The Politics of Mathematics Education 1997

Jan Thomas
Victoria University of Technology

A review of the politics of mathematics education in Australasia was completed in 1996 just as there was a change of government in Australia. In the year since cautious optimism in Australia has become deepening concern as more and more problems confront the mathematical sciences in schools and universities. This paper examines recent political developments in Australia and their effect on the mathematical sciences. Particular attention is paid to mathematics education research and to issues concerning participation.

This paper is not specifically about research, nor is it specifically about mathematics education. It is about the politics of mathematics education research in a very broad sense, and will try and make links with the politics of the mathematics sciences in general, especially issues concerning participation. The term 'mathematical sciences' is being used to encompass all aspects of mathematics and statistics including educational.

In a review of research on the politics of mathematics education, completed as Australia had a change of government, a somewhat optimistic view of the future was taken (Clements and Thomas, 1996). A year later that view has to be challenged. The comments here are specific to Australia but have broader relevance because of the educational standing that Australia does have in the region. The big question is how much longer that standing can be maintained.

The health of the mathematical sciences is dependent on the state of the individual parts although weaknesses in one area can sometimes be compensated for by strengths in others. For example, good teachers will overcome difficulties with a poor curriculum and good teaching in one sector can overcome poor teaching in another. It would appear that weaknesses are now becoming apparent in many areas. It is questionable whether a few pockets of excellence can sustain the vibrant and vigorous discipline needed in the future if Australia is to be part of a region building its economy on science and technology.

The paper summarises the situation in regard to mathematical sciences in early 1996. It then looks at some post-1996 federal election developments including the impact of the 1996 budget. Finally it sketches a view of the situation at the beginning of 1997 and looks to the future.

Mathematical sciences in Australia: Early 1996

Advanced mathematical sciences

At the beginning of 1996 a Strategic Review of the advanced mathematical sciences in Australia was published (National Committee for Mathematics, 1996). It generated a sense of achievement in the mathematical sciences and highlighted the strengths of the discipline in Australia. Although it identified a very fragile base, these concerns were tempered by an in-coming government whose pre-election policies and promises suggested that research and higher education in areas fundamental to Australia's scientific and technological would be fostered and protected. It was assumed the mathematical sciences would be seen as one such area.

Mathematics education research and teaching

Mathematics education researchers had continued to attract a number of research grants but funding for the one key centre at Curtin University was about to cease. Education faculties were being reduced across Australian universities and failure to attract prospective teachers of mathematics was an additional cause for concern as this was also leading to reductions in mathematics education academics. However, course-work higher degrees and professional development programs for teachers were continuing to be developed. Like the advanced mathematical sciences, the overall view of mathematics education research and teaching was a fragile base but with great potential.

Mathematics education in the universities

Spurred by grants to improve teaching and curriculum, requirements for course evaluations including extensive use of student questionnaires on aspects of courses and teaching, the need to attract and keep students from a shrinking pool and many more students who were under-prepared for university study, the teaching of mathematics at universities has received considerable attention. At the start of 1996 one of the major challenges facing university mathematics departments was how to continue this improvement when all students needed access to computers and relevant software but the funding base still implied that students would be taught in large lectures with the occasional tutorial. In terms of analysis and review of teaching, teachers and courses, there is no doubt that university mathematics was under much greater scrutiny than mathematics in many schools.

Mathematics education in the schools

By 1996 it was clear that there were some serious problems in school mathematics. Schools had been inundated by national and state documents which in most cases were an attempt to implement the Profiles (Curriculum Corporation, 1994). They were complex, difficult documents that mixed content and pedagogy and teachers were given very little help in implementing them. What seemed to have got lost in this process was that the Profiles had been recognised as flawed and any attempt to implement them should have be done with careful trialing. In particular, the emphasis on process rather than content in the hands of teachers who were weak in their content knowledge should have been recognised as something that could create problems rather than solve them.

The need to make the mathematics explicit for many students, especially if they have language difficulties, can be a problem if teachers themselves do not recognise the mathematical concepts underpinning the activities they are using. There is growing evidence of participation in education falling (see for example, Messina, 1997) and that achievement levels, especially for disadvantaged groups, may be declining. By the beginning of 1996 it was also apparent that teacher shortages were looming and that the chances of solving the problems of the many primary and secondary teachers who needed to up-grade their content knowledge were unlikely to improve.

The election of the new government, with a commitment to literacy and numeracy was seen as an opportunity to re-assess some of these issues. It was hoped that a broader range of people would be consulted about curriculum and teaching and that examples of 'best practice' from countries other than America and England would be taken seriously. Nobody expected anything other than a very conservative approach with the need for appropriate accountability and standards clearly outlined. What most did not want was for the juggernaut of self righteousness 'experts' from educational bureaucracies in federal and state government departments that rode rough-shod over any criticism under the previous government to be able to continue to control the mathematics curriculum.

Post the election, March 1996: The ministry

Almost immediately after the election the Treasurer found a 'black-hole' and it became apparent that there were going to be budget cuts across the board. There are various ways that budget cuts can be made but without a vision or knowledge of what they are dealing with, especially if the relevant minister is supported by a weak department, some dreadful mistakes can be made and they become very difficult to undo.

The science ministers

The senior minister who has responsibility for the Department of Industry, Science and Tourism (DIST) has seldom been sighted in scientific circles preferring to look after other aspects of his portfolio. He has left science to the minister for science, Peter McGauran who is enthusiastic about his portfolio and communicates well with the science community. Staff in DIST usually seem to know what they are talking about and have expertise in their area.

The education ministers

The senior minister for the Department of Employment, Education, Training and Youth Affairs (DEETYA) is Senator Vanstone who did not want the portfolio. She has kept control of the higher education sector which she appears to actively dislike. Her understanding of her portfolio seems to be limited and she has failed to communicate with most of the educational community.

The junior minister, Dr David Kemp has responsibility for schools and vocational education. As a former academic, many academics with an interest in educational matters have been disappointed to find themselves still excluded from debate about issues in schools. He has managed to keep their respect by his obvious commitment to literacy and numeracy and a certain optimism that he will eventually realise that he may on occasions get very bad advice and that the juggernaut from educational bureaucracies in federal and state government departments needs to be controlled.

DEETYA has had a reputation over the years as an inefficient, inexpert branch of government. The inability of the senior Minister to maintain leadership in DEETYA may indicate that it is unworkable and needs a major re-structuring. The most recently appointed head's "surprise departure" (Juddery, 1997 p.6) to take up a position with the Sydney Olympics saw a senior economic adviser become the new manager. Further, staff cuts have left it vulnerable to mistakes such as one recently involving the provision of Austudy which was blamed on loss of "the Department's corporate memory and expertise" so that mistakes were made in the forms "making them nonsense" (Richardson, 1997, p.5). While numeracy is a key issue there appears to be nobody in DEETYA who actually has a solid background in this area, let alone anyone who can link literacy and numeracy or even understand that they are related.

DEETYA has responsibility for administering research funding so its operation impacts on allocation of funding for mathematics education research. While a peer review system largely isolates this from political interference, lack of resources to support this can lead to problems. Further, as Australia does not have a national science policy, funding for research operates in something of a policy vacuum.

Post the budget, mid 1996: The level playing field

The level playing field mentality meant that all federal government departments had budget cuts. In science the most damaging in the long term are likely to be cuts to research and development (R & D) concessions as this has caused some industries to re-think investment in these areas. This both decreases development in Australia and reduces the number of careers for graduates. Compared with other areas, science did well. In the long term however, science depends on the health of the education sector and the budget effects there have been much more dramatic and damaging.

Schools remained relatively unaffected by the federal budget as the bulk of their funding comes from grants to the States. Some states, including Victoria, had already dramatically cut funding to schools in recent years. The higher education sector is much more dependent on direct federal funds. Prior to the budget, and over a period of years, the university sector had taken in many more students but levels of teaching staff had remained more or less the same. One set of figures from the University of Melbourne quoted by the Dean of Science at the end of 1995 showed 20% more students for no increase in staff. This would be the norm rather than the exception.

Further, the number of students taking mathematics and science at advanced levels at year 12 has been decreasing (for example see DeLaeter & Dekkers, 1996) and it was becoming difficult to fill places in science based courses, including engineering. In turn,

this was further reducing the number of people considering careers in mathematics and science teaching.

The budget cut operating grants to universities, failed to fund a pay increase for staff and introduced a three tiered band for the Higher Education Contribution Scheme (HECS) which placed science based courses in the middle band. Taken together these measures are likely to have a profound effect on the mathematical sciences.

On November 20, 1996 a forum was held in Canberra to address the collective concerns of many in the sciences about education at the school and tertiary level. The Forum was hosted by the Federation of Australian Scientific and Technological Societies (FASTS) with assistance from the Australian Academy of Science (AAS). Participants, speakers and support came from FASTS, the Academies, Deans of education, science and engineering, the Institution of Engineers, mathematics and science education researchers, teachers and business groups. The Forum identified a number matters of urgency (Thomas, 1996):

- The supply of teachers
- Professional development and the professional status of teachers
- Career awareness and advice for students
- HECS changes
- University funding cuts
- Networking

From this list it is apparent that many serious issues were developing. It was widely predicted for example that applications for science and engineering in 1997 would drop which they appeared to do. What is more problematic is determining to what extent this was due to falling year 12 enrolments and to what extent it is due to changes such as those in the HECS. Further, competition between tertiary institutions can lead to aberrant interpretations of data that do not really reflect reality. For example, in the interests of perceived prestige, a university can report higher cut-off entrance scores but not report that this has been achieved by accepting fewer students into the particular course being discussed. What the Forum did demonstrate was the willingness of quite diverse groups to work together on a number of issues.

Mathematical sciences in Australia: Early 1997

Advanced mathematical sciences

The review of advanced mathematical sciences had found a fragile base for advanced mathematical sciences in Australia. In the current climate of constraint, data collected by the National Committee for Mathematics (Healy, 1996) and the situation at Deakin University at the start of 1997 exemplifies how fragile. Mathematics at Deakin has been reduced to service teaching with new students having to be admitted to another subject major and studying mathematics as a second choice. The staff has been decimated and the Head of Mathematics, a mathematician of considerable professional reputation, secured a research position in Berlin and left taking two PhD students with him.

Mathematics education research

Little has changed in the situation in regard to mathematics education research funding. However, continued difficulties relating to attracting students to become mathematics teachers means fewer opportunities for positions in universities. For example, the number of people in full-time positions in mathematics education in Victoria has dropped and mathematics methods courses are being combined either within or between universities. In New South Wales a campus of the University of New South Wales which was concerned largely with education is to be closed and a number of positions lost. Mathematics education courses have been eliminated at other universities.

The impact of the HECS changes to higher degrees is expected to greatly affect the participation of teachers in this valuable form of professional development unless state Ministries of Education offer incentives that in some way compensate for the additional costs teachers will have to bear. The alternative is that either the universities or the federal government will find a way to ensure that these do not all become full-fee paying. As this could open a pandora's box of special pleading it is unlikely to happen.

Mathematics education in the universities

Continued improvement in course delivery will be difficult with fewer staff and every indication that even more students, especially in service courses, will be ill-prepared. There is concern that mathematics departments at some universities may cease to exist with the few remaining staff being deployed to other departments and faculties to provide service teaching. This is more or less what has already happened at Deakin.

Many second and third year courses are small. This makes them very vulnerable in a situation where universities are given no encouragement to maintain areas of strategic importance and university administrators are setting minimum sizes for classes.

The provision of appropriate support for teaching that incorporates use of computers remains a dilemma. The Strategic Review recommended low cost loans to students so they could purchase a computer and appropriate software. The increases in the HECS means that this is no longer an option as it would further deter some students from mathematics. The use of computers in the teaching of mathematics is a major equity issue as increasingly tertiary students have access to their own personal computer. The ones least likely to are those from lower socio-economic groups who are already under-represented in mathematics and are also more likely to be deterred by the increased HECS. Further, young women are well aware of how long it is taking women to repay HECS at the old rates and additional costs associated with the use of computers in their studies in addition to increased HECS, may affect their participation in mathematics.

Mathematics education in the schools

The malaise in school mathematics becomes more apparent each year as fewer students enrol in advanced level mathematics courses at year 11 and 12, especially in some states. The reasons almost certainly include lack of appropriate course and career advice in schools, issues relating to teaching and the curriculum.

The Third International Mathematics and Science Study (TIMSS) results for Australian 13 and 14 year olds were reported on very favourable in the Australian press but the results from the different states had considerable variations and the gap between Australian students and those in high achieving countries was considerable (Lokan, Ford & Greenwood, 1996). The spread of results was disturbing. A major difference between Australia and Singapore, the highest achieving country, is that in Australia it would appear that the community and schools are prepared to accept the concept of failure in mathematics and in Singapore all students are expected to be numerate. Achieving significant improvements in Australia is going to be very difficult.

A hidden teacher shortage has existed for years and has manifest itself as reduction in time for mathematics and teachers with little or no mathematics teaching at primary and secondary levels. Unpublished data collected by the Mathematical Association of Victoria had demonstrated that, in secondary schools, using under-qualified teachers is not confined to the junior secondary years but can exist at year 12 and suggests that 34% of teachers teaching mathematics are not fully qualified to do so. It is clear from recent data (Preston, 1997) that this is about to get much worse. Further, another disturbing finding of the TIMSS study was that over 50% of Australian (and New Zealand) teachers would choose another career if they had the opportunity (Lokan, Ford & Greenwood, 1996). It is a worrying finding in need of urgent research. It is possible that this figure could be reduced if teachers teaching without appropriate discipline knowledge could be reduced as being asked to teach mathematics without appropriate content knowledge can be a demoralising experience. In junior secondary years it is likely to be confounded by not having studied mathematics method either.

Finally, the outcomes based curriculum which has been imposed on schools must be questioned both in how well it is serving students and the effect it is having on teacher morale. The Eltis Committee Report (Eltis, 1995) remains the one comprehensive report where teachers were genuinely consulted and it rejected the National Profiles. This report showed both the lack of research base for outcomes based education and teachers' concern for how it could be implemented. The slowness of the implementation of the recommendations of the Eltis Committee have recently been the subject of stories in the

NSW press. This is not surprising as there is little indication that many of the key education bureaucrats in NSW either wanted the report or were keen to implement it.

The re-thinking of the outcomes based approach to mathematics education through a more collaborative approach has yet to eventuate. As suggested by Clements and Thomas (1996), the Profiles have now become 'benchmarks' and a recent 2 day meeting was hosted by the Curriculum Corporation (CC) in Melbourne to establish this project. The Australian Mathematical Sciences Council (AMSC) was asked to nominate a representative who has since submitted a report to the Council (available from http://www.dms.CSIRO.AU/~noel/AMSC/amschome.htm).

The 'benchmarks' need much greater involvement of MERGA members and others in the mathematical sciences. It makes sense in any project to build on existing documents. However this project has been given to a group who have been ardent supporters of particular approaches and groups like the CC and the Australian Council for Educational Research whose finances are largely dependent on implementation of existing documents. A recent Mathematical Association of Victoria Newsletter reported that the AAMT has serious reservations about the 'benchmarks' so in their current form there would appear to be little support for them within any of the major groups in the mathematical sciences. They are, however, likely to dominate approaches to mathematics curriculum in schools in the foreseeable future.

Where to now? 1997 and beyond

It is clear that the mathematical sciences are in for a very difficult time in Australia. The problems are not unique to mathematics and neither are the causes and the solutions. To exemplify I will digress and recount a personal experience. Recently, on the Wednesday of one week, I heard one of Australia's top scientists note that some people were going to have to die in a capital city before the dangers of deregulating water supplies was recognised. The next day, Thursday, I heard another top scientist discuss his concerns that an antibiotic might be released for veterinary use against the recommendations of the expert committee and that this might further decrease the effectiveness of the last line of defence antibiotics now available. On the Friday the President of a peak body of medical scientists told me a sorry tale of interference in the allocation of research funds for cancer in one of the States. On the Saturday it was announced that two people had die of salmonella poisoning and over the weekend there was another major outbreak of food poisoning in Victoria, both blamed on self-regulation in the food industry.

The bottom line is that political expediency driven by economic rationalism means that even safe food and water can get sacrificed. If expert opinion runs counter to economic arguments, economics wins. In this climate, the mathematical sciences are just as vulnerable as every other important or valuable activity. If they are not publicly defended by those who understand their importance, including their economic importance, then they will be neglected and ignored. There has probably never been a greater need for political action in the mathematical sciences. MERGA members need to constantly remind government that much of the expertise in mathematics education is not being used effectively in resolving some serious problems with both achievement and access in mathematics. We also need to listen to, and speak for, teachers.

Teachers to a great extent have been silenced and can face threats of dismissal and lost career opportunities if they make public comment critical of government actions. A national forum for teacher professional associations was established in 1996 from which discipline based societies and academics were largely excluded. This exclusion included both MERGA and the Mathematics Education Lecturers' Association. The Executive Director of the Australian Science Teachers' Association (ASTA) believes the formation of this group has led to the Ministers of Education consulting with this 'peak' body rather than groups such as ASTA (personal communication) and presumably the Australian Association of Mathematics Teachers (AAMT). I have argued on other occasions that mathematics and science teachers need to work with the discipline people for an effective voice (see for example the MERGA Newsletter for December 1996) and I believe this is becoming even more important. They must be members of peak educational bodies but

mathematics and science teachers are always in a minority in these forums and they should also use their natural allies in the disciplines and science and mathematics education research.

Teachers have become so used to minimal support that $260 per teacher for professional development in Victoria evoked a headline "Why the generosity?" (Richards, 1997, p.8). What industry, if it was serious about staying economically competitive, would allocate such a paltry sum to keeping its professional staff up to date? The National Professional Development Program (NPDP) funded by the previous government was so well promoted to teachers that they saw it as generous but it represented a fraction of what has been allocated in previous years.

Media issues

The problems and challenges of the mathematical sciences are being debated publicly in the press and other forums in spite of very active government media and public relations. This is largely the work of bodies like FASTS and AMSC and some individual academics. Increasingly the focus of some of this activity is on alerting business and industry to the dangers of allowing educational infrastructure to further deteriorate (see for example, Thomas and Guttmann, 1997). The Strategic Review of advanced mathematical sciences comprehensively documented just how important the mathematical sciences are to Australia, culturally and economically. The pervasiveness of the mathematical sciences is both a strength and a weakness as it has the effect of sometimes rendering the mathematical sciences invisible. Their role in underpinning science, business and industry can be taken for granted. This aspect has however been picked up by the media with the result that the 'bad' news stories of teacher shortages, for example, are often balanced by 'good' news stories about uses of mathematics to solve important problems.

An aspect of the invisibility of mathematics is the current concern about literacy and numeracy. While literacy and numeracy are sometimes linked, increasingly literacy is being separated from numeracy at the school level and the numeracy focus is being lost. This is an unfortunate development as to understand text that has mathematical or scientific concepts embedded in it is very difficult, if not impossible, unless those concepts are understood. Science awareness programs also sometimes fail to emphasise mathematics, an issue that is constantly being raised by the AMSC.

The changing face of lobbying

The value of the internet in lobbying has yet to be realised. The use of e-mail to generate support for petitions was an early use adopted by the mathematics community (Ellerton and Clements, 1994). However what government has been slow to realise, and what professional associations have still to fully utilise, is the way in which e-mail and the Web can be used to tap into communities, gather new information, share information and so on. There is no need for secrecy or for decision making by small groups acting on behalf of much bigger groups. A leader in this has been the FASTS Web page which contains regularly up-dated material including media releases, drafts of documents for comment, policy and so on . The recently established AMSC site is following this lead. (The sites can be located at http://bimbo.pharmacol.su.oz.au/fasts/fastshome.html and http://www.dms.CSIRO.AU/~noel/AMSC/amschome.htm).

Conclusion

There is room for optimism. There are many reviews under way at both the state and federal level and eventually the talking will have to stop and some concrete actions taken. The AMSC, in conjunction with the National Committee for Mathematics and other bodies such as FASTS and the Institution of Engineers continues to build a network of people who are concerned about mathematics education and mathematics education research. These bodies have learnt lobbying and media skills and they know how to use them. The teachers, largely silenced by government, have powerful allies in these groups. In two years as President of the AMSC I never heard mathematics teachers criticised but I heard plenty of criticism of what they were being expected to do and the lack of support for them. In the next few weeks there will be two meetings with Dr Kemp involving

representatives of the mathematical sciences. It would be nice to think the juggernaut may be about to be tamed and a wider professional view of the mathematical sciences start to influence government. Only then can all the parts of the mathematical sciences thrive and equity, economic and cultural objectives be achieved.

References

Clements, M.A., & Thomas, J. (1996). Politics of mathematics education: Australasian perspectives. In P. Sullivan, K. Owens & B. Atweh (Eds.), *Research in mathematics education in Australasia 1992-1995* (pp. 89-117). University of Western Sydney: Mathematics Education Research Group of Australasia.

Curriculum Corporation. (1994). *Mathematics a curriculum profile for Australian schools.* Carlton, Vic: Author.

DeLaeter, J., & Dekkers, J. (1996). Science enrolments trends in Australian schools. *Search, 27*(9), 269-272.

Ellerton, N., & Clements, M.A. (1994). *The national curriculum debacle.* Perth: Meridian Press.

Eltis, K. (Chair) (1995). *Focusing on learning: Report of the review of outcomes and profiles in New South Wales Schooling.* Sydney: NSW Department of Training and Education Co-ordination.

Healy, G. (1996, November 13). Maths decline adds up to division. *The Australian.*

Juddery, B. (1997, January 15-21). New DEETYA head is named. Campus *Review*

Lokan, J., Ford, P., & Greenwood, L. (1996). *Maths & science on the line.* Melbourne: Australian Council for Educational Research.

Messina, A. (1997, March 13). State school retention rate keeps dropping. *The Age.*

National Committee for Mathematics (1996). *Mathematical sciences: Adding to Australia.* Canberra: Australian Government Publishing Services.

Preston, B. (1997). *Teacher supply and demand to 2003: Projections, implications and issues.* Canberra: Australian Council of Deans of Education.

Richards, M. (1997, February 11). Why you shouldn't groan when 'curriculum day' comes around. *The Age Education.*

Richardson, J. (1997, February 22-23). Champagne sure to repeat on Vanstone. *The Weekend Australian.*

Thomas, J. (1996). *Report from final session.* National Forum—Valuing Education: The Case for Mathematics and Science, Canberra, November 20, 1996. (Available from http://www.dms.CSIRO.AU/~noel/AMSC/amschome.htm)

Thomas, J., & Guttmann, T. (1997, February 10). How deficit cutting is eating our young. Sydney: *The Australian Financial Review.*