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THE EMERGENCE OF A DISCIPLINE -
MATHEMATICS EDUCATION
TOWARDS AN EXPLANATION OF TRANSITION
IN MATHEMATICS CURRICULUM

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(16 TEACH 5)

Nov. 1991

TECHNICAL REPORT

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THE EMERGENCE OF A DISCIPLINE - MATHEMATICS EDUCATION

TOWARDS AN EXPLANATION OF TRANSITION IN MATHEMATICS CURRICULUM

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This paper takes as its point of departure the transitions in educational emphasis within mathematics in Victoria during the latter part of the twentieth century. The term transitions is used advisedly, as it is not the intention of this paper to get involved in discussions of the meaning or definition of 'change'; nor is it the intention to enter debate on the meaning of 'curriculum'. Curriculum is a very evasive concept - and just when one feels that one has mastered it it tends to fade off into the chimeral - so that this paper regards it in a general way as the sum total of those activities necessary to communicate mathematics to the student.

That some transition has occurred might be noted by looking at some of the matriculation examination questions of 1990 and comparing them with those of 1900.

VCE(HSC) examination (1990)

Solve for x correct to two decimal places
 $\log_e(3x + 1) - \log_e(4 - x) = \log_e 4.$

Find an antiderivative of $e^{-2x} + \sin 3x.$

Each time Mikki plays a video game, the probability that she wins is 0.2, independently of the results of other games. Suppose Mikki plays the game ten times.

- Find the probability that she wins more than once.
 - Find the probability that she wins for the first time at the tenth game.
 - Find the probability that she wins for the second time at the tenth game.
- Give your answers correct to four decimal places.*

matriculation examination (circa 1900)

arithmetic

Write down in words the quotient and remainder obtained by dividing seventy-five thousand five hundred and forty-three billions by seven hundred and sixty-three millions and twenty-two.

algebra

Solve the equations

$$yz = a(y + z - x)$$

$$zx = a(z + x - y)$$

$$xy = a(x + y - z)$$

Euclid(geometry)

Write the following Propositions -

Book VI. - Prop. 24, 16.

Book IV. - Prop. 15.

Book III. - Prop. 14.

There can be little doubt that the demands placed on the students have undergone transition, (as have certain social perceptions - whether Mikki or Mickey or a game), and what is needed is some explanation to account for these transitions. Undoubtedly the transitions are due to a series of complex factors. What is attempted here is to isolate some of these factors that may account, in part, for some of the changes that have taken place.

Pre-1945

In common with the other States and many countries, Victoria did not have a system of public secondary education until the beginning of this century. In 1910 the first State secondary school was opened, and only then in the face of extreme opposition from the registered private schools sector and 'The Argus', a newspaper noted for its establishment sympathies.

Until this time secondary education was the preserve of the registered private schools and they basically saw its purpose as preparing students to matriculate so that they might continue their studies at university. In order to matriculate a student could pass the Leaving examination, held at the conclusion of five years of secondary education, or could qualify by the award of a Headmaster's certificate bestowed by the school itself. There existed at this time a situation whereby 'approved' schools were certified by the University to conduct its examinations within the school under the responsibility and control of the Headmaster. Known as Class A schools, these schools were responsible for the teaching and examining of all subjects offered within the school. The Schools Board, which was the body responsible for the conduct of the Intermediate and Leaving examination, adopted recommendations for Class A approval on the reports of members of the Board of Secondary Inspectors, who were delegated to act on behalf of the Schools Board.

After matriculating, many students would complete a Leaving Honors year before proceeding to University. The Leaving Honors year was based on the first year university requirements and the success rate in first year university of those completing this year was significantly higher.

Even though a number of schools were Class A university requirements determined the syllabuses. The requirement to matriculate was a pass in English, Latin and Greek languages, and in the elements of mathematics. As these subjects were also examined at university the pressure to conform was enormous.

Schools Board

In the period prior to 1945 the Schools Board was responsible for the determination of syllabus and conduct of examinations at the Intermediate, Leaving and Leaving Honors years of secondary schooling.

The composition of the Board reflected very clearly that it was in fact a 'Schools' Board since its membership comprised

- 8 members from registered schools,
- 8 members from Departmental schools,
- 8 members from university,
- 2 members from business world,
- 2 members from Roman Catholic schools.

The university often commented that they were in a minority, but this tended to overlook the realities of the situation. At this time there was a regular interchange of staff between the private registered schools and the university, and consequently the Schools Board was seen as another arena wherein the antipathy between the Education Department and the registered schools/university was played out. The somewhat turbulent beginnings to State secondary education and the resistance of the established institutions to its emergence had sown the seeds of an antipathy that was to mark all decisions of educational import.

For many years the field of primary education had been left almost entirely to the Education Department, which prided itself on its achievements. In the face of all the adversities confronting a newly emergent nation an education system had been put in place that offered the same opportunities to the remote country child as to the city dweller. Flushed with pride in their achievements the personnel concerned did not appreciate the resistance put in their way to the development of a public secondary system. It took all the guile and political nous of the first Victorian Director of Education, Frank Tate, to create a secondary system; but once the foot was in the door there was no turning back.

From the outset the Departmental approach was at odds with the established secondary tradition within Victoria. For a start the public schools were catering for a very different clientele. Many of the students who had stayed on in Elementary Schools, Central Schools, or Higher Elementary Schools did so in order to complete Grade VIII and gain a terminating certificate known as the Merit. By contrast many of the students in registered schools were continuing on to university. The need for an approach that catered for these terminating students became a major priority in the eyes of the Education Department. But as well there was the conflict that arose from the fact that the Schools Board controlled the examination agenda. While this was in place the Education Department was not in a position to exercise direction and control over the syllabuses within *their* school system.

In an attempt to gain control over the examination system the Education Department proposed, through a representative on the Schools Board, that it would introduce its own certificates for Intermediate and Leaving. The Department wanted to award the Intermediate at the end of third year as an exit certificate for many of its students. Support for such an exit certificate was forthcoming from the Catholic school sector as most of their students were also leaving school at about this time, but the registered schools were opposed as they found the end of fourth year a more apt time for an exit certificate for non-matriculating students. A long debate ensued within the Schools Board and the proposal was subsequently defeated. The outcome however was that the Department introduced a Proficiency Certificate to be awarded at the end of third year. Ironically, as one of the arguments introduced into the debate by Education Department representatives was the need to reduce the pressure of examinations on the students, the outcome created the requirement for a student in a public school to proceed through examinations for Merit, Proficiency, Intermediate, and Leaving (and possibly Leaving Honors).

The development of syllabi by the Schools Board was conducted by the Subject Standing Committees. The composition of these Standing Committees were also designed to reflect the interest of the schools.

Membership of a SC consisted of

- A. Chairman
- B. Member of the Schools Board
- C. University representative
- D.i) 3 teachers of registered secondary schools
ii) 2 teachers of state secondary schools
- E. Member from Board of Secondary Inspectors
- F. First and Second examiners
- G. Teachers of long experience whose advice would be helpful.

The majority of members were practising teachers and the committees were fairly large to cater for a diversity of expertise and interest. In 1944 the Mathematics Standing Committee consisted of, among a total of 27 members:

A,B,&C: Prof. Cherry

Others: R.Wilson, A.D.Ross, F.R.Potts, Dr.K.Bullen, R.J.A.Barnard, Assoc.
Prof. Belz, A.E.Schruhm,...

The presence of a number of authors of textbooks of that period appears to be no mere coincidence.

Matriculation Examination

By the nineteen forties the Schools Board had reached a position whereby it was in favour of the abolition of the Intermediate and of the introduction of a Secondary School Certificate to mark the end of five years of secondary schooling. In this respect the Schools Board reflected teacher thinking on the issues, due in part to the composition of the Board itself, but also to the fact that the Board had taken

the position that it would survey the schools before any major changes were introduced. An extensive survey was circulated to practising teachers and the results were collated and analysed before being presented to the Board. The decision taken to recommend the abolition of the Intermediate thus had the support of the majority of teachers in the schools.

The Schools Board may have had total responsibility for the promulgation of syllabi and the conduct of the examinations, but the decision as to what constituted matriculation rested with the Professorial Board of Melbourne University. By insisting on certain prerequisites from the Intermediate examination they were able to exercise influence to keep the Intermediate in place. However the possibility of a Secondary School Certificate presented a direct challenge to their hegemony. The Professorial Board insisted that in order to matriculate a student must pass at Leaving in the following subjects :

- i) general elementary mathematics;
- ii) a science subject;
- iii) a language other than english.

The Schools Board argued very strongly for a pass in only two of these three categories.

The Professorial Board perceived their position under threat - not only did the Schools Board propose that the requirements for matriculation should be eased but they were also proposing the introduction of a certificate that would stand outside the control of the University.

In 1943 the Professorial Board introduced the Matriculation Examination. This examination would be the normal channel of entry to the University from 1945 onwards. In a preamble reasons for the innovation were given. The Leaving examination had been used for two purposes, neither of which it had performed satisfactorily: as a measure of attainment for those whose formal education was about to end, and as a test for fitness to enter University for those wishing to pursue academics careers.

The new Matriculation Examination had four significant features: the examination would be taken at the end of sixth year, thus following the trend to lengthen the period of schooling by adding one more year to pre-matriculation schooling; it would provide specifically for University entrance requirements; it would be external for all candidates, thus reversing a trend towards increased Class A matriculation accreditation wherein approved schools conducted their own examinations; and it would be directly controlled by the University's Professorial Board rather than the Schools Board.

The new matriculation requirement was for a pass in four subjects, including English Expression. Control had been passed to the Professorial Board and the sole objective of the sixth-year course and examination was to be to test for fitness for University entrance. But control had not been relinquished by the Schools Board. The Leaving Certificate year replaced the Intermediate as the prerequisite for the Matriculation Examination, and the Schools Board remained firmly in control of the Leaving Certificate year.

VUSEB

By 1959 the creation of a second university was well under way and the fledgling Monash University immediately sought representation on a joint Matriculation committee and Schools Board (Musgrave, 1988). On 1 July 1964 the Victorian Universities Schools and Examination Board (VUSEB) came into existence. By this time a third university, Latrobe, was in the offing.

From the outset VUSEB was constrained by its own *raison d'être*. The Matriculation examination had been inaugurated for the sole purpose of determining the fitness of candidates to enter Melbourne university. The advent of Monash meant that it was desirous of being involved in a process to select its future students. VUSEB was thus promulgated with just this aim - to determine the fitness of candidates to enter either university. Thus it was a body designed to cater only for those students taking matriculation with the intention of proceeding to university, and was consequently unable to provide for those students not proceeding to university but desirous of a terminal certificate, and was further constrained in the services it could offer the schools by way of assistance to their academic mission.

The emergence of VUSEB also changed the education agenda. The former Schools Board had taken the decision in 1958 to abolish Intermediate. This decision lapsed with the arrival of VUSEB, partially because the attention shifted to Matriculation and partly because fees collected from students sitting for Intermediate were critical to the financial health of VUSEB in its early years (Musgrave, 1988). Even though schools were 'encouraged' to be innovative in their curricula programs in the early years of secondary schooling the continuing presence of the Intermediate examination mitigated against experimentation.

But in a more direct way the advent of VUSEB had an impact on subject curriculum. The membership of the Subject Standing Committees under the Schools Board and Professorial Board of the University of Melbourne consisted of a majority of teachers, but under VUSEB the membership was such that only half were serving teachers (The Secondary Teacher, 1965: p.34). The composition of the Subject Standing Committees under VUSEB were:

- a) 6 members of teaching staff of a university;
- b) 6 members to be secondary school teachers, 4 of whom were to be nominated by the subject association;
- c) 5 members, nominated by the committee, from organizations such as SCV, ACER, ...;
- d) 3 members, consisting of
 - i) an inspector,
 - ii) a nominee of the Catholic Education Office,
 - iii) a nominee from the registered schools.

Control would appear to be firmly returned to the universities, closing the circle begun with the return to universal external examinations with the advent of Matriculation in 1945. Emphasis was thus shifted away from the classroom teacher, and in the process the role of the M.A.V. was enhanced. In reality, of the six members provided for under b) the Mathematics Standing Committee only ever

appointed the four members nominated by the MAV.

VUSEB began with a very restricted charter, and nowhere was this more felt than within VUSEB itself. One of the first issues addressed was: what could VUSEB do? In an attempt to address this problem a committee of the Board suggested that its charter could embrace the determination of subjects to be examined and their syllabuses; the revision of syllabuses for these subjects; the provision of assistance and advice to teachers in these subjects; some responsibility for in-service training where revision is done; the publication of research results to administrators and teachers; some responsibility for courses in educational measurement; some responsibility for creating banks of test items for teachers and others; cooperation with organizations/persons in carrying out these functions; and provision of a series of lectures, perhaps through the medium of television, for Matriculation students. But under the statutes whereby VUSEB existed there was no case for developing courses for non-university students, although advice could be given on courses for years 7-10. Advice need not be taken but matriculation prerequisites had to be obeyed. In the final analysis VUSEB had no option but to adopt a restricted conception of its responsibilities.

Mathematics Education

In 1956 the Australian Mathematics Society(AMS) was founded. The newly emergent AMS, conceived as it was to provide a focus for the professional development of Australian mathematicians, soon found itself confronted by the issues of curriculum content. Overseas, new programs were being put in place and many of the local mathematicians had studied these trends and were suitably impressed. In Tasmania and NSW proposals were in place that portended great changes in the way mathematical education was to develop.

Perceiving the need to retain leadership and influence on the development of mathematical education the AMS hosted a seminar on Mathematics Education in Sydney in August 1962. This was the first such gathering of its kind in Australia, and in excess of one hundred delegates heard speakers from Australian schools, universities and teacher training colleges, and from overseas, highlight the problems in mathematics education and raise hopes for their future resolution.

The conference may have kept the university participants from the AMS in the limelight, but events had been put in motion that were to have a significant impact on the mathematics education scenario. The delegates from the various State branches of the Mathematical Association had a number of meetings during the duration of the conference and approved in principle the formation of an Australian association of mathematics teachers. It was to remain 'in principle' for a number of years but the seeds had been sown(AMT,1962).

Secondary mathematics within Australia was again under scrutiny at a UNESCO Australian seminar in January 1965 attended by a number of overseas mathematics educators. Education in mathematics at secondary level had been opened up for debate and Australian mathematicians, in their own inimitable way,

were putting in place the potential for change as they manoeuvred for consensus on a national scale.

The MAV had responded to the new conditions by putting in place a Curriculum and Research Group to keep abreast of current thinking in mathematics education, and this group conducted summer schools to provide assistance for inexperienced teachers. A tertiary committee was formed in 1961 and this group set about the task of preparing new syllabuses which were to be adopted by VUSEB to commence in 1967. On a wider front the MAV responded by founding, in 1965, the School Mathematics Research Foundation (SMRF), based at Monash University.

It was from within Victoria that the next major move towards a national consensus originated.

In late 1965 the MAV took the decision that was to prove crucial to mathematical developments in future years. The commitment to a national association at the 1962 seminar had not been allowed to pass into posterity. Throughout the months following the conference correspondence had passed between the various State Mathematical Association branches further exploring the idea. The MAV judged the time to be opportune for the next step. In November 1965, the MAV wrote to all the other States inviting them to be present in the Michell-Barnard library, Melbourne University, at 10 a.m. January 29, 1966 to participate in the formation of the Australian Association of Mathematics Teachers (AAMT). To ensure attendance the costs were borne by the MAV which also offered \$100 towards the expenses of any branch having difficulty in attending.

The first of regular biennial conferences of the AAMT was held in August 1966 at Monash, and from April 1967 the AAMT took over publication of the Australian Mathematics Teacher (AMT), previously a publication of the NSW Mathematical Association.

The mathematics education scenario was burgeoning - in 1968 AAMT had a representative at the Jamaican conference on "Mathematics in Commonwealth Schools", and in 1969 Australian mathematics educators demonstrated their interest in international events by attending the 1st International Congress of ICMI held in August.

Not only were Australian mathematical educators making their presence known on the international scene, they were expanding their influence on the national scene as well. In January 1969 the AAMT conducted the first National Summer School for Mathematics students, a program designed to encourage interest among mathematically adept youngsters. Mathematics was still seen in elitist terms.

When the International Journal of Mathematical Education in Science and Technology was founded in 1970, an Australian, A.L. Blakers, was invited to act as an advisory board member.

The birth of AAMT proved a watershed in the development of a national consensus of mathematical educators. Not only did it provide a focus for overseas interest in Australia, but in this and subsequent developments were contained the seeds of the emergence in Australia of the new discipline of Mathematics Education. The shift from mathematicians to mathematics educators was something taking place throughout the world. New journals, new positions, new conferences reflected the evolving focus within the education fraternity from attention primarily directed towards content to attention primarily directed towards the learner. Much of this can be explained by the emergence of the disciplines of the social sciences (Crittenden, 1980), but what is of interest is that the evolution of mathematics education in Australia took place alongside, if not before, its emergence overseas.

A discipline needs interest groups, conferences, international respectability, journals, and research groups. The birth of AAMT helped to provide the infrastructure for the development of this discipline, for now the Australian mathematical community had a national association that published a regular journal and conducted a conference that had international respectability. AAMT also provided exposure for Australian educators.

Mathematics research groups had been catered for by the birth of AMS in the middle fifties. What was initially lacking in the mathematics education field, given the observed shift in emphasis away from content towards the person, was an identifiable group whose concerns addressed the mathematical needs of all students. In this area a fillip was given by political decision taken in 1957 by the Federal government. Having decentralised control of education at Federation the Federal government had acted, since the War, in such a way as to assert influence on many educational decisions. In 1957 the Murray committee of enquiry into universities was established, and as a result of its recommendations, the Australian Universities Commission(AUC) was established in 1959 with the responsibility of overseeing allocation of funds to Universities. In March 1965 the Prime Minister presented to Parliament the first two volumes of the Report of the Committee on the Future of Tertiary Education in Australia. Known as the Martin Report the Committee was established in 1961 "to consider the pattern of tertiary education in relation to the needs and resources of Australia" (Pratt, 1966).

One of the decisions that the government subsequently implemented was the provision of finances for Teachers' Colleges and the establishment of the Colleges of Advanced Education. The government had thus established tertiary institutions with a mission different from that of the universities and had consequently, although inadvertently, created the conditions for the emergence of research groups with interests related not so much to content but to social concerns. When subsequently the Teachers' Colleges were granted autonomy the way was paved for the emergence of an intellectual resource group within the mathematical education community. Freed from the shackles of Education Department uniformity these academics were able to now define the issues they saw as relevant to their work. Such was the flowering of this talent that Blakers (1978), himself a professional mathematician with a keen interest in mathematics education who had done much to

develop this new community, opined that mathematicians no longer appeared interested in the developments of education and were leaving it to their education colleagues.

By the 1970s the mathematical education fraternity had come of age, and sources of innovation and critique had been institutionalised within Australia. The developments in the mathematical education field could be expected to proceed in a different way thereafter.

