PROVISION FOR NESB STUDENTS IN THE MATHEMATICS CLASSROOMS OF VICTORIAN SCHOOLS

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ABSTRACT

The task of teaching secondary©level mathematics in classrooms containing large numbers of non©English speaking background (NESB) students, has long been recognised to be a difficult one for any mathematics teacher. In this paper, we report on a pilot study investigating the range of strategies that have been adopted by schools. ESL staff were reported to be involved in some way in the learning of mathematics but more so in science, where the most common way they work with students is either in a team teaching mode or in a support capacity. Mainstream subject teachers were reported to be under resourced and in need of professional development in this area. Apart from some specific exceptions, the dominant pedagogy is that the study of mathematics itself, is essentially language free, or at least this belief lurks not far from the surface. Since the recent education budget cuts in Victoria, best practice schools reported that specific programs have been either diminished or dismantled entirely.

Key Words:© Mathematics Education, ESL students

INTRODUCTION

It has long been recognised that the task of teaching secondary©level mathematics in classes containing large numbers of non©English speaking background (NESB) students with different first languages is a difficult one for any mathematics teacher working in an English©speaking society. Catering for the needs of NESB students has been acknowledged to be a social justice issue by both Federal and State

Governments in documents such as A National Statement on Mathematics for Australian Schools, (1991), in the former Victorian Ministry of Education publications The Mathematics Framework : P©10, (1988) and in The Science Framework: P©10, (1987).

How to achieve greater participation for these students in mainstream mathematical and science classes has received increasing attention over the last decade and research is making an impact by clarifying the kinds of difficulties mathematics learners face when learning through a second language by exposing the cultural nature of the mathematics being taught and by commenting on the kinds of teaching practices which seem either to ameliorate or exacerbate the learners' problems (Bishop 1988, Cocking and Mestre 1988, Clarkson 1991, Sayers 1992 and Secada1992).

This focus on the learners' situation would appear to be at the expense of examining either the mathematics issues involved, or the impact on the teachers' practices. One consequence of this imbalance has been that `implications from the research' have been limited to `advice for teachers'. That in itself is no bad thing, and the book by MacGregor & Moore (1991) is without doubt the best example of this kind of advice, not only in Australia, but probably anywhere.

However, teachers are not autonomous professionals, and as is known, but all©too™seldom reflected in research, many other people affect what they are able to do and also what their students are able to do in class. The social dimension of mathematics education is one which researchers are only gradually coming to grips (Bishop, 1993). In particular, research has told us little about the roles and influences on mathematics learning of those in the schools who are not mathematics teachers. In this pilot study, we investigated the roles of three groups of teachers who influence NESB mathematics students' learning in secondary schools; mathematics, science and ESL teachers. We also report on some of the pedagogical issues that

teachers say influence
their teaching of NESB students in mathematics.

The broad aims of this study were to:
* identify the range of ways in which ESL staff, and mathematics and science faculties in schools are catering for NESB student's needs
* locate and characterise examples of best practice
* see if a need exists for further resource materials and professionaldevelopment to support mainstream and ESL teachers.

METHOD

All Melbourne metropolitan secondary schools with a NESB student population of >25% were sent a questionnaire seeking information on their provision for NESB students in mathematics and science in 1993. From an initial list of 115 schools or campuses that met this criteria, 66 responded (57%), and of these, 57 schools had ESL staff. The analysis reported here is based upon these 57 schools.

The ESL Coordinator was asked to report on the extent to which ESL staff worked with the mathematics and science staff, particularly in relation to specific practices; Joint Planning, Team Teaching, Integrated Withdrawal and Parallel Teaching. The framework for this question was largely taken from McKay & Scarino (1991) which details selected practices for ESL learning in schools. The mathematics and science Coordinators were asked to report on any specific programs and strategies adopted to accommodate NESB students and the level of professional development and awareness of staff on ESL issues. Eleven schools were subsequently followed up who indicated that they were implementing specific programs and practices for NESB students and who therefore were assumed to represent some of the best practice schools. When feasible, the ESL and maths/science Coordinators were interviewed at this time to obtain greater detail on their programs and strategies. Sometimes subject teachers who were involved in a major way with particular programs in the school were also a part of the interview process.

RESULTS

It is important in a study like this to not overgeneralise, particularly in view of the wide variation in provisions and practices. Just in regard to ESL staffing, the number of EFT (Effective Full Time) teachers ranged from 0.1 to 12.7 (keep in mind that zero ESL staffing schools were removed before tabulation). Furthermore, the number of NESB students ranged from 25©95% although no distinction has been made between the categories of language background in terms of newly/recently arrived students and other NESB learners. Student and staff profiles, school philosophies, historic precedent and current pressures (e.g. amalgamations) were other salient features that interweaved to affect the environment of the schools. The tables of results should be read bearing in mind not only that each school is unique but that all surveys have limitations and are set in a certain time frame.

ESL Involvement in Mathematics and Science

ESL staff were reported to be involved in some way in mathematics and science education in the majority of schools, but there was a difference in support between the two subjects. In nearly one quarter of schools no ESL involvement in mathematics was reported compared to only 7% in science (Table 1).

TABLE 1: Question: With respect to mathematics and science teaching/learning, have any of the following ESL approaches been adopted by the school as regular approaches to subject specific learning for some section of the school population, or at a particular year level?

TYPE OF ESL STAFF INVOLVEMENT	MATHS	SCIENCE
Joint Planning: The mainstream and the ESL teachers frequently jointly prepare materials for use in regular classes.	5%	19%

Team Teaching: The mainstream and ESL teacherstogether teach the one class of "NESB only" students some or all of the time.	4%	7%
Team Teaching: The mainstream and ESL teacher together teachthe one class of mixed NESB and English speaking background students some or all of thetime.	12%	19%
Integrated Withdrawal: The ESL specialist takes a group out of the mainstreamclass and integrates the ESL learning with the subject content.	4%	12%
Parallel Teaching: The ESL specialist teaches the mainstream program, or a modified program, to a group separated out of mainstream classes.	0	4%
At least one of the above Selected Practices	20%	49%
Other methods of involvement (see Table2)	63%	63%
No involvement	23%	7%

In terms of the implementation of any of the five selected practices the most commonly adopted involved ESL staff working with students in a Team Teaching situation (Table 1). From follow©up contact with eleven best practice schools, Team Teaching was becoming more difficult to plan for and maintain with the recent State Education budget cuts and was reported by two schools to have been abandonedentirely.

Since last year joint planning and team teaching has diminished to being near non©existent. The reason is lack of time, lack of free periods to organise such processes due to funding cuts (ESL Coordinator)

At the time of the survey, regular Joint Planning occurred as frequently as Team™Teaching in the sciences as might be expected, but was reported to be less frequent in mathematics. From both telephone contact and follow©up interviews with schools, the disparity appears to be due to ESL staff playing more of a support role in the maths classroom rather than being involved in the design of the course. It was pointed out though that ESL support could be far from a passive role.

In Pre©VCE it is more of a support role that we play. I listen for words that are used by the teacher that I think will be a problem for the students. I can stop the class at anytime and ask the teacher to elaborate on meanings or if there is need, I can bring in a work sheet with new vocabulary for the next lesson. ... I leave the academic side of the maths to the teacher and I support the language side (Pre™VCE ESL Team©Teacher).

The difference in support between science and mathematics was explained by science being more clearly identifiable as language©based.

In year 10 we send in aides or a teacher, more in science than maths due to more language being involved. We tend to support science more than maths, and I would say that is right throughout (ESL Coordinator).

From follow©up contact with schools another factor emerged to explain the difference in support between the sciences and mathematics that concerned the educational background of ESL staff who have a strong humanities background but a weak grasp of mathematical principles and concepts.

I know enough about maths to be able to have a vague guess at what they (students) are trying to say although sometimes I give up because I don't know enough (ESL teacher).

The educational background of ESL staff also had an impact upon the Year level where priority was given to mathematics.

At Year 7 it is relatively non©threatening, I mean even the English teacher who doesn't know any maths can cope with Year 7 maths basically. ... the higher up you get, the more difficult the cross faculty stuff becomes (ESL Team©Teacherspeaking about the schools priority program at Year 7).

An ESL Coordinator who was currently engaged in a regular Joint Planning program in the sciences also conveyed that one reason for avoiding a particular ESL Science resource book available was that it incorporated a consideration of the mathematicsin science!

Hence it takes time for ESL staff to develop both their knowledge and confidence in the mathematics and science areas. One of the consequences of having to prioritise ESL support due to the budget cuts has been the forgoing of specialist skills acquired by ESL staff.

it is just a ridiculous situation now, like we have got a person who really has the Year 12 physics course under her belt and was the person who originally would say `I can't do maths and science,' ... but she has actually gone in and learnt it, so she understands it well enough to be able to really effectively help the students and deal with the language demands of the subject. But we can't put her in there because there are more urgent priorities, (new arrivals) even though the class is full of ESL students. (ESL Coordinator)

The tendency to use ESL staff in a support role rather than as active Team©teachers was of concern to some Mathematics Coordinators who raised this in the form of a request for inservice provisions. They sought strategies on how to incorporate ESL staff more effectively in the classroom.

As with Team©teaching, regular Joint Planning required a supportive Time©tabler to enable strategies to be implemented. Otherwise ESL support occurred where it could be fitted in, e.g. helping subject teachers with wording of tests and assignments, putting up displays of mixed ability/ESL resources in the staffroom, providing interpreters at course information sessions and parent©teacher

interviews and raising
ESL awareness via faculty meetings.

Although a significant number of schools did not adopt any of the five categories for
ESL involvement, two©thirds of the schools did employ one or more other

practices
that commonly involved a support teaching role for ESL staff. A large proportion of
this support teaching was conducted by MEAs (Multicultural Education Aides) whoseinvolvement is addressed later in the text.

What the survey design was unable to deliver was the extent to which practices
occurred. Written responses on some questionnaires, follow up telephone
conversations and interviews with best practice schools, suggested that ESL support in
mathematics and science appears to be restricted or frequently occurs on an ad hoc
basis. The restrictions included the targeting of specific students with aides, the
targeting of particular year levels, (either Year 7 or Year 10) and the targeting of
senior classes when written CATs were due. The diminished ESL focus at senior
levels at particular schools was explained by one Science Coordinator to be due to a
perceived conflict between helping students get high marks at VCE level andlanguage concerns.

Mathematics and Science and the NESB Student

Staff Training Only a base©line indication of staff
expertise in a school in relation to
NESB students and subject specific learning was available from the survey as the
questionnaire did not ask for numbers of staff who had any specific training. The
number of schools with at least one ESL trained maths/science teacher was quite low,
and not quite half reported they had at least one maths/science teacher who had
attended a relevant inservice(s) (Table 2).

TABLE 2:

SURVEY QUESTION	MATHS	SCIENCE

Has any mainstream teacher currently teaching in maths/science had training in ESLteaching (as a method)?	18%	11%
Is any maths/science teacher currently using teaching strategies as a result of aninservice program on meeting the needs of NESB students?	45%	47%
Do ethnic aides and/or volunteer parents form part of any program toteach maths/science to NESB students?	42%	40%
Does the maths/science faculty provide bilingual lessonnotes to students?	2%	12%
Does the maths/science faculty undertake any systematic assessmentof students language difficulties and needs?	7%	5%
With thematths/science faculty is it policy or routine practice to select student textscarefully for:		
(a) the level of language difficulty?	91%	91%
(b) The cultural diversity reflected in thecontent and/or format?	61%	56%

Some Coordinators made specific mention of one or more staff attending the professional development program "ESL in the Mainstream." From the follow up contact with schools, genuinely positive remarks were made about this program.

It opened my eyes to the dilemmas faced by these students. Like how the students think about things, like the Vietnamese will say `yes' to you when they want to indicate they are listening to you rather than saying `yes' I will do that or `yes' I can do that. I repeat myself and ask them to explain to show they understand (Mathematics Coordinator).

It was pretty intense, three hours each week and a couple of days for commitment. ... Basically teaching us what it would be like to be an ESL student and therefore you are more aware. Anything you can do to help ESL students is obviously going

to help the others clarify things, to break it down into, you are not going to waste your time. I found like understanding how they learnt, like they pick out key words and this meant I could use key words to my advantage, and I could expand it, get them to use their knowledge (Mathematics Teacher).

However, there was a note of caution expressed as to the impact `ESL in theMainstream' was having on teachers.

What I think teachers have taken on from ESL in the Mainstream is the most superficial aspects of it rather than the larger set of things, like approaches and strategies. ... My big worry with maths teachers is that they have learnt that they have to deal with the maths specific vocabulary, but I don't think they have an awareness of the everyday language as much, ... the little words, the signal words like `so' and `however', prepositions that signal changes in direction of the sentence. ... The problem with that is that they may be deluded into thinking they are meeting the language needs of their students. (ESLCoordinator)

More than 90% of mathematics and science Coordinators said their staff would definitely benefit from further professional development in regard to teaching NESB students. A sample of the inservice requests included: Resources for working with NESB students whose mathematical knowledge was very good but their proficiency in English was poor; Resources for working with mixed ability classrooms where NESB students' mathematical knowledge varied from mid©primary to senior levels but whose English language skills were at similar low levels; Input from a case©study of an integrated curricula approach; How to teach other staff strategies that you want to share; How to effectively use resources that are available in the school; How to bring the ESL and maths/science faculties together; and information on how students were schooled in their own countries.

For a few Coordinators, professional development was not an issue because they said NESB students did not have major problems with mathematics. For example, the issue was "not viewed as important," or "it lacked priority, since it was fortunate that apart from worded problems, a lot of maths involves little language" and "it is a very minor problem and as a result there are little or no resources". From follow©up contact with schools, a small number of the recent arrivals were said to be quite proficient at maths and "often got quite bored."

Multicultural Education Aides (MEA)

The use of Education Aides was reported to be present in 40% of schools in maths/science both in and outside the classroom, and was hence one of the main practices used by schools to target NESB students (Table 2). Other occasional duties for MEAs included writing bi©lingual lesson notes and translating tests. Follow up contact with schools did suggest that one outcome of using aides in the classroom would be to reduce the need for subject teachers to alter their teaching practices for NESB students. This impression fits with comments made by some maths Coordinators that they saw the problem in terms of individual student needs. Furthermore, professional interaction between MEAs and teachers can be hampered by cultural factors. One ESL Coordinator explained that MEAs would feel they were stepping outside their role if they provided critical feedback to the subject teacher. In response to a question as to whether there were times when they thought the teacher could be more effective with their language,

`Yes, sometimes think of them, but would never ... don't dare to say [laugh] (MEA)

Special School©Based Programs

Special school©based programs to meet the needs of NESB students were reported to have been developed in approximately half of the schools (Table 3).

These programs

ranged from being major school policy initiatives such as a Pre©VCE program or
some other ESL©only Year level class, to informal arrangements by individual
teachers for helping students at lunchtime and after school.

The Pre©VCE program was initiated in 1990 when it was piloted in four schools. The
aim of the course then was to prepare recently arrived ESL students for
the VCE who had Year 10 equivalent schooling. Mathematics and science
were a part of this

TABLE 3: QUESTION: Are there any special programs that have been
specially developed to cater for theneeds of NESB students?

	MATHS	SCIENCE
Pre©VCE course	18%	18%
After school help	21%	21%
Cross©age or peertutoring	7%	11%
Other	47%	42%

course. Eight of the eleven follow©up schools had a
Pre©VCE and considerable
diversity in the course offered under this umbrella name was revealed. Three schools
maintained the Pre©VCE in its original form as a separate year or semester. In two of
these schools staff indicated there was some difficulty enrolling students as they
tended to perceive the course to have lower status than VCE and to be too similar to
Year 10. The other six schools did not convey that they had a problem getting
students to do the Pre©VCE and in these schools some flexibility had been introduced
into the course. For example, students could enrol in one or more VCE subjects,
usually mathematics and Australian Studies, while completing Pre©VCE English and
science studies. This flexibility was sometimes part of a whole school strategy that
also allowed Year 10 or 11 students to enrol in Year 11 or 12 studies, and again
students usually chose mathematics as one of their advanced studies. Concurrent

enrolments as a practice has not been adopted without some contention, and there is
some irony in the debate.

One ESL Coordinator commenting on the strength of their concurrent enrolment
approach pointed out that allowing Year 11 ESL students to do Year 12 mathematics
provided them with an understanding of what was required at Year 12 in terms of, for
example, report writing. A member of the Mathematics Faculty had a

concern with
the concurrent enrolment approach which was based on the argument that
mathematics is language©based.

What we have happening is they are doing Year 10 English but
Year 11 maths.
They might still do well, but they don't do as well as they could do, they certainly
don't have the understanding that they should have. Given they are still going to
be in the school the next year after, and maths is so important to do well in, they
should seriously be thinking of doing it when their language is at its best. ... If I
look at my students from last year, yes they did well, they coped, but
they would have done better, a lot better if they had waited.
(Numeracy Coordinator)

In the follow©up schools, mainstream maths/science teachers (some with and without
ESL training) were mainly found to be still responsible for the planning of Pre©VCE
classes in conjunction with the ESL faculty but was not always the case. The ability
to maintain two teachers in each class, an ESL and a subject specialist, was becoming
increasingly difficult too, and increasingly did not occur. Team©teachers were usually
an over entitlement and so allocation to other classes would occur on a
priority basis. This situation of unstable staffing levels
was reported to be making planning
increasingly difficult and as a consequence the quality of the
maths/science Pre©VCE course had declined.
Of those schools who indicated in 1993
they were running or
about to run a Pre©VCE course in maths/science, a follow up found two
schools had cancelled their maths/science program due to funding cuts.

While no school spoken to had formally evaluated their Pre©VCE, senior staff from two schools had given the idea serious thought and believed that the outcome would reveal some very beneficial results.

Apart from the Pre©VCE, other separate year level classes for ESL students appear to be on the increase. This strategy was reported to be a consequence of staffing cuts as there were not enough staff to cater for ESL students in different classes. Staff were quite sensitive to choosing this approach.

This year we put in for a separate class, a specific class for students who have severe language learning difficulties. So it is not streaming in a sense, and it is really hard to talk about that because everyone is `Oh streaming.' It is not that. This is an entirely different situation when someone is 19 years old and struggling to count by 3's. (ESL Coordinator)

We had our ESL staffing cut by half. And last year it worked out that 7A and 7B were ESL classes, that meant (both) ESL and non©ESL students were in there (together), so the make©up was half and half. 7A and 7B would get ESL support wherever they could. Because of the cuts, teachers can't go into both classes they only go into 7A. To ensure ESL students get the resources available there are no longer any (ESL students) in 7B, they are all in 7A. So what we have done across the board is make 7A,8A,9A,10A,11A,12A the ESL classes. Educationally unsound, I don't know. (ESL Coordinator)

The visibility of ESL students in mainstream maths/science classes can still be an issue despite the ESL faculty having lists of students. This finding highlighted the level of communication in some schools between the faculties.

Students can go unnoticed much longer in maths/science than in the humanities where written work is more prevalent. (ESL Coordinator)

An interesting point of contention in terms of strategies that emerged from follow©up contact with schools was the encouragement of ESL students at certain times to use their first language when discussing the meaning of English vocabulary with a partner. This practice was used by two mathematics teachers who said they had discovered this to be a process that worked as the students English and first language skills had both subsequently improved. One Pre©VCE ESL mathematics teachers, however, indicated she actively discouraged this practice by placing students with partners from different countries of origin to ensure they only spoke in English. When raised as a possible strategy with other teachers, concerns were raised that the practice would prevent students from learning English. Recognising the significance of the students first language in their learning of a new language per se can ultimately enhance their level of confidence and is likely to have beneficial effects on their mathematics learning (Bishop 1991, Cocking & Mestre 1988).

CONCLUSIONS

The ESL response indicated that ESL involvement is most likely to be of a support nature with staff going into the mathematics classrooms rather than a partnership arrangement of shared responsibility, ie joint planning and team teaching. ESL classroom support is designed to assist the individual student but by its very nature, and by the qualifications of the majority of personnel involved, it is likely to have little or no effect on the way the subject teacher teaches the class or assesses student progress. ESL and mathematics staff also appear to operate from different pedagogical frameworks and so the problem is compounded through inadequate communication between the Mathematics and ESL Faculties.

The subject teachers ability to cater for a wide range of NESB students is much more likely to be a result of pre©service or inservice training aimed at

providing teachers
with language learning strategies which can be incorporated into their teaching
methodology and be applied at the planning stage of course design and delivery. The
high level of interest in professional development conveyed via the questionnaires is
encouraging but from follow©up contact, severe time constraints on teachers through
the recent budget cuts has dampened enthusiasm.

A few of the schools have mathematics and science staff with ESL training and nearly
half have staff who have been inserviced to meet the needs of NESB students, but
they are in the minority. A small but significant number of Coordinators reported that
staff are not aware of the issues, needs and teaching strategies appropriate for NESB
students in their classes. More importantly, there are indications that the issues have
not been addressed by whole faculties but only by particular staff, if at all.

I use strategies in the classroom that I've learnt from
inservices but I am not sure about other teachers (Science
Coordinator)

The higher involvement of ESL staff in the sciences compared with mathematics was
apparent through the investigation of selected practices and in terms of the extent to
which ESL staff said they were not involved at all in mathematics. The apparently
lower involvement of ESL staff in mathematics compared to science education is a
reflection of a number of issues, a lack of expertise and confidence in this area by
ESL teachers themselves and perceived less need by mathematics teachers.

There is some broader evidence to support the position that NESB students generally
have fewer problems in mathematics than non©NESB students from recent VCE
studies. Asian background students were relatively over©represented in the 1992 Space
& Number, Change & Approximation Studies, (Student Participation in the
Curriculum, Years 11&12, 1992) and the 1992 ESL students out©performed non©ESL

students across all six VCE mathematics Studies, even in CATs that required written reports (Rowley et al., 1994). However, NESB students and

those able to obtain ESL status are by no means a homogeneous group. Language proficiency or cultural and socioeconomic differences between ethnic groups are not factors that can easily be extracted from this type of data. We do know that the actual dispersion (s.d.) in the 1992 VCE mathematics scores of the ESL students exceeded those of the non©ESL students in the large majority of CATs, (Rowley et al., 1994), indicating that variability in performance of ESL mathematics students is greater than for the non™ESL mathematics learner.

The main conclusion which can be drawn from this initial research is that the most common way in which ESL staff are involved in mathematics and science education, and the development of special programs such as the Pre©VCE, will not affect the education of the vast majority of NESB students. Recent arrivals from non©English speaking countries will benefit in some classes in some schools. This means that most NESB students must rely solely on the expertise of the subject teacher. For this reason a concentration of effort on the professional development of mathematics and science staff and the development of support materials seem to be essential to increase the access and success of NESB students in these subject areas.

The results suggest that despite there being concrete initiatives being made in a number of schools to provide for the needs of NESB students in maths/science, the importance of this issue, like that of gender, has not really been fully appreciated todate.

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