Review of Teaching and Teacher Education

Response to Discussion Paper Young People, Schools and Innovation: towards an action plan for the school sector by the Australian Association of Mathematics Teachers Inc.

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Summary

This response argues that the teaching and learning of mathematics in schools must play a unique and vital role in developing the capacity to innovate in our young people. Mathematics in schools provides essential underpinning knowledge and skills — among the "stuff" on which innovative applications are based, as well as providing experiences through which students apply that underpinning knowledge in real situations. By learning to be effective mathematical modellers through their experiences in the mathematics curriculum and more broadly across the curriculum, young people develop thinking, analysis and communication skills — essential to the "how" of innovation. The pervasiveness of mathematics in cultures of innovation can seem invisible and is often not understood at the level of detail that can inform programs and practice at the school level. An important initial step in an action plan for innovation in the school sector must be to make explicit the nature of what is meant by terms like "innovation" and "innovative culture". In addition the key contribution that mathematics makes, as the language and understandings which underpin all scientific and technological innovation, as a way of modelling the world and solving problems, and as an essential literacy through which active and aware citizens articulate and analyse their relationship with the world, must be identified and explicated. It is on this basis that the domains and intentions for action on innovation by the schooling sector can be identified.

The response argues that, to build a culture of innovation in schools, substantial effort is needed to enhance the quality and teaching of mathematics in schools, with a particular emphasis on giving mathematical modelling — as a core element in innovation — a much more central place in the curriculum in mathematics and beyond. Seeking to establish an innovative culture from a school structures perspective in the first instance is likely to be rejected by teachers as "managerialism". Teachers and schools need to be given both the licence and the support to be innovative in their core business of teaching and learning, with structural or management changes being driven by the needs of teaching and learning.

Much of the current educational discourse suggests a number of dichotomous positions with regard to education: discipline-based knowledge versus life-related skills, "rich" assessment tasks that emphasise real-world contexts versus more focused assessment of students' understanding in a given domain, apparently holistic ways of structuring schools and curriculum versus subject-based arrangements. Indeed the Discussion Paper itself, in suggesting that innovation is the process by which knowledge is transformed into value creating products, suggests yet another dichotomy. This is reflected in the very different orientations to innovation expressed on p3 by Hargreaves, from a school perspective, and by Australia's Chief Scientist. This response argues that these dichotomies are unhelpful, and that if we are to promote a truly innovative culture, knowledge, creativity, application, citizenship, communication and entrepreneurship are inseparable. Further, creating a climate in which students can develop a capacity for innovation cannot be separated from fostering innovative teachers, which in turn promotes effective teaching and learning in schools.

The response highlights the key role that professional associations already play in promoting such innovative teaching practices. This role should be recognised and supported in tangible ways by business and government, and these organisations better enabled to bring together, celebrate and disseminate the many innovative examples of excellent teachers across Australia.

Section 1— Young People, Schools and Innovation

1.1 What are the characteristics of innovative organisations/cultures that are able to successfully develop a capacity for innovation?

The apparent circularity of the question ("innovative organisations/cultures… develop a capacity for innovation") perhaps underlines the lack of clarity about the concept of innovation, at least as it applies to the schooling sector. There would be much greater clarity — and capacity to engage in the discussion — if there were some clear examples to illustrate terms such as "innovation" and "innovative culture". The very broad definitions provided in the Paper (page 3) may be useful as starting points, but an informed discussion and purposeful subsequent development requires further clues as to what is meant. Such lack of clarity is out of tune with the outcomes orientation of current times.

The paper mentions the National Goals of Schooling (page 2). In blunt terms, any schools that are seriously addressing those Goals must be working in innovative ways as learning institutions/communities. They must, by definition, be working in new and different ways. Note that this definition of innovation is a long way from the definitions that focus on commercialisation of knowledge provided in the paper. This difference in what it means to be innovative is probably inevitable in the context of schools and schooling. Whether what these schools are doing represents a culture that develops a capacity for innovation in their students remains unknown. In fact, a whole of government focus on promoting innovation would seem to imply that the community (as educated in our schools and other institutions) is insufficiently innovative.

1.2 What is schooling's role in promoting an innovative learning culture and in fostering creativity? What is needed to encourage a culture of innovation in schools?

The role of schooling, first and foremost, needs to be the purposeful pursuit of its core business, as defined by the National Goals. For a young person to be able to commercialise knowledge (ie be innovative), s/he first of all needs some knowledge that is able to be commercialised. To this one should add two further components. First is experience with how knowledge can be applied and used — perhaps this can be seen as understanding that knowledge can be connected to the world and to other knowledge. Second is a mix of personal attributes such as confidence, interpersonal skills, vision and planning — attributes that may be able to be characterised as habits of mind and being.

It appears common for those who are somewhat distant from schooling to have something of a blind spot when it comes to the first component outlined above — the students' underpinning knowledge base itself. The reason for this is perhaps that as individuals functioning in a field, their knowledge base is so assimilated into their thinking and what they do that the other components (application of knowledge and, to an even greater extent,

personal attributes) take much greater prominence. A good example of this is in the identification of employability skills (pages 9-10). The dot points are all worthy and important, but it would be a foolhardy employer who actually gave no status to knowledge per se.

To illustrate this point about the importance of underpinning knowledge, consider the work of the artist Pablo Picasso. Picasso was a highly skilled conventional drawer, able to create technically outstanding work of this kind. It is on this basis that his more famous abstract work was built, through processes of creativity and innovation. Some people respond to Picasso's abstract work by saying "Any child could do that". Yet no serious analysis would support such a notion. The work is based on the three components outlined above — knowledge, application and personal attributes.

While there is much of merit in current educational reforms that attempt to connect schooling with students' experiences in the world, that look at new domains of knowledge as key organisers of the curriculum, and that seek to break down boundaries between discipline areas, there is also much of concern. Too often these avowedly innovative approaches to education are seen as a dichotomous binary, to replace traditional discipline-based approaches. There is thus a danger that fundamental, underpinning knowledge may be seen as a means to an end, rather than also being an end in itself. How people who are apparently closely connected with schooling can discount knowledge as a purpose of schooling in comparison with other components is a mystery, shrouded in a fog of post-modernism.

In order to encourage a culture of innovation, schools need to be innovative in their approaches to teaching and learning. This is how schools can model innovation for the students and community. To do this there needs to be

- A licence for individual teachers and teams of teachers to experiment and push boundaries.
- An expectation, in fact, by the community and through it the responsible school authorities that teachers and schools will experiment. The extent to which experimentation and diversity in schooling is possible may well be limited and inhibited by the economic imperative of attracting students in a competitive environment.
- Real support — in the form of substantial, ongoing, sustained and purposeful professional development — from the community and education authorities to approach schooling in this way.

1.3 What practical activities to support the development of a culture of innovation in students are happening in your school and community? How can we best promote and disseminate good practice in this area?

The comment on this question may seem like self-interest, coming as it does from an organisation representing mathematics educators. It arises, however, from an analysis of the three components above, and the unique potential for school mathematics to contribute to young peoples' development in these areas to become innovative in their approach to work and life.

The process of mathematical modelling — using mathematics to understand our social and physical worlds — is an essential component of all innovation. It is a capacity that can and should be developed through students' experiences in their mathematics learning. Skills in mathematical modelling and an appreciation of its power should also be developed through multi-disciplinary projects that students undertake while at school.

It is a reality that the role of mathematical modelling in innovation and, indeed, in the multi-disciplinary work undertaken by students in schools is most often not explicitly acknowledged. On the one hand this can be seen as a positive in that the processes are so embedded in practice that they become invisible. However, the lack of explicit acknowledgment makes it difficult to highlight the importance of focussed attention to developing skills in mathematical modelling as an important component of schooling.

It is also a reality that the capacity to be innovative and creative in solving problems and applying knowledge cannot be adequately measured in system-wide assessments administered on a mass scale. Thus a key component of promoting a culture of innovation in schools must be a recognition among systems, business, parents and the wider community, that system-wide tests can provide only a very limited picture of how our schools are performing. Any assessment of schooling's capacity to develop students' capacity for innovation must, of necessity, encompass a far greater range of measures than is currently the case. The AAMT recommends a de-emphasis of system-wide tests of literacy and numeracy as the key indicator of how our schools are performing, and the promotion of more holistic and inclusive measures, based fundamentally on teachers' professional judgement.

Section 2 — the Challenges

2.1 What are the knowledge, skills, understandings and capabilities needed by students to develop an innovative capacity? What changes are occurring (and need to occur) in early childhood education, primary education, the middle years and secondary education?

The Key Competencies from several years ago would seem to encompass much of what might be needed, with the following caveat.

There would seem to be a move in emphasis away from the 'knowledge' component that students require from schooling in order to be in a position to be innovative (see above). This is a change that is not in the interests of developing a truly innovative capacity in young people. While efforts to identify and implement effective learning strategies should continue, these need to be associated with substantial content that is treated rigorously.

A common line in educational discourse suggests a dichotomy between "knowledge and standards" and "equipping students with work and life-related skills, attitudes and values, and a sense of community responsibility" (see 1.2). The Discussion Paper and others who make this distinction stress that the two types of outcomes for schooling are complementary, but the making of the distinction is largely unhelpful.

Such a dichotomy represents an unsophisticated view of "knowledge and standards" and their roles in students' work and life. It mitigates against connections between the two suggested domains of outcome (for example, meeting community responsibility requires citizens to use skills and knowledge as mathematical modellers to contribute to their understanding of and opinions about social issues). It implies that knowledge and standards have traditionally been, and are currently, well done and "under control" in schooling, and that the only sensible emphasis must therefore be on developing work and life related skills. The AAMT would argue that, unless the mathematical knowledge that students acquire is related to their life and current and potential work, and that unless their functioning as productive members of society is underpinned by deep understanding and sound mathematical skills, "knowledge and standards" are not under control. Thus significant effort must be made to not only look at how schools can promote the employability skills listed on p.10, but also to find ways through which schools can help students to develop deep mathematical and scientific understanding. Such an effort will require extended and effective professional development, owned by teachers, supported by systems and schools, and implemented as a collaborative venture between teachers and researchers.

2.2 What do we know from research and practical experience that will help us better prepare teachers to better develop an innovative capacity in school students?

Practical experience and raw logic suggest that unless teachers have their own innovative capacity they will not be effective in creating it in their students. Making this point will be in part about helping teachers and schools recognise that "what they always do" is, in fact, highly innovative. An appropriate framework for what it means to be innovative will enable self-awareness of existing innovative capacity and practice.

The AAMT Standards for Excellence in Teaching Mathematics in Australian Schools, developed and owned by the profession, provide an excellent vehicle through which to promote such a self-awareness. It is hard to envisage that a teacher of mathematics who meets the criteria outlined in these Standards, whether at early childhood, primary, the middle years of schooling, or secondary education, can fail to be innovative and can fail to assist students to become creative problem-solvers and effective users of their mathematical knowledge.

In a larger measure, preparing teachers and schools to develop an innovative capacity in their students will require them to be innovative themselves. This requires support as outlined in 1.2 above.

One practical example by which some teachers have been able to promote an innovative capacity in students has been involvement in various work placement programs. These would seem to have worth on at least two levels. Firstly, there is the opportunity to see innovation "in action" in business and industry, and this is clearly valuable in the context of teachers responsible for creating innovative capacity in their students. Secondly, these experiences are extremely valuable as personal professional learning and development in relation to the material they need to cover with their students. Very often

teachers on placements such as these see new directions in their subject and new applications of knowledge that can and do have an impact on their teaching. Both these components would be particularly relevant to teachers of mathematics, and would very likely be welcomed by them.

Following on from highlighting, in response to 1.3 (above), mathematical modelling as an important component of learning in multi-disciplinary tasks (and in learning areas other than mathematics), the overall numeracy awareness and capability of all teachers will have an important impact on the development of students' innovative capacities. Hence, efforts to enhance all teachers' numeracy will contribute, inter alia, to the building of innovative capacity in students.

2.3 What examples are there of good practice in any of these domains, including formal evaluations?

As noted above there is much merit in many of the practices currently taking place in schools, and in attempts to improve the capacity of students to understand mathematics deeply and apply that knowledge in innovative and creative ways. There is particular merit in some of the recent developments in the primary and senior secondary years.

Programs focusing on developing primary teachers' own understanding of mathematics, and their capacity to identify stages in students' understanding, such as Count Me In Too in NSW and other states, the Early Years Numeracy Project in Victoria, and First Steps Numeracy in WA have made a significant impact in improving pedagogy. Such programs are assisting teachers to provide students with engaging and meaningful learning that is both connected to their world and provides a foundation through which they can become creative and innovative problem-solvers.

At a senior secondary level, and continuing the theme of highlighting the importance of good innovators as good mathematical modellers, it is appropriate to note that there are several world-leading examples of mathematics courses with a strong modelling emphasis in Australia (eg in Queensland, South Australia, Tasmania). Concurrently, students and teachers, supported to varying extents by systems and the policies of Boards of Studies, are making increasing use of technologies such as computers and graphics calculators. The use of these technologies mirrors the way new mathematical knowledge develops and the way in which mathematical knowledge is applied in the world. The AAMT sees such technologies as integral to the effective learning and application of mathematics in a knowledge society.

However, senior secondary courses which emphasise mathematical modelling are, in the main, not those with the highest status. Hence we have an issue of curriculum construction — many of our most talented students do not receive effective education as mathematical modellers whilst at school. This is further compounded as a result of there being little explicit attention in curricula or by teachers to the development of mathematical modelling skills in the compulsory years.

The picture in early childhood and middle school settings is somewhat bleaker. While there are many excellent examples of early childhood centres

in which mathematical thinking is valued and promoted, they are often isolated and disconnected. Project Good Start, conducted by the Australian Council for Educational Research, is investigating the characteristics of those centres in which young children demonstrate high levels of mathematical understanding. These centres are ones in which there is a richly resourced mathematical environment, in which teachers are able to challenge children's understanding through deep questioning, and in which there is a strong connection to the local community. The AAMT would argue that excellent early childhood mathematics is absolutely fundamental to promoting engaged and excited lifelong learners, and hence to the development of an innovative culture at all levels of schooling. A concerted program of research and professional development, with clear links between the home, the early childhood setting and formal schooling, is an urgent need.

Similarly, and as outlined in 1.2, there are many examples of innovative practices in middle school mathematics education, which in turn develop the capacity to be innovative in students. These practices are occurring in both traditional and non-traditional settings, and within discipline-based and integrated curriculum structures. However, they are dependent on teachers having depth of both subject knowledge and pedagogic content knowledge. Unfortunately this specialist knowledge can be undervalued in systemic reforms that focus on organisational change. There is an urgent need to bring together the expert knowledge of teachers from a range of settings, and to value the wisdom of practice as an integral component of all systemic attempts to address the well-documented problems of disengagement of students in the middle years of schooling. The AAMT argues strongly that a focus on curriculum or assessment organisers, or on patterns of school organisation that ignore the wisdom of practice or fail to value teachers' specific knowledge of mathematics and pedagogy, will do little to promote a culture of innovation.

Thus there must be significant expenditure at school, system and national levels, on sharing and disseminating the many excellent examples of innovative mathematics teaching in upper primary, middle schooling and junior secondary schooling already happening in Australia's schools. The recent AAMT Springboards to Numeracy Conference, in which teachers with identified excellence came together to showcase their practice, and in which curriculum leaders listened to their stories, provides one model of how this wisdom can be valued, shared and disseminated. As noted above, explicit attention to the development of mathematical modelling skills in the compulsory years of schooling should be a key ingredient of this and other programs of professional development.

Section 3 — Developing a culture of innovation in schools

Through their focus on organisation these questions miss the fundamental starting point for effective change. Schools are made up of people (students, teachers and parents) embedded in a community. Before even thinking about "organisational structures and partnerships" there MUST be a coherent and practical vision expounded that can win over the hearts and minds. Any movement in education that STARTS with consideration of organisational structures (in schools) is comprehensively doomed to be resented and rejected

as "managerialism". Creating and arguing for this vision is the responsibility of government and positional leaders in education (as outlined previously).

It is interesting to note that the Discussion Paper makes reference to the encouraging outcomes of Australian students in international comparisons of mathematical and scientific knowledge and literacy. Such outcomes are the result not of organisational or school governance structures, but of the commitment and professionalism of teachers. There is a real danger that managerial approaches to developing a culture of innovation will, in fact, diminish that commitment and undermine that professionalism, and hence, in turn, result in a decline in outcomes for Australian students in an international context.

What is also clear from these, and numerous other studies of student achievement, is that outcomes are highly dependent on socio-cultural background. The AAMT agrees that teachers need to be better equipped to teach the broad range of students now in our schools. However, a school climate that nurtures reflection, self-evaluation and support, as described in the Discussion Paper, does not, of itself, equip teachers with these skills. There is an urgent need to address the achievement gap between different groups in Australian society through research and professional development that focuses on achievement for all. This requires significant expenditure at all levels, particularly to address indigenous numeracy. If we fail to address the current unacceptable inequities in numeracy outcomes between indigenous and non-indigenous students, we will continue to deny indigenous students access to levels of achievement in high status subjects that are valued by society and essential to scientific and technological innovation. Thus we will fail to tap into the creative and innovative potential of a unique culture.

3.1 What school organisational structure and partnerships would best support the development of an innovative capacity in students?

No one organisational structure best supports the development of an innovative culture. As argued above, the structures must arise from a shared vision of the goals of schools and their role in promoting an informed and innovative society. The partnerships and structures that best support such a vision may well be different in different settings. To impose particular structures would, as noted above, only serve to disenfranchise and depower the professionals who are entrusted with developing innovative and informed members of society. The clear role of educational leaders is to argue for a shared vision of schooling that values knowledge, creativity and flexibility.

3.2 What school governance arrangements would enable and encourage schools to develop a culture of innovation and an innovative capacity in students?

School governance arrangements must value the knowledge and contribution of all partners – students, teachers, parents, administrators and the community. In particular, the professional knowledge, practices and

attributes of teachers, as outlined in the AAMT Standards of Excellence, must be valued and promoted.

3.3 At your school and in your community, what are the immediate, medium and longer term priorities for developing an innovative capacity in students and a culture of innovation?

3.4 What examples are there of success — and of difficulties — in the development of a culture of innovation in schools and an innovative capacity in students?

Any examples of success or failure hinge on the development of this shared vision and the valuing of teachers as professionals. For example, in the ACT all Government high schools are required to participate in a Year 9 Exhibitions program, in which students complete an extended multi-disciplinary task that focuses on innovation and connectedness to the world. While formal evaluations would suggest that this program has been very successful, conversations with many of the teachers involved suggest that its effectiveness has been very varied. In particular, in those schools in which a shared vision and culture has been created, some students have achieved remarkable outcomes. However, in other settings teachers have felt that the excellent learning and assessment practices that have been the norm in their classrooms have been devalued and somehow seen as no longer authentic. The imposition of the Exhibitions program is seen by these teachers as a distraction from the core business of learning.

In looking at examples of successful programs, the Review Committee should be mindful that it is this shared culture that is the key ingredient through which any attempt to create a culture of innovation rises and falls.

Section 4 – Teacher preparation, professional learning and development in a culture of innovation

4.1 What skills, knowledge and support do teachers need so that they can develop an innovative learning capacity in their students?

Given the connection between teaching for innovation and the National Goals of Schooling as already discussed, the skills and knowledge to teach well are at the heart of what teachers need. Important among these will be strong pedagogical content knowledge, and awareness of wider issues and competencies. There needs to be an emphasis on teaching and learning with and about ICTs, including technologies that may not reside in schools.

In terms of teachers of mathematics specifically, the AAMT Standards for Excellence articulate the knowledge, practices and attributes that are the foundation of excellent teaching, and hence the capacity to develop innovative learning for students. In particular, the emphasis on mathematical modelling as discussed in response to Sections 1 and 2 (above) will require a raft of support including curriculum and assessment change, materials and resources, skills in accessing and forming partnerships with business and industry and professional development programs.

4.2 What are the implications for teacher education and for renewing cultures of innovation in schools?

Just as excellent and innovative teaching in schools rests on a strong subject and pedagogic knowledge base, coupled with a supportive environment that encourages and values diversity, so those involved in teacher education must have current knowledge and be supported in looking at diverse ways of teaching.

Those involved in teacher education in Universities should have appropriate experience, including successful teaching in a school setting. It should be recognised that, whereas higher qualifications such as a Ph.D. may be necessary for University lecturers in many areas, this may not be the case, at least initially, for all involved in teacher education. Successful teachers have much to offer potential teachers, and it is often the case that the most successful teachers have had neither the time nor the incentive to complete higher degrees.

Notwithstanding the above, it is also essential for teacher educators to have an up to date knowledge of current research into teaching and learning, and highly desirable for those involved in teacher education to also be active researchers.

Teacher education has a key role to play in developing teachers who are able to adopt a critical perspective on education. It is not the role of teacher education to develop teachers who can "fit the system", although this may well be part of all teachers' experience in their initial years of teaching. More important is that teachers are able to critically evaluate their own teaching, to critically evaluate school and systemic developments, and hence to be life-long learners.

4.3 How do teacher education programs support and develop their students' appreciation and capacity for learning, creativity and innovation? In what ways do they do this and what are the successes?

Universities appear to be under increasing pressure to do more with fewer resources. This pressure can lead to innovative teaching practices, particularly in the delivery of courses on-line. However, it is debatable whether effective teacher education programs can be delivered solely on-line. Excellent teaching will always rely on a strong and supportive teacher-student relationship, and is thus a human resource rich profession. The same is true for teacher education.

In considering the extent to which pre-service teachers are provided with opportunities to be creative and innovative, it is vitally important to consider the role of the practicum. There are examples of very successful models, such as internships for pre-service primary and early childhood teachers. Through a prolonged internship at a particular school, pre-service teachers have the opportunity to experiment with different approaches in a supportive environment. However, it should be noted that the success of any such program is heavily dependent on the relationship between the participating schools and staff at the University, who regularly visit the pre-service teachers.

Primarily for budgetary reasons, some Universities no longer provide liaison staff for pre-service teachers during their practicum. This should be strongly discouraged, and the complementary roles of University staff and school-based mentoring teachers recognised.

4.4 What is currently being done in on-going professional learning and development to support teachers to update knowledge and skills to maximise their impact on developing an innovative capacity in students?

There are numerous examples of Universities working effectively with systems and schools to update teachers' knowledge and skills. These include funded national and state research projects, small-scale action research projects with local schools and teachers, and formally accredited courses for practising teachers. One such course is the Graduate Certificate in Education (Enrichment Mathematics) instituted by the Australian Mathematics Trust and accredited at the University of Canberra. This course provides teachers from across Australia with opportunities to share approaches and gain new knowledge to enable them to provide a richer and more creative learning environment for students. It uses a blend of face-to-face delivery at a residential school and regular Internet-based tutorials. The collaboration between a professional (industry) body and a University provides an excellent opportunity to foster innovation. Further opportunities for collaboration between professional bodies, industry and Universities should be investigated.

The AAMT Standards of Excellence provide an ideal framework by which on-going professional learning can be structured. Teachers who undertake the accreditation process for these Standards could well do so as part of a formally recognised post-graduate course.

4.5 What on-going role could higher education institutions and others play in supporting and promoting professional learning and development in the teaching profession?

As noted earlier in this response, opportunities for teachers to gain cutting-edge knowledge in a University setting should be encouraged. This is particularly the case in the areas of mathematical modelling and the use of

ICTs. Programs which enable teachers of mathematics to work with research and industrial mathematicians should be developed, with appropriate funding from education systems. Of critical importance in such programs is the collaboration between teacher education and mathematics/statistics faculties.

Professional development and learning in the teaching profession is ultimately dependent on the professionalism of teachers. Any program, whether developed and implemented in a higher education system or in industry or by systems must recognise and value that professionalism as one of the key principles on which it is based. Professional learning must be relevant to the current needs of teachers, as well as providing insights into how new knowledge can enhance the effectiveness and creativity of teachers.

Section 5 — Leadership at all levels

5.1 What are the roles of the principal-leader and teacher-leader in supporting an innovative capacity in students and a culture of innovation in schools?

Whilst it will be very important for the principal-leaders of schools to play a positive and visionary role in supporting innovative capacity in students and a culture of innovation in their schools, they, in turn, need support from leaders in educational authorities and leadership from government. It is inappropriate given the complex and far-reaching nature of the developments envisaged for the whole responsibility to be devolved to the local level.

In short, principal-leaders will need to be visionaries who challenge and support their people. They will forge and lead sensible and productive partnerships. They will set and meet high standards for their own personal innovation, and expect their staff to be innovative.

It can be argued that the teacher-leader has been the most overlooked and under-resourced member of the school leadership team. Whether this is the coordinator of a learning area in a secondary school, or someone who has a broader cross-curriculum responsibility in a primary school, these "middle managers" are the people in schools to whom other teachers look for guidance, and who have the most direct and tangible impact on the quality of teaching and learning. Teacher-leaders thus have a key, perhaps *the* key, role to play in supporting a culture of innovation in schools and an innovative capacity in students.

The AAMT believes that professional development for teacher-leaders is long overdue. While the support given to principal leaders through the Australian Principals Associations Professional Development Council is to be applauded, there has been almost no acknowledgement at either a national or state level of the professional development needs of teacher-leaders. Such professional development needs to include both an administrative and staff management focus and, more particularly, a clear curriculum and assessment focus. This must include the specifics of curriculum and assessment development and management within learning areas as well as the integration of knowledge across learning areas. No school can develop a culture of innovation without

highly qualified and expert teacher-leaders who are able to drive the curriculum and assessment practices within the school.

5.2 What do parent groups, professional associations, teacher unions, higher education institutions, business, industry and the wider community need to be convinced of in order to sign up to supporting schools develop a culture of innovation?

The AAMT is encouraged by the recognition of professional associations as leaders. We do not need to be convinced of the need to support schools and teachers to develop a culture of innovation – this has been our principal reason for existence for many years.

The demise of curriculum consultants in almost every state and territory has meant that professional associations such as AAMT and its Affiliated Associations have, to a large extent, become the instigators of pedagogic change, and the principal providers of professional development. In one sense this is a welcome development as it places the locus of responsibility for such change firmly with the profession itself through these associations. However, there is a very real sense in which this also reflects an abrogation of responsibility on the part of education systems. The increased responsibility that professional associations have accepted has not been supported to anywhere near the levels required through appropriate funding. The most recent round of Quality Teacher Program funding failed to support national professional associations in undertaking projects of national significance. Yet the history of such projects is one of enormous success on limited budgets. There is clear evidence of the value-added contribution of teachers, who devote large amounts of time and expertise above and beyond that which is funded. Rather than needing to be convinced, associations such as AAMT need to be supported in their endeavours to work with schools to create a culture of innovation.

The role of business and industry may well be a relatively untapped source of such support. While in countries such as the USA business and industry support individual teachers through awards and professional associations through major grants, this seldom happens in Australia. Promoting a philanthropic mindset towards education, and supporting partnerships between industry and professional associations, should be encouraged as a potentially fruitful way of developing a culture of innovation in schools, students who have the capacity to be innovative, and future workers who can play a vital role in ensuring the competitiveness and long-term viability of the business.

5.3 How should leaders within school communities be supported?

All teachers are leaders in school communities. In particular, excellent teachers should be able to pursue a career path that enables that excellence to be recognised and rewarded in tangible ways. The AAMT response to the Discussion Paper on strategies to attract and retain teachers of mathematics, science and technology, made this argument.

In particular, teachers of mathematics should be supported as they seek to become Highly Accomplished Teachers of Mathematics as defined in the AAMT Standards of Excellence. This support needs to take the form of time, mentoring and recognition. Those teachers who successfully undertake this process will offer a high level of leadership to their colleagues, will promote deep and relevant learning for students, and will model innovation to the wider community.

5.4 What models are already operating successfully?

Arguably the most successful leadership model currently operating in mathematics education is the Mathematical Association of Victoria (MAV). The MAV offers an extensive professional development program for teachers and schools, both through large scale state and regional conferences and through targeted courses as requested by teachers in schools and clusters. The MAV is able to act as a broker for schools wishing to undertake specific professional development designed to foster innovative and effective teaching and learning. This is often conducted in partnership with tertiary institutions.

It is no accident that the MAV is the state-based association with the greatest capacity to provide this leadership. There is a long history of support from the Victorian Education Department, matched by huge commitment of teacher time. The secondment of a teacher as a professional officer was instrumental in the development of the MAV as a strong and attractive organisation that is supportive and representative of teachers. It is indicative of the value of providing tangible financial support to professional associations, and of the value-added contribution made by teachers working within such associations.

5.5 How are students learning about leadership, responsibility and decision-making?

A range of student leadership initiatives has been fostered under various guises in recent years (eg Discovering Democracy in some jurisdictions). These have great potential for students to learn about leadership, responsibility and decision-making, all of which are components of successful and sustainable innovation.

Increasingly students are expected to adopt personal responsibility for their learning, and to become self-reflective. Teachers are the central component in promoting lifelong and self-reflective learning, and hence a sense of leadership, responsibility and decision-making among students.