Trends & Issues

in curriculum and assessment

Issue 1: April 2014

Trends & Issues in curriculum and assessment is a new occasional e-bulletin that draws on QSA data to inform education debates and support leadership and instructional effectiveness in Queensland schools.

Identifying enrolment trends in senior mathematics and science subjects in Queensland schools

Current Perception

It is commonly claimed that enrolments in maths and science in senior secondary schools are in steep decline and this will impact adversely on Australia's pool of scientists, mathematicians, engineers, IT professionals and future economic competitiveness. Even Australia's Chief Scientist[1] has lamented the declining numbers:

> *After a lot of effort by many people, the proportion of mathematics and science students in schools still goes down; and in universities (as with engineering) it is virtually flat. Something different has to be done demanding a paradigm shift.*

There may well be problems with students not choosing careers in maths and science but any analysis should consider the various factors that affect enrolment patterns in secondary schools.

Counting the changes since the 1990s

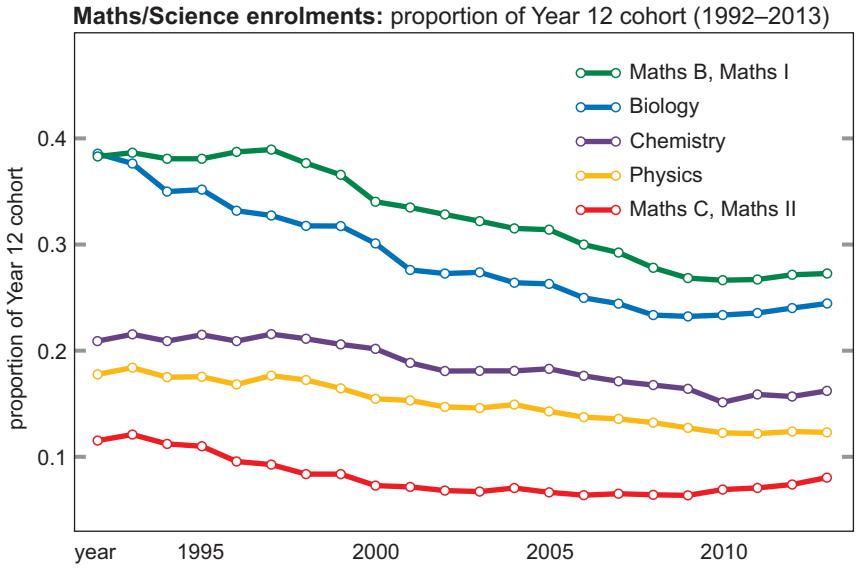

Figure 1

Figure 1 shows the type of analysis that is pointed to by many researchers and commentators. Whilst hardly indicating a crisis or steep decline, the proportion of Year 12 students studying maths and science subjects has fallen since the early 1990s. Most of the decrease happened before 2005 and participation levels seem to have stabilised now. In the past couple of years participation has actually increased. Analysis shows that some common observations about the decline in enrolments are not supported by the data in Queensland.

Perhaps there is simply a belief that the more students doing maths and science, the better the outcome for society, and that leakage to other subjects is a cause for concern regardless of the choices students are making. Is that alone sufficient to

1. Office of the Chief Scientist (2012), *Mathematics, Engineering and Science in the National Interest,* Office of the Chief Scientist, Canberra. Accessed on 3 March 2014 www.chiefscientist.gov.au/wp-content/uploads/Office-of-the-Chief-Scientist-MES-Report-8-May-2012.pdf

make it desirable for us to try and turn the clock back to the 1992 proportions? Some might say “yes” but merely citing the change in proportions obscures some important facts about what has changed in senior secondary education since the 1990s.

A more diverse cohort of students

Today more students than ever before are staying at school. A combination of society’s changing expectations and legislative reform has encouraged students who might have left school at Year 10 in 1995 to now complete Year 12. Schools have changed to accommodate this more diverse cohort of senior students. It is not necessarily reasonable to expect that subjects like Maths C and Physics could or should maintain their proportion of enrolments during this transition.

Broader curriculum pathways

The 1990s were marked by increased curriculum choice. More choice naturally means subjects must compete for students. Consequently, many subjects now have reduced proportions of the student cohort. We cannot simultaneously embrace curriculum diversity and complain about falling proportions. We commonly hear that students should be studying more history, more languages or more science. The obvious corollary is there must be some subjects that will receive fewer students.

In 1992 there were 709 distinct curriculum choices certificated by the Queensland Board of Senior Secondary School Studies. By 2013 this number had grown to 8457. Many of these choices include units of competency completed as part of vocational education and training (VET) courses. VET has attracted strong enrolments in Queensland secondary schools — an outcome widely regarded as positive as Queensland strives to find enough skilled workers to support various sectors of the economy. About 65% of Year 12 students who graduated in 2013 achieved a VET Certificate I, II, III or IV qualification.

The dot-com bubble

A good example of how changes in society can affect subject choices may be observed in enrolment trends in the Authority subject Information Processing and Technology (IPT). Figure 2 shows that enrolments in IPT grew steadily from the mid-1990s, peaking in the early 2000s, before markedly declining — reflecting the worldwide rise and fall in demand for IT specialists. We may reasonably assume that this growth meant enrolments shifted from other subjects. It is likely that maths and science were the main recipients.

The effect can be seen by comparing the group of students who studied the maths-science combination of Maths B, Maths C and at least one of Physics and Chemistry with the group of students who studied just Maths B plus IPT and at least one of Physics or Chemistry. The counts are a near perfect complement. There is little doubt that a proportion of students dropped Maths C to make room for IPT. Can this really be interpreted as a poor outcome given the employment opportunities at the time?

Maths C (Maths II)/IPT enrolments: proportion of OP-eligibles (1992–2013) (studied Maths B and at least one of Physics/Chemistry)

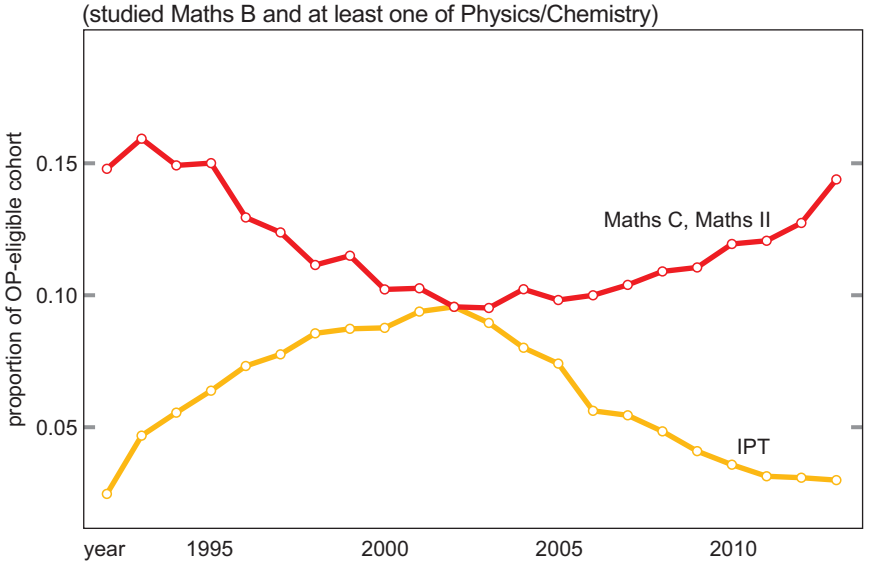

Figure 2

What happens to a subject cohort when numbers decline?

Which students have dropped out of maths and science subjects? Is it our prospective engineers and chemists who are abandoning Maths C and Physics? The data in Figure 3 are stark. There has been a significant decline at the lower achievement levels (Very Limited Achievement (VLA) and Limited Achievement (LA)). Students who previously would have achieved poorly in these subjects are choosing to do something else — arguably as a consequence of wise counsel. The introduction of the Queensland Certificate of Education (QCE) from 2008 is likely to have influenced these subject choices. To achieve credit towards the QCE, students must be awarded at least a Sound Achievement in Authority subjects. They also need to achieve a Sound Achievement in at least one semester of a mathematics subject. Students do not receive credit for a VLA or LA.

These points have attracted little attention from researchers and education leaders. Would restoring this group of low achieving students to Maths B actually be seen as a positive outcome for our future technological prospects?

After English (99.7%), the next five most popular subjects for the 2013 OP[2] 1–5 group — our 5166 highest achieving students — were Maths B (89.2%), Chemistry (59.8%), Physics (44.5%), Biology (44.1%) and Maths C (39.5%). What must teachers of Physical Education (12.3%), Accounting (10.7%), Economics (10.6%) or Geography (10.1%) think about their ration of the high achieving student body?

An alternative analysis

As explained above, it is deceiving to compare maths and science subject enrolments over time as a proportion of the Year 12 cohort because the makeup of this population is changing. When critics point at these figures, they inevitably conclude that scientists and mathematicians are endangered species. However, senior schooling is not only about preparation for university. There is a growing VET cohort in Queensland schools. Students who typically choose careers in maths and science have always come from the OP-eligible sub-group. If we wish to make inferences about university-trained professionals, it probably makes more sense to compare rates within the OP-eligible sub-group. After making this adjustment, Figure 4 is what is being portrayed by some as a steep decline in maths and science enrolments.

2. The Overall Position (OP) tertiary entrance ranking system is explained at www.qsa.qld.edu.au/630.html

It shows small but discernible increases in enrolments from the mid 2000s. It is worth noting that these increases all follow the introduction of new syllabuses which seem to have reinvigorated enthusiasm for these subjects amongst teachers and students in some schools. For example, the 2004 syllabus for Biology was implemented with a full senior cohort for the first time in 2006, the 2007 syllabuses for Chemistry and Physics for the first time in 2009, and the 2008 syllabuses for Maths A, B and C in 2010.

Furthermore, Figure 3 shows who has really abandoned maths and science: it is the students who, in the past, believed they had to choose these subjects to enhance their tertiary entrance prospects, or had few other options, and ended up with a VLA or LA.

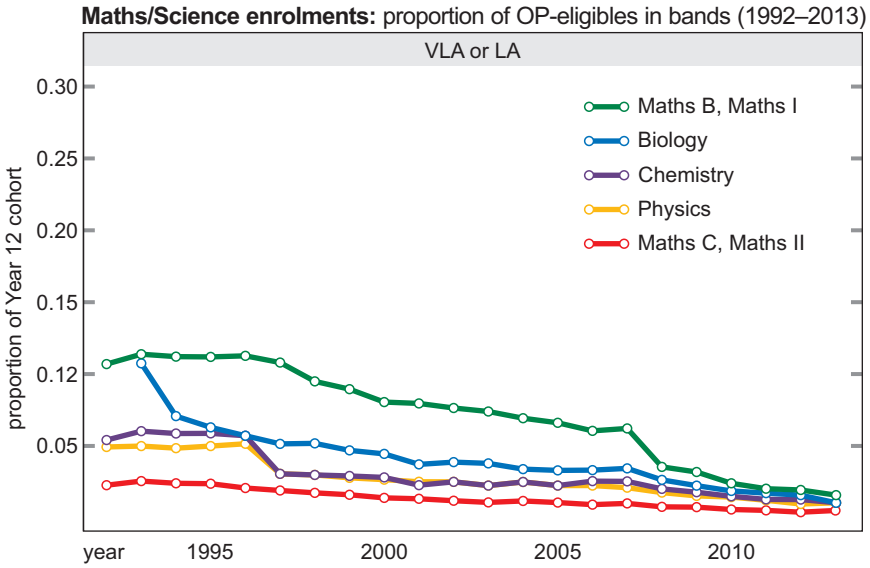

Figure 3

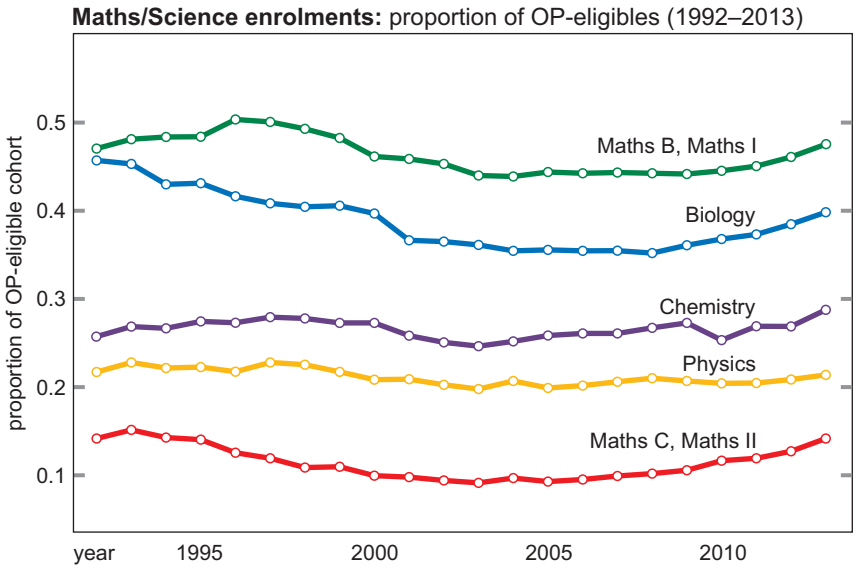

Figure 4

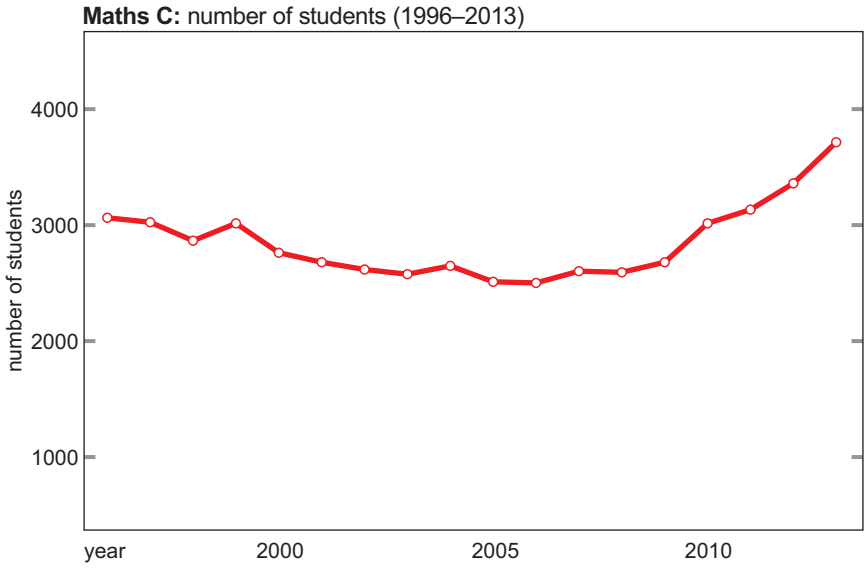

Figure 5

The effect of university bonus ranks

Maths C enrolments are trending upwards with more Maths C students in 2013 than any other year. Along with the implementation of the revised 2008 Maths C syllabus in 2010, university entrance bonuses are likely to have played a part in this development. For example, the bonus points awarded to University of Queensland applicants who had studied Maths C were introduced in 2008 and applied to students enrolling in 2009. The clear upward trend in Maths C enrolments following this is shown in Figure 5.

Such measures have been recommended by the Australian Government Chief Scientist[3]:

> *Physics and chemistry (and some mathematics) are seen as difficult subjects. Students will be more inclined to choose them if there is sufficient reward for effort. In recent years, many universities have relaxed the requirement for students to have completed these subjects, thus reducing their strategic value. The perceived relative difficulty of these subjects needs to be matched by appropriate rewards.*

Summary

The proportion of Year 12 students who study maths and science is not as high as it was in the 1990s but there are some good reasons for that and they should not necessarily alarm us. The proportion of OP-eligible students studying science is quite healthy and high achieving students still flock to these subjects. Student enrolment decisions are influenced by a variety of factors, including the selection signals made by universities. If we need more maths and science students, then that should be made clearer in tertiary selection policies. For these reasons we should be wary when fluctuations in enrolments are portrayed as a symptom of declining standards rather than a response to policy and cultural changes.

Have your say

We hope you have found the information in this bulletin to be informative. If you would like to share your views on the topic in this issue, please email us at trendsandissues@qsa.qld.edu.au

3. Office of the Chief Scientist (2012), *Mathematics, Engineering and Science in the National Interest*, Office of the Chief Scientist, Canberra. Accessed on 3 March 2014 www.chiefscientist.gov.au/wp-content/uploads/Office-of-the-Chief-Scientist-MES-Report-8-May-2012.pdf