

THE SeMTAC PROJECT:

Rationale, Methodology and Recommendations

David H. McKinnon, Bruce Horton, John Oakley, Paul Donaldson and David Jeffries

Charles Sturt University - Mitchell
Bathurst

Abstract

This paper presents the rationale for undertaking a study into the factors which influence school leavers to consider, or not to consider, a career in secondary mathematics teaching. The study questioned Year 12 students, their parents, the mathematics teachers at their school, and the students from Charles Sturt University - Mitchell studying to be secondary mathematics teachers. The methodology employed in the study is described and the recommendations arising from the results presented.

Background to the Project

CSU-Mitchell, as Mitchell College of Advanced Education (MCAE), began to offer a full-time Bachelor of Education (Secondary Mathematics) Course in 1972. Demand for the Course grew steadily during the 1970's, and by 1976, 62 full-time students were enrolled over the four years of the Course. In the late 1970s and early 1980s demand began to wane with only single figure full-time new enrolments occurring in each of the years from 1980 to 1983 inclusive. In 1984, no new full-time students were enrolled. The Course however, was not abandoned: continuing students were placed in existing classes of students enrolled in the College's Bachelor of Applied Science (Industrial Mathematics and Computing). At the time, this lack of demand for the Course was attributed to the oversupply of secondary teachers, including mathematics teachers, in NSW. In fact the NSW Department of Education operated a scheme to prepare some newly graduated secondary teachers in disciplines where oversupply existed, for teaching in primary schools.

Other NSW institutions offering courses to prepare secondary mathematics teachers also experienced a similar decline in enrolments in their courses.

By 1984, however, it was obvious that NSW was facing a shortage of qualified secondary mathematics teachers. The (then) NSW Department of Education began to conduct 10 week retraining courses for qualified teachers to prepare them for teaching secondary mathematics. This strategy replaced the overseas recruiting campaign undertaken in the late 1960s and early 1970's which resulted in many North American teachers being employed in NSW secondary schools. These 10 week courses continued throughout the remainder of the 1980s.

In 1985, school leavers showed renewed interest in MCAE's B Ed (Sec Maths) Course and 21 new full-time students enrolled. It was assumed that knowledge of the shortage of mathematics teachers in NSW had been a factor in their decision to enrol in the Course. In the same year, MCAE undertook extensive promotion of the Course in NSW Western Region secondary schools with emphasis being placed upon: almost certain employment upon graduation; the nature of the Course; and the advantages of studying at a relatively small institution.

This promotional exercise has been continued each year since 1985. In 1986, 20 new full-time students enrolled and the quota allocated by the College to the B Ed (Sec Maths) was achieved.

In response to NSW's continuing need for secondary mathematics teachers, MCAE raised the B Ed (Sec Maths) quota to 35 for 1987 and 1988, and 39 and 35 new full-time students respectively, enrolled in these years. It was assumed that the College's success in filling the quota allocated to the Course had resulted in part from the promotion of the Course in Western Region secondary schools, the shortage of secondary mathematics teachers, and the availability of NSW Department of Education Cadetships for fourth year students in 1988 (\$10 000 per annum). Scholarships valued at \$30 000 for the four year course have been available since 1989.

At the end of 1988, as MCAE assembled data for the DEET Discipline Review of Teacher Education in Mathematics and Science, an extensive examination of the entry marks and progress of students enrolled in the course was undertaken. This examination revealed that although there had been a small increase in the number of students with HSC aggregates over 400, 38.8% of entering students had dropped out of the Course for various reasons such as failure, transfer or discontinuation.

The College/University quota was raised to 40 for 1989 and 1990 and 19 and 28 new full-time students enrolled in these years respectively. In 1991 only 28 new full-time students enrolled and the Course quota of 40 was not filled. The attrition rate for the course noted at the end of 1988, however, is increasing. Only 7 of the 1986 intake of 20, 16 of the 1987 intake of 39, and 12 of the 1988 intake of 35 continued to the fourth year.

Whereas in the early 1980s Mitchell College's main problem with the B Ed (Sec Maths) Course was in attracting sufficient students into the Course, in the late 1980s and early 1990s CSU-Mitchell's main problem was

attracting students of sufficient calibre to complete the Course successfully. It would be improper, however, to suggest that the Course itself plays no part in students' choices to discontinue or that the increased quota for the course (which has existed since 1987) and the need to achieve it, has not contributed to the attrition rate (for example, to achieve the quota, more "less qualified" school leavers have been accepted).

By the close of 1989 it was apparent that the experience of MCAE with its B Ed (Sec Maths) Course was not unique. Newspaper articles appeared describing a similar lowering of entrance requirements for teacher training courses, particularly in secondary maths and science in NSW institutions. Anita Catalano¹ described the difficulties which many NSW universities were experiencing in early 1991 in attracting sufficient numbers of well qualified students to maths and science teacher training courses. In her article, Catalano quoted Dr Harry Thompson of Macquarie University as having said "We just can't get them (school-leavers) in maths or science" and "the quality of students has decreased and the failure rate, especially in science, has risen".

Various reasons have been advanced anecdotally for suitably qualified high school leavers avoiding secondary mathematics teaching as a career. These include:

- teachers' salaries being low, relative to the remuneration being available in the professions (eg law and medicine) and in industry
- the status of teachers
- the working environment of teachers
- the demands made on teachers by changing societal conditions and employer expectations.

Around the same time that CSU-Mitchell was experiencing difficulty in attracting students into the B Ed (Sec Maths) Course, concern was building in the United States over a similar set of problems. For example, Empey (1984) warned that "the shortage of qualified mathematics and science teachers has already reached crisis proportions". He reported data from a number of state and national surveys which indicated a drastic reduction both in the number of students in mathematics teacher education programmes and the number of teachers receiving certification for teaching mathematics (and science). He quoted Shymansky and Aldridge (1982) who, from a 1981 survey of 450 American teacher placement offices, reported a 79% decline over a ten year period in the number of mathematics teachers preparing to teach in secondary schools. As well as highlighting his concern about the quantity of mathematics teachers in the USA at that time (either trained or in training), Empey also expressed disquiet about the quality of those entering teacher preparation courses. He observed that "Though teaching has never attracted the most gifted students, there is some evidence that the quality of new recruits is declining."

To recruit and retain teachers Empey recommended the need for improvement in four areas:

1. Increased public confidence in, and support for, USA schools through increased funding, and publicity about "the many good things that take place in schools";
2. Increased compensation systems for teachers (improved salaries, improved starting salaries, improved career ladders, and increased avenues of recognition for teachers' work);
3. Improved working conditions to remove the frustrations associated with "lack of student discipline, increased paper work, classroom disruptions and so forth";
4. Improved recruitment programmes promoting career opportunities in teaching, the importance of teaching and the future demand for teachers.

Smithers and Hill (1989) discussed the difficulty being experienced in the UK in recruiting sufficient numbers of physics and mathematics teachers in the context of making "teaching once again an attractive profession". They reported a 1987 study undertaken with a sample of 177 recent sixth formers who had been first interviewed in 1985. They sought to establish this sample's views on a teaching career in relation to their personal values. From interviews with individuals in the sample the authors sought to determine:

- (a) what the young people were actually doing two years after leaving school;
- (b) their reactions to their school experiences;
- (c) their occupational and life values;
- (d) their attitudes to teaching as a career;
- (e) their beliefs about the satisfactions provided by teaching ;
- (f) their interest in a broader teaching degree;
- (g) their interest in a degree combining science/maths with education, and
- (h) whether such a degree would have led them to think of teaching as a career.

These authors concluded:

" Against a background of concern with the salary and status of teaching, probably engendered by the lengthy teachers' dispute, the results point to what may be a fundamental difficulty in recruiting maths and physical science teachers: the satisfactions provided by teaching may be very different from those which people who specialise in these subjects are seeking. Teaching is recognised to be primarily a people-oriented profession, but many people attracted to the abstractions of maths and physical sciences express low levels of interest in working with people or being involved in a helping profession. This is borne out by the responses to the question about ' what puts you off teaching?'. The major difficulty envisaged was discipline and the attitude of pupils, and another commonly

given reason was ' unsuitable personality/do not like children' ".

Evans (1986) examined the factors which operate to discourage prospective teachers from entering a teaching career. Selected first year students at a medium sized American engineering university were classified as either "teaching oriented" or "non-teaching oriented". The "non-teaching oriented" students provided the following reasons, in order of priority, for not wanting to enter teaching:

- (i) low salary;
- (ii) aversion to having to do that which teachers typically do each day;
- (iii) concern for job security;
- (iv) low maximum salaries after years of work;
- (v) poor employment prospects.

The aim of the Secondary Mathematics Teaching As a Career2 (SeMTAC) project, therefore, was to identify those factors influencing school leavers to enter, or not to enter, secondary mathematics teaching as a career. This aim is being pursued by seeking to determine:

- (i) the attitudes of Year 12 students towards the teaching profession in general (salaries, professional status, working conditions, prospects, etc.) and secondary mathematics teaching in particular;
- (ii) the attitudes of CSU-Mitchell's population of secondary mathematics teacher trainees towards the teaching profession in general and secondary mathematics teaching in particular, and the factors which were significant for these trainees in their decision to enter a secondary mathematics teacher training course; and
- (iii) the extent to which mathematics teachers, careers advisors, parents, peers, and the media influence school leavers' choice, as this may be related to the attitudes of these groups towards the teaching profession in general, and mathematics teaching in particular.

This paper :

- (i) describes the Project design and methodology;
- (ii) presents some results in relation to the discussion; and,
- (iii) suggests some possible strategies to overcome the difficulties in attracting suitably qualified school leavers into secondary mathematics teaching as a career.

Project Design and Methodology

To pursue the aim of the Project it was decided to survey:

- (a) in a sample of Western Region secondary schools, in 1991

- (i) all Year 12 students;
 - (ii) parents/guardians of these Year 12 students;
 - (iii) all mathematics teachers; and
- (b) CSU-Mitchell's 1990 population of trainee secondary mathematics teachers.

The Western Region of the NSW Department of School Education covers a vast area. Great diversity exists in the cities and towns, and consequently the schools, of this region. This diversity derives from such factors as population size, remoteness, potential employment avenues and prospects, economic prosperity, and proximity to tertiary institutions.

In the planning phase of the Project it was decided to select a stratified sample of secondary schools based on the populations of the cities or towns in the region. The populations of Western Region cities and towns are distributed in the following approximate proportions:

Major Urban	:	Minor Urban	:	Rural
=		6 : 2 : 1		
(pop. > 14 000)		(pop. 4000 - 14000)		(pop. < 4000)

Accordingly, it was decided to collect data in 9 schools, 6 in Major Urban Cities/Towns, 2 in Minor Urban Towns, and 1 in a Rural Town. The sample schools were selected finally by accounting for the factors described above and by considering the practicalities associated with the Project Team's need to visit all sample schools.

A tenth school in a Major Urban city was selected to undertake a Pilot Study for the Project. The purposes of this Pilot Study were to:

- (i) use the data collected from the students, their parents/ guardians and the mathematics teachers, to refine the questionnaires to be employed in the 9 sample schools; and
- (ii) develop the Project Team's skill in administering the questionnaires to be used in the 9 sample schools.

The Project Questionnaires

Four separate questionnaires were developed for the Project, one for each of the target groups identified. Prior to the construction of the instruments, members of the Project Team met informally with the Mathematics teachers in two large Western Region secondary schools. From these meetings, (arranged to gain teachers' opinions on perceived factors influencing Year 12 School leavers' choice with respect to secondary mathematics teaching as a career) an extensive list of attractive and unattractive features of secondary mathematics teaching as a career was compiled. This list (added to by members of the Project Team) was recast into a "Key Factors" format .

The Key Factors list covered the following broad areas:

Salaries	Working Environment
Support for Teaching	Societal Influences
Government Policies	Students in Schools
Mathematics as a Discipline	Career Opportunities
Role of the Mathematics Teacher	

This Key Factor list was used to construct Likert Scale Items for each of the four Project questionnaires. Each questionnaire also sought additional information from each respondent beyond that provided in response to the Likert Items.

To expedite the processing of the gathered data it was planned that all target groups, except the parents, would record the majority of their responses to the various questionnaire sections on mark sense "General Purpose Answer Sheets". The open ended responses on the questionnaire pages were transferred to the mark sense sheet by members of the Project Team. This resulted in very rapid entry of the data, with very few of the sheets being rejected due to faint marking by respondents.

A Pilot Study was carried out to provide researchers with "a feel" for the data which might be expected from Stage 3 of the Project, and give the Project Team experience with the administration of the questionnaires. It was not possible to survey the Year 12 students in the school chosen for the Pilot Study because these students were sitting for the 1990 HSC examinations. Thus, Year 11 students, and their parents/guardians were surveyed, as were the school's mathematics teachers. Data were gathered from 85 Year 11 students, the parents/guardians of 47 of these students and 9 mathematics teachers. An exploratory Factor Analysis was conducted on the completed Year 11 student questionnaires but there were too few to produce an interpretable factor solution for the Likert Items. (The number of completed mathematics teachers and parents'/guardians' questionnaires was too small to even attempt a factor analysis).

The CSU-Mitchell Students' Questionnaire was administered separately to each of the first to fourth year groups of students enrolled in the University's B Ed (Sec Maths) course in October 1990. The Project Team completed the loading of data on to the mark sense sheets during November 1990 and the processing of the data was undertaken in December 1990.

The Nine Sample Secondary Schools

Negotiation for access to the target groups in the nine secondary schools began in February 1991. Two of the schools selected for the study were unable to assist and these two schools were replaced by two having similar characteristics. The administration of the instruments was undertaken in the second and third weeks of April 1991. Each school was visited by four

members of the Project Team who administered the questionnaires to Year 12 students and Mathematics Teaching Staff during a school teaching period.

Students were requested to deliver a questionnaire to their parents/guardian for completion within the next few days. The Head Teacher (Mathematics) in each School would return the completed Parent Questionnaires to the Project Team at CSU-Mitchell.

Results of the SeMTAC Project

Discussion of the results of the high school students and their parents/guardians responses is to be found in Oakley et al (1991), and of the CSU-Mitchell students and the high school mathematics teachers in Horton et al (1991). A discussion of the Factor Analysis undertaken, the procedures undertaken to produce reliable and valid subscales, and some results relating to the application of the subscales is presented in McKinnon et al (1991). The final Project Report has been presented to the NSW Department of School Education, Western Region.

Discussion, Conclusion and Recommendations

The Secondary Mathematics Teaching as a Career (SeMTAC) Project was undertaken to attempt to identify those factors which influence school leavers to enter, or not to enter secondary mathematics teaching. Data have been gathered from 714 Year 12 students, 320 of their parents/guardians, 73 secondary mathematics teachers in 10 Western Region Department of School Education schools, and from 69 trainee mathematics teachers at CSU-Mitchell, Bathurst. Whilst most of the recommendations focus on the career of secondary mathematics teaching, much of what is said is relevant to secondary teaching in general.

Critical Factors for Choosing Secondary Mathematics Teaching as a Career

Entry to a secondary mathematics teacher preparation course was not a "last resort" option for 89% of the mathematics teachers and 65% of the CSU-Mitchell students. Rather, it was enjoyment of, and success in, school mathematics which had the strongest influence on their decisions to enter a course to prepare for teaching secondary mathematics. For the mathematics teachers, fascination with the subject of mathematics seems to have persisted into their professional activities as teachers with 95% of them having agreed that they enjoy working in a profession that uses mathematics. Yet only 67% indicated that they liked being secondary mathematics teachers. The work of Smithers and Hill (1989) suggests that other characteristics of those who enjoy mathematics, and who are good at it, may militate against such people being interested in teaching mathematics. Further research is necessary to determine if this is the case

and to identify the 'other characteristics'.

Recommendation 1

That further research is needed to explore the speculation that those who enjoy mathematics and who are good at it, have personality traits which militate against them entering a "people oriented career".

The factor analysis of the Year 12 student responses produced a factor (Factor 5) interpreted as students' attitudes towards mathematics. Examination of the frequency distribution of summed scores of their responses to the Likert Scale items indicates that 59 % of the students had either a neutral or negative attitude towards mathematics.

The importance of good mathematics teaching is underscored by the fact that almost two thirds of the mathematics teachers and almost three quarters of the CSU-Mitchell students noted that their mathematics teachers' teaching of mathematics influenced their decisions to enter a course to prepare for teaching secondary mathematics. These findings highlight the pre-eminent position held by the mathematics teacher when considering the influence that they have on school leavers on their choice of secondary mathematics teaching as a career.

Recommendation 2

That teacher education institutions incorporate explicit examinations of the characteristics of "good" secondary mathematics teachers in their secondary mathematics education programmes.

Midgley et al (1988) suggest that certain teacher behaviour is an important variable in influencing school students' valuing of mathematics. For example, in a longitudinal study conducted in American schools with a focus on students' transition from Elementary School to Junior High School these researchers found that " the value of math increases for students who move from less supportive to more supportive teachers after the transition, and decreases for those who experience the opposite pattern of change". Here, 'supportiveness' has been identified as an important factor in helping pupils make the transition from elementary to junior high school.

A generally surprising finding of this investigation has been that gender issues in the learning and teaching of mathematics are not perceived to be particularly important by year 12 students. In a similar vein, parents were not particularly concerned about the sex of their offspring's teacher. The vast majority of parents, however, did have the conception

that it was harder for girls than for boys to learn mathematics. Thankfully, this 'misconception, was not evident in the majority of responses from the teachers or from the teacher education students. The teacher education students agreed that gender is an important issue which teachers must take account of in their teaching.

The findings reported above are evidence that a steady supply of secondary mathematics teachers will only exist if secondary mathematics classes are taught by teachers who like their subject, who are able to transmit this liking to their students and who are able to provide their students with opportunities to experience success with the subject. It may be argued that it is unlikely that teachers whose mathematical knowledge and ability is mediocre are capable of performing at a level necessary to attract students to the profession.

Recommendation 3

That there be extensive promotion of the importance of secondary mathematics teaching and the worth of the profession in order to attract more of the able students into the career.

The results of the status rankings of various occupations against secondary mathematics teachers are a major cause for concern. The Year 12 students perceived the relative standing of secondary mathematics teachers to be the lowest in the list of twelve professional occupations and sixth in the list of twelve general occupations. The participating parents perceived the relative standing of secondary mathematics teachers to be tenth and third respectively. Similarly, the secondary mathematics teachers perceived the relative standings to be ninth and fifth.

It could be forcefully argued that Year 12 students are unlikely to want to enter a profession that they perceive to have such a low status. Similarly, parents/guardians are unlikely to encourage their offspring to enter a career when they too perceive it to have a relatively low status. That the status of the profession by secondary mathematics teachers themselves is so low is somewhat distressing. While there is undoubtedly a degree of bias in these status results introduced by the locations where the study was carried out, it remains distressing to note that secondary mathematics teachers rank themselves below mining in status. Whilst there is an obvious need to raise the perceived status of secondary mathematics teaching, the methods by which this may be accomplished are not obvious. Empey (1984) for example, recommended increased compensation systems for teachers including improved salaries, improved starting salaries, improved career ladders, and increased avenues for recognition of teachers' work. Despite a recent substantial increase in teachers' salaries in NSW, they are still seen as an important issue by mathematics teachers and by CSU-

Mitchell students. While remuneration is only one of the components of people's perceptions of the status of an occupation, it remains an important one, at least in the eyes of the practitioners.

Recommendation 4

That avenues should be explored for raising the status of secondary mathematics teachers and recognising the work of secondary mathematics teachers.

It is interesting to note that in listing reasons for deciding against a career in secondary mathematics teaching, many Year 12 students whose parents were teachers gave similar comments to a female studying 4 unit mathematics who intended to be a physiotherapist. This student indicated that her parents had actively, and strongly discouraged, her from entering a teaching career.

The factor analysis of the student questionnaire revealed a factor which was related to the amount of encouragement that they perceived themselves to have received to consider a career in secondary mathematics teaching. The year 12 students reported themselves as having received little encouragement in this respect. A similar factor in the parents'/guardians' responses supports this view with almost 70% of the parents providing no positive support for their offspring to enter a career in secondary mathematics teaching. Less than a quarter of mathematics teachers agreed that they actively encourage able students to consider secondary mathematics teaching as a career. Further, in considering the role of Careers Advisers, almost two thirds of the Year 12 students indicated that Careers Advisers had not encouraged them to consider secondary mathematics teaching as a career. In many respects, these results are not altogether surprising given the status of teaching in general and mathematics teaching in particular.

Further examination of the factor analysis carried out on the Year 12 students' responses indicates that a significant proportion of the students believe they would receive parental support to undertake further study. This support does not appear to be directed towards courses involving preparation for secondary mathematics teaching, with almost 60% of the parents having a negative view of the extent to which they would offer support to their offspring to consider teaching as a career.

Why is there so little encouragement for students to enter secondary mathematics teaching as a career? The answer to this question is far from simple; the lack of encouragement is probably the result of a combination of many factors, each of which is accorded varying importance from person to person. The perceived status of secondary mathematics teachers may be one factor contributing to this lack of encouragement.

Other factors which have been identified in this study probably also play a

part. These include:

The Climate in Mathematics Classroom;
The Morale of Secondary Mathematics Teachers;
The Working Conditions of Secondary Mathematics Teachers; and
The Salaries of Secondary Mathematics Teachers.

Large proportions of the surveyed groups agreed that school leavers are not interested in becoming secondary mathematics teachers because of what teachers have to put up with in their classrooms. They also agreed that increasingly, school students are challenging the authority of teachers in mathematics classrooms and that maintaining a positive classroom atmosphere is a real problem in most secondary mathematics classrooms. These results support the contentions of the consulted teachers who assisted with the compilation of the "Key Factors" list. It is interesting to note that while parents have not had direct contemporary experience in mathematics classrooms, they indicate a surprisingly negative perception of the events occurring in these classrooms.

These perceptions may, in part, be due to the pedagogical approaches being employed by the mathematics teachers. McKinnon and Nolan (1991) in examining change underway in education related to societal restructuring and the nature of work note that:

"Within traditional schooling, students have been expected to display positive attitudes, and the presence or absence of these has been used by teachers to explain students' academic success or failure..... Moreover, schools have tended to focus upon extrinsic rewards and punishment to motivate students to learn. For example, at the secondary level, it is fairly common practice for teachers to seek to motivate students by invoking examination success as a necessary condition for achieving, or gaining, desired occupations or life-styles (Nicholls, 1985)..... This approach works best only with a minority of students, those who have already been well socialised into the culture of "delayed gratification" (Bernstein, 1976)."

The perceived problems may be also due to the changing composition of the secondary school population and its aspirations as retention rates in Years 11 and 12 rise sharply. Pope (1991) quotes 1991 Bureau of Statistics figures indicating that:

"...whereas in 1980, senior secondary students made up 7.6 per cent of the the total school population, by 1990 they were 12.4 per cent. In 1980 34.5 per cent of students stayed on into Year 12, by 1988 this had climbed to 57.6 per cent and by 1990 64 per cent."

Pope went on to observe that:

"The changing shape of the youth labour market and the impact of the Commonwealth government social security arrangements, including the abolition of the under-18 unemployment benefit and the introduction of

AUSTUDY, have helped push increasing numbers of young people back into the classrooms. This, coupled with the increasing credentialism that has come with larger numbers of young people seeking the decreasing number of available, full-time, tenured (that is career path) positions, has placed new demands on secondary schools and increasingly, on tertiary and TAFE institutions."

Recommendation 5

That secondary mathematics teachers need more in-school and system support in meeting the challenge presented by the changing clientele.

The majority of both mathematics teachers and CSU-Mitchell students agreed that the morale of most secondary mathematics teachers is low. Whilst the parents and the Year 12 students were not asked directly about the morale of secondary mathematics teachers, they were asked to respond to a number of related items which, overall, indicated morale was an issue of which they were not aware. The data reported in Horton et al (1991) support the contention that unless the teachers perceive that there is a dramatic improvement in their working conditions and morale, the worst possible outcome is that the sample schools could lose almost half of their current secondary mathematics teaching staff. If this situation is representative of the perceptions and intentions of teachers Statewide, then the current crisis is likely to assume catastrophic proportions.

Since it appears that mathematics teachers are the most powerful sources of encouragement for school leavers to consider choosing a career in secondary mathematics teaching, it would seem prudent to address the issues which teachers report as causing low morale.

Recommendation 6

That further research be undertaken to determine whether teachers' perceptions of their professional adequacy are realistic.

Recommendation 7

That system and school mechanisms be evolved for a more efficient transmission of curriculum information to classroom teachers.

Recommendation 8

That mathematics teachers be provided with system and school organised in-service courses to review, and develop, adequate contemporary pedagogical strategies.

Teacher morale is probably also related to the way in which mathematics teachers perceive the value which school students place on the mathematics which they teach.

Whilst 87% of the mathematics teachers agreed that mathematics is one of the most important school subjects, 61% of them disagreed that most students are interested in the mathematics which they teach. Almost three quarters of the Year 12 students and their parents also indicated that they see mathematics to be one of the most important school subjects. However, more than half of the Year 12 students disagreed that school students are interested in the mathematics which they are required to learn. These perceptions may be related to the opinions which the mathematics teachers (87%) have about the mathematics courses which Year 11 and 12 students are attempting, i.e., that too many senior students are attempting mathematics courses beyond their capabilities. (This belief was shared by 40% of the parents and 36% of the CSU-Mitchell students.)

Pope (1991) observed that:

"Throughout the 1980s, for example, with youth unemployment climbing, efforts were made to make the secondary curriculum more responsive to the needs of the 'non - academic' students at the post - compulsory level, either by expanding the range of options within the traditional subject boundaries that make up the so called 'academic' curriculum or by developing alternative programmes."

Within NSW, the Mathematics in Society and Mathematics in Practice Courses were developed as were school based Other Approved Studies (OAS) Courses in Mathematics in response to the changing population of mathematics students. Pope's (1991) conclusions regarding curriculum initiatives such as these were:

"...by and large, the 'academic' curriculum with its tight subject boundaries and orientation towards tertiary entrance requirements has proven remarkably resilient.... Overall the programmes seem to demonstrate the ability of the traditional curriculum to absorb or marginalise threats to the integrity of the established boundaries and hierarchies."

It could be that teachers too have been "remarkably resilient" and able to impose traditional teaching methods onto courses designed to be taught in more adventurous fashions.

Examination of the factor scores of the Year 12 students' responses reveals that there is a degree of polarisation evident amongst the students concerning the working conditions of the secondary mathematics teachers with 40% of the students having positive perceptions and 43% having negative perceptions. Parents' responses to a similar factor reveals that 64% have positive perceptions of the teachers' working conditions. In contrast, over 60% of the mathematics teachers disagree that teachers

have good conditions of employment. An explanation may for this disparity may be that the students and their parents perceive teachers employment conditions to be liberal in "harsh economic times" especially in the Western Region. One secondary principal has described teaching as "recession proof"; perhaps it is this aspect which students and their parents are focussing on.

In spite of salary increases awarded in early 1990, salaries remain an issue with the mathematics teachers and to a lesser extent the CSU-Mitchell students. There appears to be a degree of uncertainty amongst the Year 12 students and their parents concerning whether secondary mathematics teaching is a well paid profession. However, a significant proportion of both the Year 12 students and their parents disagreed that secondary mathematics teaching is a well paid profession. When asked to compare the salaries paid to secondary mathematics teachers with those available in other professions requiring tertiary mathematics, 89% of the teachers agreeing that the comparison was not favourable. A much smaller proportion of Year 12 students and their parents (32% and 26% respectively), agreed that the comparison was not favourable but there was a large proportion of both parents and students uncertain about the adequacy of remuneration.

Recommendation 9

That a critical appraisal of the actual salaries paid in other professions which require tertiary mathematics be undertaken to establish realistic comparisons with the salaries of mathematics teachers.

The results of this study highlight the crucial role that secondary mathematics teacher play in influencing school leavers to consider secondary mathematics teaching as a career.

The recommendations presented above have therefore focussed on:

- raising the status of mathematics teachers;
- developing a more appreciative valuing amongst all groups in the community of the worth of the work of the mathematics teacher; and
- providing a supportive management, curriculum and pedagogical framework for the mathematics teacher.

Some Limitations of the Project

Close scrutiny of the procedures followed in the Project has revealed some limitations associated with the data gathered and with the samples employed.

- Three of the four questionnaires used for the Project contained two lists of 12 occupations amongst which respondents were asked to rank the "secondary mathematics teacher". The fourth questionnaire for the CSU-Mitchell students did not contain these two lists. This occurred because of the Project Team's need to develop the CSU-Mitchell questionnaire rapidly so that it could be administered before the end of the 1990 Academic year. The decision to include the two occupation lists was made subsequent to the administration of the CSU-Mitchell students' questionnaire.
- The location of the two occupation lists at the end of the other three questionnaires may have been unwise. The possibility exists that the respondent's reading of the preceding Likert Scale items may have influenced their rankings within these lists. For this reason it may have been better to place the two occupation lists before the Likert Scale items.
- Data could have been collected on the Year 12 students' anticipated Tertiary Entrance Rank and achievement in mathematics.
- The sample of Year 12 students, their parents, and the mathematics teachers employed in the Project arose from the Project Team's decision to select a stratified sample based upon the population distribution of towns in the Western Region of the NSW Department of School Education. Other criteria, however, for the stratification could have been employed, for example socio-economic status.
- The Year 12 students and their parents who participated in this Project were residents of mainly farming or mining communities and thus it would not be valid to generalise the results and conclusions to the more diverse population of NSW or Australia. The Project Team made a deliberate decision not to seek demographic data from the parents regarding gender, age, level of education etc. This decision was taken in the belief that avoidance of seeking such personal data would increase the likelihood of the having the Parents' Questionnaire completed and returned.
- It is probably unlikely that the sample of mathematics teachers is representative of those in the State with respect to number of years they have been teaching mathematics. Nearly 60% of the 73 teachers had been teaching for 10 years or more (over 25% had been teaching for more than 15 years), with only 13.7% teaching for fewer than four years. The Project Team suspects that the Western region figures may mirror "favourable" teaching locations in the State although Western Region is not really regarded as a "favourable" teaching locality.
- The Project did not seek to elicit data from Year 12 students, their parents, or the mathematics teachers in Catholic or Independent secondary schools. Such data could be interesting given that only four of CSU-Mitchell's 69 B Ed (Sec Maths) students, and only one of the secondary

mathematics teachers surveyed, reported attending an Independent school.

CONCLUSION

The SeMTAC Project was conceived as a result of CSU-Mitchell's difficulty in attracting sufficient numbers of suitably qualified school leavers to its B Ed (Sec Maths) Course. Analysis of the data provided by the Year 12 students surveyed in the project, indicates that this difficulty is likely to persist for 1992 at least. Only 67 (9.4%) of the students involved in the Project indicated an interest in secondary mathematics teaching as a career. When the students' HSC course in mathematics were taken into account, however, 33 (or 4%) individuals were considering secondary mathematics teaching as a career.

If this number of students is representative of Year 12 students in all NSW schools, then institutions offering similar courses may be inundated with applications. It is, however, extremely unlikely that this proportion of students will end up in mathematics teacher education courses. An intake of 33 students of this calibre to the relevant course at CSU-Mitchell would constitute an infinite improvement, if this were mathematically possible! It would seem that the sample was biased in some way. This may be due to the publicity campaigns undertaken in the region, perhaps the effects of the current economic recession and perhaps the actual act of asking these students to consider a career in mathematics teaching.

Data gathered from mathematics teachers and CSU-Mitchell secondary mathematics teacher trainees suggest that a number of factors influence school leavers' choice with respect to a career in secondary mathematics teaching. Success in, and enjoyment of, school mathematics are two factors which have a strong influence. There is some hope in so far as more than two thirds of both groups indicated that their decision to enter a teacher preparation course was not a "last resort option". Teachers' salaries continue to be an issue for all groups for whom data have been reported. The data on the perceived status of "secondary mathematics teacher" is most certainly linked to this issue. The Project has revealed that, for a host of reasons, Year 12 students receive little or no encouragement to enter secondary mathematics teaching as a career.

The SeMTAC Project has provided some validation of speculated opinion on reasons for suitably qualified school leavers avoiding entry to a career in secondary mathematics teaching. Many more questions remain to be asked and answered.

Select References

Blair, D. (Ed.), (1982). The Pocket Macquarie Dictionary.

Department of Employment Education and Training. (1989). Discipline Review of Teacher Training in Mathematics and Science. Vol. 1,2,3. Australian Government Publishing Service, Canberra.

Empey, R. H. "The Greatest Risk: Who Will Teach?" Elementary School Journal. Vol. 85, No. 2, 1984.

Evans, R. H. (1986). "Why Potential Science and Maths Teachers Are Choosing Not to Teach and What We Can Do About It". Paper presented at the Joint Meeting of National Science Teachers' Association and the Association for the Education of Teachers in Science, San Francisco.

Horton, B., Oakley, J., McKinnon, D. H., Donaldson, P. and Jeffries, D., (1991). Factors Which Influenced Secondary Mathematics Teacher Education at Charles Sturt University to Choose Secondary Mathematics Teaching as a Career. Symposium session at AARE, Bond University, November.

Horton, B., Oakley, J., McKinnon, D. H., Jeffries, D. and Donaldson, P. , (1991). The SeMTAC Attitudes of Secondary Mathematics Teachers to Mathematics Teaching as a Career. Symposium session at AARE, Bond University, November.

Hoyles, C. (1985). "The Pupils' View of Mathematics Learning". Educational Studies in Mathematics. Vol. 13, No. 4.

Hoyles, C. (1985). "Snapshots of a Mathematics Teacher: Some Preliminary Data from the Mathematics Teaching Project". For the Learning of Mathematics. Vol. 5, No. 2.

McKinnon, D. H., Horton, B., Oakley, J., Jeffries, D. and Donaldson, P. , (1991). The SeMTAC Project: Factor Analysis, Reliability, Validity and Results Eventuating from Parent and Student Questionnaires. Symposium session at AARE, Bond University, November.

McKinnon, D. H. and Nolan, C. J. (1991). "Education in Change: Appraising the System". Unpublished paper related to Ph.D. thesis.

Midgley, C. et al. (1988). "Student / Teacher Relations and Attitudes toward Mathematics Before and After the Transition to Junior High School". Institute for Social Research. Michigan University, Ann Arbor.

Oakley, J., Horton, B., McKinnon, D. H., Jeffries, D. and Donaldson, P. (1991). The SeMTAC Project: Attitudes of Year 12 Students and their Parents to Secondary Mathematics Teaching as a Career. Symposium session at AARE, Bond University, November.

Pope, B. (July 1991). "Setting the Policy Agenda for School Education". A Background Paper presented at the "Educating the Clever Country"

Conference, Royal Australian Institute of Public Administration (A.C.T. Division) an Australian College of Education. Canberra.

Smithers, A. and Hill, A. (1989). "Recruitment to physics and mathematics teaching; a personality problem?" Research Papers in Education. Vol. 4. No. 1.

1 Anita Catalano, 'Crisis Fear over Maths and Science', Sun Herald, 27 January 1991.

2The research has been made possible by financial support from the Western Region Office of the NSW

Department of School Education.