Teacher Education Ministerial Advisory Group Consultation 2014 SUBMISSION

NAME OF ORGANISATION OR INDIVIDUAL MAKING SUBMISSION

The Australian Association of Mathematics Teachers Inc.

AREAS FOR RESPONSE

1. What characteristics should be fostered and developed in graduate teachers through their initial teacher education?

   How can those best suited to the teaching profession be identified?

   What are the skills and personal characteristics of an effective beginning teacher? How can teacher education courses best develop these?

International evidence from TEDS-M (ACER, 2012) points clearly to the nexus between entry standards for teacher education and student achievement as measured by international student assessments in mathematics, science, reading and literacy. Given this nexus it is imperative to scrutinise what is expected of those entering teacher education. It is AAMT's view that the expectations in relation to mathematical background and attributes need to be ramped up considerably, and made nationally consistent.

The TEDS-M findings support a similar argument in relation to the qualities – what they know and are able to do – of graduates from teacher education programs.

For primary pre-service programs there should be a measure of general intellectual capability by means of a minimum ATAR score or similar. Since all primary teachers are expected to teach mathematics there should also be a minimum standard related to senior school study of mathematics for those entering university directly from school.

Mature age entrants to primary programs need special arrangements to ensure they have suitable mathematical background. An interview; and an entry test, and/or one taken during the first year of their course should be viable.

For entry to secondary pre-service programs in mathematics – either double degree or postgraduate – mathematical background and other expectations seem to be adequately, if not uniformly, addressed through current arrangements. Consistency in the application of current mathematical study requirements by universities needs to be improved.

However, two other sets of attributes are critical to teaching mathematics well in both primary and secondary schools.

The first is to have a positive personal mathematical 'identity' – a positive disposition to the subject and its place in society; be a competent and confident user of mathematics; willing and able to learn more mathematics. Unfortunately many people are currently entering primary pre-service programs without these attributes – indeed considerable numbers have 'maths anxiety' developed from their experiences with the subject. Primary pre-service courses need to actively address these issues, through the ethos and focus of their programs. It may also be that selection processes (attitudinal or similar testing; interviews) are needed to ensure that only those for whom a turnaround in attitudes is likely are admitted.

Facility with mathematical content is necessary on entry (above). Pre-service programs need to further develop students' content knowledge. However, the knowledge of mathematics required for teaching is of the content as connected within mathematics and with its uses. The Effective Teachers of Numeracy study by Askew et al (1997) leads to the conclusion that "It is not how much mathematics the teacher knows, it is how they know it." Hence the second set of attributes that all mathematics pre-service programs must develop is graduates with a connected view of mathematics and its teaching. This includes attention to conceptual development and potential misconceptions.

2. What teaching practices should be developed in graduate teachers through their initial teacher education?

How can the teaching practices that produce the best student outcomes be identified?

How can teacher education programmes encourage teachers to reflect on evidence to support their choice of teaching practice?

How does reflection on evidence translate into student outcomes?

AAMT takes the view that, whilst the teaching and learning of mathematics may be informed by generic educational thinking, our field has distinct characteristics that set it apart. This is reflected in the vibrant and productive mathematics education research community here and overseas. That body of research evidence about Pedagogical Content Knowledge (PCK) in mathematics is the source of answers to the first question.

In his Teaching Mathematics paper, Sullivan identified six "principles for effective teaching of mathematics" (ACER, 2011). This high level synthesis is useful, but in AAMT's view Sullivan's principles need to be taken to a more detailed, practical level in order to inform practitioners in schools and teacher education about mathematics "teaching practices that produce the best student outcomes".

These descriptions of most effective teaching practices form part of teaching standards –statements of the knowledge, skills and attributes required for effective teaching. AITSL currently has carriage of teaching standards at different career stages on behalf of the governments in Australia. AITSL has consistently rejected subject specificity in its standards. AAMT views the 'generic' AITSL standards as being of minimal professional use to teachers of mathematics.

The tried and tested AAMT Standards for Excellence in Teaching Mathematics in Australian Schools (2006; Exhibit 1) provide one piece of the framework of mathematics specific teaching standards. A similar document for the Graduate level is urgently needed – AAMT has the experience and expertise to coordinate its development. Mathematics standards at other career stages should also follow.

The questions about reflection on evidence in themselves indicate the critical role that assessment plays in teaching and learning. Whilst AAMT endorses attention to reflection on evidence as an essential part of pre-service courses, that attention needs to be integrated with developing effective teaching knowledge and practices in mathematics. What we need are beginning teachers who are as alert as they can be to potential and actual student mathematical misconceptions, and opportunities for learning; and who are knowledgeable and flexible enough to respond to these.

The discussion in the previous section noted the need for teacher education programs to address matters of mathematical identity and views about mathematics and its teaching. In this section the development of teaching practices, including reflection on evidence, has been discussed. This must be the central component of pre-service teacher education courses that have sufficient time to teach mathematics this PCK well, in ways that expressly address the affective domain and the graduates' knowledge and overall views of mathematics and its learning. In order to further build the mathematical skills in the teaching population, primary pre-service programs should, in addition to high quality provision for all graduates, ensure that there are pathways for taking more mathematics subjects as a specialization (major) within the course.

3. What level of integration should there be between initial teacher education providers and schools?

What evidence is there that effective integration achieves good teaching practice? What are the most effective types of integrated experiences in preparing new teachers?

What are the cost implications of more integrated professional experience? Are there more effective ways in which professional experience might be funded?

What other methods, or combination of these methods, could achieve better outcomes than the current approach to professional experience?

How can partnerships between teacher education providers and schools be strengthened to make teacher education more effective?

How can teacher education providers and schools best work together to select and train mentor teachers to effectively support pre-service teachers on professional experience?

How can consistency of good practice and continuous improvement across teacher education providers and schools be assured?

Partnerships between universities and schools in this area need to be long term. A key aim must be to connect pre-service students with good practitioners. This is especially the case in mathematics because the "I teach mathematics as I was taught" syndrome is common to a significant number of current practitioners. Pre-service students need images of better alternatives in mathematics to validate their theoretical learning about good practice in the subject.

This is one of many areas in which universities should be encouraged to collaborate to avoid duplication of effort, generate greater consistency and lead to better use of highly skilled teachers of mathematics. They are a relatively scarce resource.

Teachers involved in practical experience programs certainly need to be trained and supported in that role. They should receive recognition through credentialing as teacher-mentors, and financial or professional incentives such as paid study leave.

Different approaches to pre-service teacher education such as Teach for Australia (TFA) are trialling an approach that may be characterised as an 'apprenticeship model'. Whilst there is insufficient longitudinal data to inform an opinion about the effectiveness in mathematics of programs such as TFA, the emphasis on on-the-job mentoring of early career teachers highlights an important area for further development.

The first few years of teaching are challenging for all teachers. Current employment practices see many/most graduate teachers in a series of contract or casual positions, and this is not conducive to 'growing into the role'. Secondary mathematics teacher graduates, and primary graduates with a major in mathematics should have preferred treatment for long term employment by education authorities.

Education authorities, schools, universities and professional associations should collaborate to establish and maintain effective mentoring programs for all new teachers of mathematics. Professional associations are particularly important as partners as they are the 'glue' in the profession. AAMT and its state and territory Affiliates need to lead the development of a profession wide culture of actively welcoming new teachers of mathematics, and assisting their transition into the role. Training and ongoing networking and support will be needed for those who act as teacher-mentors; rewards will be mainly intrinsic through 'contributing to the health of my profession'. In the context of this 'system' education authorities should make long term commitment to establishing cadres of office based personnel (e.g. 'consultants') to provide direct support in mathematics for teachers and schools.

Building the quality of practical experience programs in mathematics, and high quality mentoring programs for graduate teachers of mathematics for the first few years may be seen as expensive, but AAMT asks what is the cost of not taking these actions? There is strong societal and political will to drive up the quality of teaching and student outcomes in mathematics (and STEM generally). This must be translated into effort from stakeholders working in partnership.

4. **What balance is needed between understanding what is taught and how it is taught?**

What is the desirable interaction between content knowledge and teaching practice for developing teachers? What is the difference for primary and secondary teaching? Why is there a difference?

Should there be explicit training in how to teach literacy and numeracy in all teaching courses?

How can the balance between the need for subject specialisation and a generalist approach in primary teaching qualifications be addressed?

What, if any, changes need to be made to the structure of teacher education courses? Should content be studied before pedagogy (i.e. should 'what' to teach be studied before the 'how' to teach)?

What barriers are there to restructuring teacher education courses to ensure they address these concerns, and how may they be overcome?

Why does Australia face a shortage of maths, science and language teachers?

What can be done to encourage teaching students to develop a specialisation in these areas?

It is fair to conclude that many faculties of education in Australia's universities have been slow to pick up and respond to the need for greater emphasis on STEM in their teacher education courses. The results from a recent survey involving around 90 mathematics teacher educators (AAMT, 2014; unpublished) lead to the conclusion that mathematics (or numeracy) plays second fiddle to literacy and 'generalist' concerns in these programs. Time allocated within the programs is probably the most telling measure of the imbalance of valuing between the areas, and current allocations are inadequate in the view of those involved.

Yet this is set in the context of the current political and social imperatives re STEM education. The concern re balanced attention to STEM is not new – the Speedy Report (1989) made strong recommendations in the area that resulted in some improvements in the quality and amount of mathematics in teaching awards, but that report's impact was short-lived.

The shortages of mathematics teachers in Australia is nestled in the broader issue of fewer students in the STEM education 'pipeline' from school to university. Whilst the decline in student numbers is an international trend, in Australia the teacher shortage is exacerbated by decades of neglect in Australia. AAMT first raised the issue of supply of mathematics teachers with the directors general of education in 1996 and AAMT and others since have really only achieved having the issue acknowledged. Current political and bureaucratic inertia needs to change. A range of targeted initiatives would make a difference:

- All graduate mathematics teachers employed in real, permanent (not contract) mathematics vacancies.
- Professional incentives for established mathematics teachers (such as study leave, access to training).
- Scholarships and financial incentives for appropriate career changers.
- A career structure with levels of remuneration that enable the best teachers to stay in the classroom.

All these factors would serve to encourage more young people to become secondary mathematics teachers. They would also be encouraged if they experienced teaching of mathematics in school and university that reflected more of what is known about mathematics PCK and effective, inclusive practices.

Better alignment of the structures and emphases of pre-service programs with the societal and political emphasis on STEM education is essential if they are to be part of the solution, not a continuing part of the problem. Relevant areas for change include time, status, entry expectations and establishing mathematics majors in primary courses. There needs to be better balance in emphasis between literacy and mathematics, and opportunities for deeper mutual understanding between our future primary and secondary mathematics teachers. (424 words)

5. Other

Any other comments in response to the Issues Paper may be provided here.

The Teacher Education Ministerial Advisory Group (TEMAG) is the latest in a series of reviews/reports into pre-service teacher education in mathematics going back decades. The sum of that effort is the current situation. AAMT urges the TEMAG and the Minister to create real and lasting improvements.

However, no amount of effort or investment in pre-service can solve all the problems in teaching. We need a well-designed and coherent system of support for quality teaching of mathematics that includes quality pre-service, good mentoring into the profession, early career support, ongoing support, targeted initiatives that address particular issues, mature professionals 'giving back' to the profession.

Establishing and maintaining such a system would involve universities, employers, schools and professional associations working together on a long-term collaborative effort. AAMT and its Affiliates have much to offer by linking the participation of many of the stakeholders in this enterprise through their personal involvement: mathematics educators and mathematicians in universities, pre-service teachers, graduate teachers in schools, educational leaders, providers of professional learning, curriculum officers in the jurisdictions, students in schools, and to some extent parents and care-givers.

The issue of out of field teachers of mathematics (teachers without appropriate qualifications to teach mathematics; see Exhibit 2 for AAMT's expectations) is an example of how the support system could operate. Firstly, employers would take the bold step of acknowledging the issue and gathering accurate data on the issue. Currently we have the ACER estimate of around 40% of students in years 7-10 being taught by out of field teachers; this is supported by a recent survey by the Mathematical Association of NSW (MANSW, 2014), but systematic and targeted action requires much more precise data.

Whilst overall shortages of suitably qualified mathematics teachers is a major contributor, where there are unemployed mathematics teachers, these should offered permanent employment, possibly as supernumerary in schools where out-of-field teachers use that time to undertake courses that give them the knowledge and skills they require.

Universities would be one provider of retraining courses. AAMT and its Affiliates would also be providers of quality teacher support, as they have been over many years.

In terms of resources to support the professional learning required, AAMT's Top Drawer Teachers (http://topdrawer.aamt.edu.au/) establishes a framework for professional resources that address key issues – big ideas, misconceptions, good teaching, assessment – in key topics (fractions, mental computation, geometric reasoning etc.).

As part of the Australian Science and Mathematics Partnerships Program (ASMPP), should their projects be funded, AAMT has agreements with several universities to develop a single professional learning 'portal' for the outcomes of ASMPP. Such a development would also enable Top Drawer Teachers and other AAMT products to also be packaged as professional learning. Whilst not restricted to meeting the needs of out-of-field teachers, this portal would quickly provide a coherent, powerful resource (a one-stop-shop) to address their needs in a systematic, practical way.

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