	Post-Year 10 enrolments

Current projects

Current projects

Performance and compliance audits that the Auditor-General is currently conducting:

Title	Subject
Profitability, and economic benefits to Tasmania, of Forestry Tasmania	Evaluates Forestry Tasmania's long-term financial and economic performance.
Public service productivity	The audit will express an opinion on productivity in the Tasmanian State Service in relation to the number of employees over a ten-year period. It will examine changes in efficiency of public sector outputs and whether core services have increased in quantity, quality or range.
Fraud control	Assesses the effectiveness of fraud controls in government entities.
Follow up of performance audits	Ascertains the extent to which recommendations from previous audits (namely four reports tabled from November 2006 to April 2007) have been implemented.