INFLUENCES ON SECONDARY MATHEMATICS CURRICULUM IN VICTORIA

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The creation of the Victorian Curriculum and Assessment Board marked a significant departure from prior approaches to curriculum determination. Responsibility for the development of senior secondary mathematics curriculum was entrusted to a select group of mathematics educators. However, attempts to develop a new approach to curriculum were challenged by other groups within the community. This study examines the processes and influences that helped mould a particular curriculum.

BACKGROUND

Until the nineteen sixties control of the senior secondary mathematics curriculum in Victoria was essentially the preserve of examination boards, wherein mathematicians, mainly from the university but also from the school sector, primarily the registered schools, determined both the nature of the mathematics content to be taught and the ethos of the learning environment (Connell, 1962). In the nineteen seventies government introduced a new examination board which recognised the increasingly important role of education within society and the responsibilities of teachers and professional educators for the maintenance of that role. This board was to usher in the era of School Based Curriculum Development, and the focus of curriculum development shifted towards professional educators and teachers. The nineteen eighties saw the election of the first Labor government in thirty years, which ushered in an era of social reform. Education, in general, and curriculum, in particular, underwent considerable change (Clements, 1989).

INSTITUTIONAL CHANGE

The Victorian Curriculum and Assessment Board (VCAB) assumed responsibility for curriculum development in 1986. The major concern of VCAB was to develop a new curriculum model reflecting the recommendations of the Blackburn report (1985). A new certification, the Victorian Certificate of Education (VCE), was to replace the Higher School Certificate (HSC).

The VCE Mathematics Study was developed by the Mathematics Field of Study Committee (FOSC). The FOSC was comprised of a majority of teachers, and nominees of tertiary institutions, community and industry organisations. The Study Design did not specify a course description. Rather, it provided a set of specifications for the development of courses over the two years of the VCE.

In developing the Mathematics study the FOSC capitalised on the experience of previous curriculum developments. The interest in problem solving and modelling, the *Frameworks* project (Ministry of Education, 1988), the Cockcroft Report (1982), and the diversity of courses that emerged during the HSC were all factors in its deliberations. While the selection of the content areas of mathematics did not contain any major surprises, the focus on what were identified as 'key processes' in the learning and application of mathematics did provide the basis for a redefinition of mathematics education. Skills practice, standard applications of those skills, and problem solving, modelling and investigation were processes identified as common to all areas of mathematics, and the FOSC used them as a unifying principle for the Mathematics Study (VCE Mathematics, 1987).

MATHEMATICS STUDY DESIGN

There was a single Mathematics Study, consisting of four blocks of units, titled Space and Number, Reasoning and Data, Change and Approximations, and Extensions. Within each

of these blocks the mathematical areas of study were classified as algebra, arithmetic, calculus, coordinate geometry, geometry, logic, probability, statistics and trigonometry. As was required by the Blackburn report, each of these blocks of units could be taken at either Year 11 or Year 12. Three work requirements formed the basis of the work to be completed in each unit; Projects, Problem Solving and Modelling, and Skills Practice and Standard Applications. The work requirements were one of the most significant features of the Mathematics study. Whereas the content requirements of the Mathematics study varied little from those of HSC, the work requirements represented a paradigm shift in terms of pedagogy.

The intention of the Study was that the work requirements should underline the approach to the mathematical content that was to be learned. The learning situation was envisaged as active rather than passive - students should engage in learning and applying skills rather than in receiving information from the teacher; students should learn to use mathematical knowledge and undertake mathematical investigations in new situations rather than be presented with known results; the mathematical knowledge should be presented in an applied context rather than being presented as purely abstract results. But what was also of significance is that the Study attempted to be specific with respect to the way the work requirements were to be interpreted. Detailed explanations were provided for teachers specifying the issues to be addressed in each work requirement and the teacher's responsibilities. The Mathematics Study was descriptive with respect to mathematics content, prescriptive with respect to work requirements. To some extent this anomaly arose from the dual purpose perceived of the work requirements. They were designed to assist in achieving the objectives of the study, that all students engage in concept development and communication of developing ideas, but they were also to be used in the assessment process. As an integral component of the study, the work requirements added 'diversity and choice', but as an assessment instrument they encouraged 'uniformity and convergence'.

ASSESSMENT FACTORS

The demands for the preservation of diversity and choice among mathematics educators were at odds with the requirements of uniformity and convergence of a centralised curriculum bureaucracy. In the final analysis, the bureaucratic policies prevailed (Ellerton & Clements, 1994).

The overarching nature of assessment was further highlighted by the Common Assessment Tasks (CATs). Under instructions from VCAB CATs were developed for units 3 and 4 of each sequence. For the Mathematics Study the FOSC decided to implement four CATs: 1) Investigative project; 2) Challenging problem; 3) Facts and skills task; and 4) Analysis task.. CATs 1 and 2 were conducted during the school year and were initially assessed by the teacher and verified by VCAB procedures. CATs 3 and 4 were conducted under examination conditions and assessed by VCAB examiners. Problems surfaced due to the fact that students spent an excessive amount of time on CATs 1 and 2. The response of VCAB was to limit the length of the report in CAT 2 to 1500 words (VCAB Bulletin, 1992, No. 61). This did little to help abate the widespread criticism that the new VCE was far too time-demanding on both student and teacher alike (FOSC minutes). In effect, the complexity of the assessment procedures distracted attention from the nature of the content to be taught and from the innovative processes by which it was intended to be taught. The focus should have been on how to integrate these two components to achieve real change in the classroom - rather it was distracted by the needs of competitive assessment.

The expertise of the professional administrator is in administration, and this expertise was clearly evident in the modus operandi of VCAB. The Mathematics FOSC was supported by five permanent VCAB staff - a FOSC Manager and four Project Officers. Each Project

Officer compiled a report on one of the CATs (FOSC minutes, MATH10/89/6a, MATH10/89/6b, MATH11/89/6a, MATH11/89/6b) that reported on issues such as task development, authentication, workload and time management, record keeping practices, advice to schools, timelines, complaints. There was *no* comment on content, and only incidental comment on teaching. In addition an extensive statistical armoury was brought into play: correlations, score distributions, graphical presentations of the percentages of grades awarded, crosstabulations, multiple regressions, ANOVA, enrolment numbers and the like. The encouragement of new teaching styles envisaged through the agency of new assessment criteria faded in the face of administrative demands.

The assessment procedures were the major concern for VCAB as a whole. Obviously there were genuine issues involved - authentication of individual student work, the integrity of the credential, grading for tertiary selection, to mention some. This engendered a standard response - referral of the problem to an external, expert committee. A major review of procedures, by the ACER, was commissioned. A summary of the generally favourable report appeared in 1990 (VCAB Board Report, 1990, No. 43). What this summary did underline however was the extensive administrative coordination necessary to ensure that assessment procedures are effective. The expertise within VCAB would be essential. The report however carried a word of caution.

> The current negotiations about the Mathematics curriculum highlight two relevant issues, both of which will need continuing attention across all study designs. First, they demonstrate the lack of finality of any curriculum document and the need for regular review in a context of genuine willingness to adapt and modify. Secondly, they highlight the problem of some interested parties failing to pay attention to developments while they are occurring and then intervening late and publicly in an attempt to arrest a process (VCAB Board Report, 1990, No. 43).

Apart from the apparent contradiction implied in the statement - if the process is dynamic surely developments are going to occur that will necessitate participants re-evaluating their support or otherwise - the report indicated that the Mathematics study was under contestation.

CHALLENGES TO THE MATHEMATICS CURRICULUM

In 1990, a group of academics from Monash, Melbourne, Latrobe and RMIT formed the Tertiary Mathematics Group (TMG) with the purpose of 'commenting about the VCE Mathematics study'. Year 12 of the new VCE had not commenced yet dissatisfaction with the Mathematics Study was beginning to emerge. This dissatisfaction principally arose from within the ranks of tertiary mathematicians who were concerned with the adequacy of the VCE as preparation for tertiary study.

The TMG highlighted a number of concerns: firstly, that the structure of the Mathematics Study led to the compartmentalisation of mathematics and the treatment of mathematics as a series of discrete topics; secondly, that students could enter tertiary study with quite diverse backgrounds, many lacking adequate mathematics for their chosen course of study; and thirdly, that assessment procedures did not cater for students with little intention of pursuing mathematics beyond Year 12, that students sought outside help in the completion of the projects, and that assessment should be 'content-based' rather than 'aptitude-based' (FOSC minutes). The TMG proposed modest changes to the Study to allow the more able mathematics students to select a greater number of advanced units. These criticisms were rejected by the FOSC. It was pointed out that:

> VCAB specifications for the development of study designs require that different studies, and different units within studies, are about different things. In other words, some divisions of mathematical content into reasonably separate parts is a requirement. It is difficult for others to appreciate this (FOSC minutes, 1990, Response to TMG Proposals).

The crux of the TMG criticism was that mathematics cannot be conceptualised in this way without damage to the nature of mathematics.

> ... mathematics is not a subject composed of a series of discrete topics. Rather it is a cumulative and sequential subject, with each level relying on many of the concepts taught at the previous level (Tertiary Mathematics Group on V.C.E. Mathematics, undated).

Guidelines for the development of VCE studies constrained the way in which the mathematics study was developed. The issue had become ideological. This was recognised by the chairperson of VCAB who, in arranging a meeting to discuss the above proposals, wrote to FOSC members in the following terms:

> The differences in *opinion* are associated with the kinds of interpretations and extrapolations individuals make from the different theories of learning. They are also associated with the different *opinions* on 'What knowledge is of most worth' for secondary students (Letter from Richard P. Tisher to FOSC member, 1 June 1990, emphasis mine).

Perhaps he should have asked 'Whose knowledge?', for a divergence in conceptions of the nature of mathematics was clearly emerging.

Despite the fending off of the TMG challenge the minutes of the FOSC indicate not all else was rosy. A number of letters from schools expressed concern with the effect of the Mathematics study on the performance of girls as well as other more general worries. At a meeting of the FOSC in May 1990 a list of concerns was tabled along with advice on how to answer them. The concerns included assessment, streaming, monitoring and record-keeping, authentication of student work, student workload, resources for problem solving, modelling and projects, expertise with problem solving and projects, and tertiary selection (FOSC minutes). The FOSC may have felt it had dealt with the concerns of the TMG but the feeling in the schools was not so confident. The final straw was the relatively poor performance of ex-VCE students compared to ex-HSC students on the Melbourne University diagnostic test in Mathematics administered in February 1991 (W. J. Ewens, letter to P. Stacey, 10 April 1991). VCAB was bound to act.

EXTERNAL REVIEW

VCAB required an annual report from each of the studies. VCAB decided, in 1991, to institute an additional external review of the Mathematics study (Stacey, 1991). Its terms of reference were:

> To investigate the teaching of Mathematics within the framework of a single certificate. The review would take account of the experience so far of the working of a single design for Mathematics and would consider, in particular:
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> 1. The provision of an appropriate coverage of mathematics in Years 11 and 12, and
> 2. The capacity of the single Mathematics design to meet students' needs and differing aspirations (Mack, 1991).

The final report was delivered in 1992 and recommended substantial changes to the Mathematics study. Effectively the report recommended a sequential, hierarchical structure. The VCAB requirement to develop a multi-study structure, in which all studies were equally rigorous and were deemed of equal value and status, was abandoned. While recommending the retention of work requirements and of CATs, both mandated by VCAB, the review proposed a rationalisation of offerings that would effectively answer the criticisms proffered by the TMG. In so doing it reduced the complexity of the Mathematics study to a choice from two units offered at level 1 & 2, and from three units offered at level 3 & 4. In essence, the demands of the TMG had been met. University control over entrance requirements once again provided the justification for changes in content of senior secondary mathematics. However, the flexibility of the Mathematics Study was lost, and so, presumably, was its appeal to a broad spectrum of the senior school population.

The general disquiet with the VCE was not confined to the schools. Widespread discussions in the press, on radio and elsewhere concerning the excessive and disruptive workloads caused by the project CATs, mainly through the authentication procedure, had focused attention on the teacher 'overload' problem. The FOSC responded by eliminating CAT 2. The new study was introduced with revised structure and with three CATs, to commence in Year 11 in 1993. Further changes to assessment were to follow. While the original intention of the FOSC appeared to be to integrate the assessment process with the process of teaching and learning mathematics, the use of the assessment criteria for purely grading purposes soon undermined this aim. The FOSC became preoccupied with the validity of the various CATs as assessment instruments. The school-based CATs suffered most - claims of cheating, tutorial help, sales of solutions, together with more substantive arguments relating to the advantages enjoyed by children from more educationally advantaged homes created a climate of distrust. The FOSC responded. CAT 1 was modified from a Problem-solving task to a report of a problem-solving activity authenticated by a test set by the Board of Studies (BOS), which had replaced VCAB during 1993. In addition, in 1994, the BOS introduced the General Achievement Test (GAT) to monitor school achievement for each school-assessed CAT. The notion of outcomes had clearly extended into higher levels of schooling as the BOS endeavoured to construct administrative solutions to the problems of authenticity and of comparability. The GAT was used to provide a profile that could be applied to each school-assessed CAT. The problem of authentication had become an obsession.

CONCLUSION

How is the extraordinary preoccupation with authentication and assessment to be interpreted? The VCE Mathematics Study represented a new initiative by mathematics educators that fell on the sword of bureaucracy. It would appear that the role of Year 12 in selection for tertiary entry yet again assumed paramount importance. Inadvertently, the genuine concerns of university mathematicians provided the opportunity to frustrate comprehensive reform of the senior curriculum. While concern within the community was another factor, there is little doubt that the extraordinarily complex assessment arrangements were the major factor in the failure of this innovation (McCalman, 1999). One outcome of this whole process was the strengthening of the role of the professional administrator in the control of curriculum. Thereafter, the role of mathematicians and mathematics educators would seem to be one of expert adviser to bureaucracy, within the framework of terms of reference decided by the bureaucracy. The decision as to who constitutes the expert, and whether advice is accepted, now appears to rest with the bureaucracy.

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