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Editorial

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I am a member of the editorial team of this journal since 2007. The initiative for this Australia Special Issue began with Fatih Taşar, the Editor of the EURASIA Journal, spending 4 months at RMIT University on an Australian Government Endeavour Executive Award in 2008. During Fatih's time with us we organised a seminar on "Mathematics, Science and Technology Education Down Under" which became the origin of most of the papers included here.

It was a great honour to be asked to edit this Special Issue and I would like to thank Fatih and all the authors who submitted papers for consideration for this issue – without them it would not have happened. I would particularly like to thank my colleague Professor Dianne Siemon who worked with me on organising the refereeing and editing of the submissions.

This Special Issue is timely because in Australia, and elsewhere in the Western world, there are some key issues confronting the quality of mathematics and science education in schools:

- ✓ *Declining student interest in studying mathematics and science at school and university*
- ✓ *Shortages in numbers of qualified science and mathematics teachers*
- ✓ *Concerns about the appropriateness of the school curriculum to engage students with mathematics and science*

Firstly, there is widespread concern about decreasing student participation in upper secondary and university science and mathematics courses, even though there has been a national increase in participation in upper secondary school education in recent decades. For example, Dekkers & De Laeter (1997) report that although enrolments in biology, chemistry and physics increased from 1976 to 1992 they declined quite dramatically (approximately 20%) between 1992 and 1995. In my home state of Victoria, after continuing to decline for a few years, enrolments in biology and chemistry have now increased to above 1995 levels (but have not reached 1992 levels), however enrolments in physics continue to decline (Gough, 2008).

Secondly, the shortage of qualified science teachers in Australia is alarming, with some senior physics and chemistry teachers "manifestly unprepared" for the classroom, according to a survey conducted by the Australian Council of Deans of Science (Rood, 2005). The shortage is predicted to worsen dramatically over the next decade because the workforce of science teachers is aging, there are falling numbers of science students in universities, and there are problems with retaining early-career teachers (Harris et al, 2005).

A similar story emerges for mathematics teachers where a survey by the Australian Deans of Science (Harris & Jensz, 2006) found that 75% of schools were finding it difficult to recruit qualified mathematics teachers.

The Victorian Government has responded by promising to invest $76 million over four years into boosting maths and science education, including $900,000 to fund 100 mathematics and science teaching scholarships over three years. There are also programs in place to retrain teachers and attract mathematics and science professionals to teaching. Other State governments in Australia are responding similarly (Trounson, 2008).

The third issue confronting the quality of mathematics and science education in schools is the quality and nature of the curriculum: As Tytler (2007) notes, the school science curriculum has failed to adequately respond to the changing needs of students, the changing nature of science and the changing nature of society. Similar statements could be made about mathematics given the declining levels of student interest in studying in the area.

Australia is currently moving towards a national curriculum in a number of learning areas including Science and Mathematics (see National Curriculum Board, 2009a, 2009b, 200c, 2009d). At the moment the exact nature of this new curriculum is unknown beyond the Framing and Shaping Papers, but the curriculum content could be critical. As Tytler et al (2008) conclude:

- ✓ *Career decisions are made early in life*: The majority of young people make decisions about a future

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Science, Technology, Engineering, and Mathematics (STEM) career by *the* age of 14. Accordingly, interventions designed to increase engagement may be better targeted at primary and early secondary school rather than in the later years of schooling and university. Because of the multitude of factors operating at different developmental levels, as well as gender differences, effective interventions will need to be different at each stage of the student pathway.

✓ *Identity is a key factor to understanding STEM participation:* Career and subject choice is increasingly being seen as *related* to the development of a person's identity. For example, young people, especially girls, are reluctant to participate in the physical sciences because they often perceive the identities of engineers and physicists as incongruent with their own.

✓ *Curriculum & pedagogy need to be more appealing, relevant and meaningful to young people*: Curriculum content, practice and assessment in maths and science needs to cater for students' diverse backgrounds, interests and aspirations. The relevance of STEM can be enhanced by linking students with contemporary STEM practice and exposure to role models, which also provides awareness of possible future careers.

✓ *Quality of teachers and* teaching *is central to engaging students' interest:* Investment in the quality of teachers is the most effective answer to the quality of student learning and engagement.

It may seem clichéd to say that mathematics and science education in Australia is at a crossroads, but there are certainly many challenges ahead if Australia is the achieve and scientifically and mathematically literate society able to make informed decisions about the future.

One hope for the future comes from the recently released *Melbourne Declaration on Educational Goals for Young Australians* (Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA)). This Declaration includes, as one of its goals, one that relates to environmental sustainability as well as others that relate to social and economic sustainable development (MCEETYA, 2008, p.9) which provides a context for the future development and implementation of mathematics and science curricula for schools:

Goal 2: All young Australians become successful learners, confident and creative individuals, and active and informed citizens

✓ *act with moral and ethical integrity*

✓ *appreciate Australia's social, cultural, linguistic and religious diversity, and have an understanding of Australia's system of government, history and culture*

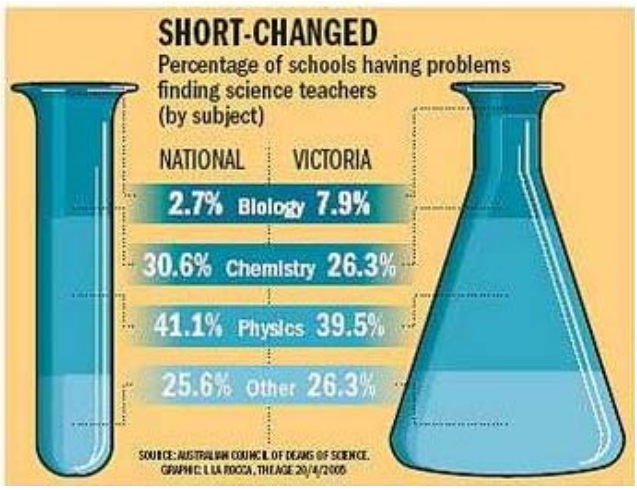

Figure 1. *L La Rocca* in Rood (2005)

✓ *understand and acknowledge the value of Indigenous cultures and possess the knowledge, skills and understanding to contribute to, and benefit from, reconciliation between Indigenous and non-Indigenous Australians*

✓ *are committed to national values of democracy, equity and justice, and participate in Australia's civic life*

✓ *are able to relate to and communicate across cultures, especially the cultures and countries of Asia*

✓ *work for the common good, in particular sustaining and improving natural and social environments*

✓ *are responsible global and local citizens*

This goal has been taken up in the even more recent Department of the Environment, Water, Heritage and the Arts' (2009) Living Sustainably: The Australian Government's National Action Plan for Education for Sustainability, where embedding sustainability in the National Curriculum is one of the action areas.

As I argued at the 2007 ESERA conference in Malmö (Gough, 2008), the challenge is to reconstruct our curricula so that our students as citizens of the world understand and respect the planet we live on. This could be a win-win situation for science education, mathematics education, environmental sustainability education and the planet. This is the challenge for all of us – not just Australians.

I hope you enjoy reading these papers from Australia. Although there is not a paper on environmental sustainability education in this collection there is always room for another Special Issue!

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