20 December, 2018

Committee Secretariat
Parliamentary Inquiry into The Status of the Teaching Profession
PO Box 6021
Parliament House
CANBERRA ACT 2600
ee.reps@aph.gov.au

Dear Committee Secretariat,

[SUBMISSION TO THE PARLIAMENTARY INQUIRY INTO THE STATUS OF THE TEACHING PROFESSION]

The Australian Mathematical Sciences Institute (AMSI) welcomes this review and the opportunity to make a submission concerning the teaching profession in Australia, and the status of teachers of mathematics in particular.

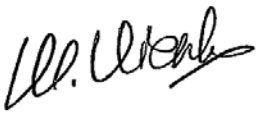
AMSI is the lead advocate for mathematics and mathematics education in Australia. Its mission is the radical improvement of mathematical sciences capacity and capability in the Australian community by (inter alia):
• supporting high-quality mathematics education for all young Australians
• improving the supply of mathematically well-prepared students entering tertiary education by direct involvement with schools.
For an overview of AMSI's activities to support and enhance the teaching of mathematics in primary and secondary schools, we refer to https://schools.amsi.org.au/. The 2017 AMSI policy document "Improving Australia's Maths Grades" contains a general summary of AMSI's policy position on mathematical education.

AMSI's CHOOSEMATHS Project is involved in improvement of mathematical teaching capacity from Foundation to Year 12 nationwide – in urban, regional and remote areas, with a wide variety in SES standards. For example, our outreach officers provide professional learning and teacher support in areas as varied as the Logan area of Brisbane, the Hunter Valley in New South Wales, Port Augusta in South Australia and the far north west of Western Australia, among others. This submission is based in part on the field expertise of our outreach team, supported by data and research.

Yours sincerely,

Professor Geoff Prince
AMSI Director

Michael O'Connor
Schools Outreach Manager



Dr Maaike Wienk
Research and Policy Officer

Introduction

In our experience, teachers in Australia are clearly undervalued and often viewed with disdain. The saying "Those who can, do, those who can't, teach" probably sums this up best. Any initiatives to improve and enhance the status of the teaching profession should be based on the recognition that teachers are qualified experts, fulfilling a central role in Australian society by creating and enhancing Australia's knowledge base. Teachers have a major impact on students' attitudes to learning, culture and career choices. The teaching workforce should be well supported by high quality pre-service training, ongoing professional learning and adequate incentives to enter and remain in the profession. There should be a nationwide emphasis on establishing teaching as an aspirational career and giving it the esteem it deserves.

AMSI is the lead body for the promotion of mathematics and statistics in Australia. This includes the promotion and elevation of mathematics teaching. As such, this submission focuses primarily on the needs of teachers of mathematics now and into the future.

Engagement with mathematics in school

Engagement with mathematics and statistics starts at school, and any effort to make it attractive for current students to become mathematics teachers should start there. Although the percentage of students studying some form of mathematics in Year 12 has been relatively stable over time, at around 80% of the Year 12 student population, the distribution of the students over different levels of mathematics subjects has shifted away from intermediate and advanced mathematics towards elementary mathematics.[1] The disengagement with intermediate and advanced level mathematics has many well-documented adverse effects. One such consequence is a decline in entry into the mathematical teaching workforce, as students who do not engage with mathematics at a sufficient level in secondary school are unlikely to become proficient and enthusiastic teachers of mathematics later on.

Recommendation 1: To adopt the recommendation from the Australian Academy of Science in its Decadal Plan for the mathematical sciences, that universities and state tertiary admissions centres should ensure that subject scaling does not discourage students from choosing advanced subjects while at high school. Universities and governments should introduce mathematical awareness programs demonstrating the career choice benefits and financial and social advantages of completing advanced courses.[1]

Re-introducing mathematics prerequisites for university entry

Parents, teachers and students need to know that intermediate Year 12 mathematics is important for university study, and essential for degrees in science, engineering, computer science and commerce. The reintroduction of clear mathematics prerequisites for university bachelor degrees will emphasise the national and personal importance of mathematics. It will introduce a powerful incentive to choose intermediate mathematics over basic mathematics whenever possible, by sending an unequivocal message to school communities. Completion of intermediate mathematics is

[1] Li N. and Koch, I. (2017), "Gender Report 2017: Participation, Performance, and Attitudes Towards Mathematics", AMSI CHOOSEMATHS Research no 2 -2017.

associated with better learning outcomes and progression at university.[2] It will also create a wider pool for the future mathematical teaching workforce.

Recommendation 2: Universities need to re-introduce mathematics prerequisites for university bachelor degrees in science, engineering, computer science and commerce.[1]

Quality and consistency of the pre-service training at universities

There is insufficient knowledge about the quality and consistency of pre-service teacher education at universities, despite this being a central issue for the status of the teacher workforce. Pre-service training should be front and centre of any approach to improve the status of the teaching profession. There is some anecdotal indication that suggests that standards vary considerably, especially in primary pre-service training. Since 2017 all potential teaching graduates have been required to sit the Literacy and Numeracy Test for Initial Teacher Education Students (LANTITE). However, the LANTITE standards are no more than an indication of the baseline of general knowledge any teacher should have. Content knowledge and pedagogy should be an essential requirement over and above basic literacy and numeracy. Teachers of English and mathematics need to know more than the mechanics of literacy and numeracy respectively, they need to have a sense of how they work as a whole.

Recommendation 3: Universities offering teaching qualifications should set rigorous benchmarks to ensure depth and breadth of knowledge to improve the quality of the qualifications and as a consequence the esteem in which teachers are held.

Workforce planning

Despite a large number of our secondary schools experiencing a severe shortage of properly trained mathematics teachers for over two decades, most state teacher registration boards do not record the discipline qualifications of registered teachers. Nor does the Commonwealth record the disciplines of students as they graduate from pre-placement training at faculties of education in our universities. In most cases a teacher completes their undergraduate degree and a postgraduate qualification to teach. The undergraduate degree may identify them as a science or mathematics specialist, but once they have completed their postgraduate teaching qualification they are 'counted' as education graduates. The result is a lack of central information, and a planning vacuum to ensure adequate teacher supply ***in all subject domains***. For example, the AITSL Teaching Workforce Reports do not identify the content domain specialisations of teachers - only if they are "early childhood", "primary" or "secondary" teachers.

Recommendation 4: State and federal governments should facilitate the collection and dissemination of data about teacher qualifications in subject domains as a starting point for workforce planning. This includes the instigation of an annual census of teacher qualifications, including through professional learning, to monitor and track the standard of the teaching workforce.

[2] See for instance Joyce, C, Hine G., and Anderton R. (2017), "The association between secondary mathematics and first year university performance in health sciences", Issues in Educational Research 27 (4), 770-782.

Ongoing professional learning for teachers

It is important to provide systematic professional learning to all teachers. Within that there are two specific groups for whom this is most critical: Recent graduates and out of field teachers. In the latter case, formal re-qualification is required.

Graduate Teachers

Teachers in the first five years of their career experience a very steep learning curve in all areas of their practice. Most important for them is to establish good teaching practices based on solid subject knowledge including methods for mathematical learning, appropriate classroom management and rapport with students. Often they do not have enough opportunity to hone the subject material in a way to cater for their students.

A proficient teacher has demonstrated satisfactory levels of competence in classroom practice and subject knowledge. It is an annual requirement of re-registration for all teachers to demonstrate continued proficiency. Proficiency means having a depth of knowledge and understanding of the subject matter that would be expected from an expert in the field. Mathematics teachers should be able to, for example, bring to the classroom examples of engineering and commerce applications of mathematical methods. It also requires the ability to examine and explain that content in multiple ways to elicit understanding in the students.

Recommendation 5: All graduate teachers should have access to a structured mentoring and support system to help them through this period and become proficient teachers.

The problem of out-of-field teaching in mathematics

> "Not knowing the content and not being able to answer the kids' questions if they throw you a curveball. I'm having a real problem with connecting concepts because I'm learning the concepts separately. A good teacher would connect it all, tell the kids how this relates to that, but I can't see it myself, so I can't tell the kids. That's another source of my frustration."[3]

As this quote illustrates, a lack of proficiency in mathematical content knowledge and pedagogical ability affects teachers' self-confidence and ability to teach mathematics. These teachers struggle to engage students' positive attitudes to learning. Furthermore, having completed pre-service training alone is not sufficient to give teachers the required knowledge and ability to teach confidently. The 2016 AMSI CHOOSEMATHS teacher surveys showed that more than 75% of survey respondents were trained to teach mathematics at secondary level, yet 32.5% of teachers regarded themselves as out-of-area – female and less experienced teachers especially.[4] These surveys also showed that the out-of-area teachers were considerably less confident and competent in almost all aspects relating to mathematics content, teaching and curriculum documentation. Furthermore, maths anxiety in

[3] Plessis, A. E. Du. (2018), "The Lived Experience of Out-of-field STEM Teachers : a Quandary for Strategising Quality Teaching in STEM?".
[4] Koch, I. and Li, N. (2017), "Teacher Confidence, Education & Experience: AMSI CHOOSEMATHS Survey 2016 in brief", AMSI CHOOSEMATHS Research no 1 -2017.

(predominantly) female teachers has been shown to be an impediment to achievement, and affects attitudes of mostly same-gender students in a negative way which is likely to induce maths anxiety in these female students – a barrier to removing the gender gap in mathematics.[5]

The Staff in Australian Schools survey in 2013[6] defined "in-field" teachers to be those who had either studied the subject for at least one semester at a second-year tertiary level, or had trained in the teaching methodology for that subject. It is important to note here that this is the standard for teachers of year 7 and 8 classes. Logically, the qualification to be "in-field" at year 12 Mathematical Methods or Specialist Mathematics (both Australian Curriculum course names) should be higher than this.

Recommendation 6: there should be an agreed standard for teaching mathematics at senior secondary level. Teachers can attain this level of qualification by engaging in appropriate professional learning whilst already a teacher. For example, a science teacher with a minor in mathematics can teach years 7 to 10, however to teach at higher levels would be required to attain additional qualifications through professional learning.

In November 2018 AMSI published a paper titled *Crunching the numbers on out-of-field teaching in maths*.[7] Using the definitions of out-of-field teaching given above it was estimated that one in three mathematics classes in Years 7-10 is taught by an out-of-field teacher. Looking at this from the perspective of the students, only an estimated 25 per cent of students will be taught by a qualified mathematics teacher in every year from Years 7 to 10. The paper went on to determine how this problem could be solved. It calculated that reducing the issue of out-of-field teaching by 50 per cent would take more than thirteen years if the recruitment of fresh graduates would merely match retirement of mathematics teachers. To significantly reduce the issue within a shorter and much more desirable timeframe, a combination of recruiting additional graduate teachers and retraining of current, out-of-field mathematics teachers will be necessary.

Recommendation 7: Given the scale of the problem and the long-term effort required to remedy it, an urgent, concerted initiative by Australian governments, schools and universities is required to provide retraining for existing out-of-field school teachers of mathematics and enhance their commitment to the recruitment and retention of new, properly qualified mathematics teachers.

[5] Koch, I. (2018), "Maths Anxiety: Students, Pre- and In-Service Teachers", AMSI CHOOSEMATHS Research no 4 -2018 (in press).
[6] ACER (2014), Staff in Australia's Schools 2013; Weldon, P.R. (2016), "Out-of-Field Teaching in Australian Secondary Schools". ACER Policy Insights Issue 6, June 2016
[7] Prince, G. and O'Connor, M. (2018), Crunching the Numbers on Out-of-Field- teaching in Maths, AMSI Occasional Paper 1.

Ongoing professional learning

All teachers need robust, sound professional pre-service teaching in mathematics and then ongoing and sustained professional in-service learning to support the teaching and learning of mathematics in Australian Schools. AITSL standards advocate and promote four levels for teachers: graduate, proficient, highly accomplished and leading. The highly accomplished and leading categories are severely under-represented, and in some states non-existent. The work required to achieve and maintain such status is time consuming, onerous and does not offer requisite remuneration as an incentive.

It is timely here to distinguish between teacher professional development and professional learning. Professional development has come to mean the delivery of information to teachers to influence their practices. Professional learning, by contrast, refers to the internal process of creating knowledge by interacting with the external information in a way that challenges assumptions and creates new meaning and improvement of practice.[8]

The mandated minimum number of professional development hours required for registration per year is twenty. Included in this are staff meetings, annual compliance sessions for anaphylaxis training etc. This leaves very little time for enhancing teacher content knowledge and content specific pedagogical development. For all primary teachers, and the vast majority of secondary teachers, this portion of time is further divided amongst the number of subjects they are required to teach.

Many current professional learning opportunities are inadequate, either in terms of quality or accessibility or both. In all states, with the exception of NSW, there is no formal quality assurance for professional learning providers. This accounts in the main for the variation in quality. As to accessibility, most face to face opportunities occur in major cities. This disadvantages not just rural and remote teachers but also outer suburban ones. Add to this the high costs of attending such courses, which include provision of substitutes, and the decision of who goes to what and when results in even further restrictions.

For professional learning in the content areas, and specifically mathematics, to be effective several studies have found that it needs to have the following attributes:[9]

a) content focused and linked to classroom lessons
b) Have opportunities for active teacher involvement in observing, receiving feedback and analysing student work
c) Be collective and collaborative, with teachers able to exercise choice over which areas to develop
d) Be coherent and consistent with school and state reforms and policies

[8] Timperley, H. (2011), "Realizing the power of professional learning", p4.
[9] Desimone, L. M., & Garet, M. S. (2015), "Best Practices in Teachers' Professional Development in the United States", *Psychology, Society, & Education*, *7*(3), 252. https://doi.org/10.25115/psye.v7i3.515; Walter, C., & Briggs, J. (2012), "What professional development makes the most difference to teachers", *Oxford: Oxford University Press*; Timperley, H. (2011), "Realizing the power of professional learning".

e) Be of sustained duration over a period of months to allow the theory to become embedded in practice.

Recommendation 8: To fund a national on-the-ground professional learning system for mathematics. To significantly improve the baseline level of content and pedagogy, on-going training should be split into two parts: Professional development and professional learning. Professional development would encompass all non-subject necessities and be conducted throughout each school term. Professional learning should adhere to the principles above and be conducted during school holidays. An average of two days per break at 6 hours per day would enable teachers to undertake nearly 50 hours per year. This professional learning should also be credentialed to a university standard.