

Bilingual Students and Tertiary Mathematics

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Figures relating to bilingual students' participation in mathematics in Australia tend to treat them as a group, labelled non-English speaking background (NESB). This ignores their cultural and linguistic diversity and that the over-representation of some groups could hide the under-representation of others. This paper briefly reviews some of the research on NESB students and mathematics and discusses some work in progress that is trying to give a more accurate picture of NESB students in tertiary mathematics in Victoria.

Introduction

NESB students studying tertiary mathematics include those born in Australia who speak a language other than English (LOTE) at home, immigrants from countries where a LOTE is the normal means of communication, and some overseas students. All of these students are bilingual in that they use at least two languages in some situations. Their proficiency in both the LOTE and in English can vary considerably.

These students come from many different backgrounds as in recent years patterns of immigration have changed significantly. In 1966-67, immigrants were predominantly from the United Kingdom, Ireland and Europe. By 1989-90, immigration from the United Kingdom and Ireland was about a third of the 1966-67 number. There was a significant increase in arrivals from New Zealand, and European migration had been supplanted by migration from Asia (Borowski & Shu, 1991).

Since the 1970's the pattern of migration has changed in other significant ways. The demand for unskilled labour in Australia lessened

and wars in Asia and other parts of the world led to an increase in the number of refugees. Recent migration has tended to fall into three categories—family re-union, refugee or economic. Under family re-union a steady stream of close relatives of families already settled in Australia has continued. Refugee and economic migrants have resulted in an increase in the number of people from Asia and other parts of the world that have not been traditional sources of immigrants in the past. In recent years this has included people from Ethiopia and Somalia for example. Recent migration has also been characterised by much higher levels of education. Borowski and Shu (1991, p.40) note that 'immigration to Australia is on a selective basis' and that there has been a rise in the number of immigrants classified as professional or skilled.

Amongst the non-English speaking background (NESB) groups there are some very stable groups exemplified by the Italian and Greek communities of Melbourne. These groups are characterised by established cultural and welfare support networks. On the surface at least, Australia has achieved a stable multicultural society and an education system that caters for linguistic and cultural diversity.

There is very little evidence of how well Australian mathematics education caters for such a linguistically and culturally diverse society. The current study grew out of a concern that by reporting NESB students' participation in mathematics based disciplines in schools and the tertiary sector, little account was taken of factors other than NESB. There was anecdotal evidence, supported by some limited data, that NESB students born in Australia have not been achieving as well as their ESB peers in schools. If this is the case, it is possible that good

representation by NESB students is being achieved by over-representation of students born overseas. The picture is complicated by full-fee paying overseas students.

The Current Study

The current study has two parts. The first is designed to give a picture of the linguistic and cultural background of students participating in tertiary mathematics in Victoria and preliminary results are discussed here. It was also hoped that this part of the study might provide further evidence for or against Cummins' theories of bilingual students. It has been contended elsewhere that this needs to be taken account of in language policies both in Australia and overseas (Thomas, 1995).

The second part is at a very preliminary stage and involves interviewing NESB students who are successful in their tertiary mathematics study in an attempt to identify the factors from school, university and home that they perceive as having helped them.

The first part of the study has utilised a questionnaire. The number of different ethnic groups in Victoria is such that a large sample was necessary. This also meant the study had a number of limitations. The questionnaire had to be easily administered to students and it needed to be relevant to ESB and NESB students. With the exception of one university where there was a specific request for some additional questions to be added it was confined to a single page. The questionnaire asked for name and student number, faculty, where the student was born, last school attended, and what languages were spoken, written and read. These latter questions, especially the one relating to what was read, were an attempt to assess how literate students were in English and LOTE.

Large samples were collected in 1991 and 1994. The students who commenced first year mathematics in 1991, with the

exception of a small group from pilot schools, had completed year 12 mathematics prior to the introduction of the Victorian Certificate of Education (VCE). The 1994 cohort was the last group prior to a revised VCE mathematics. The introduction of the VCE saw more obvious language demands placed on mathematics students in the form of projects and other assessment tasks that clearly required something other than symbolic manipulation. As linguistically demanding tasks were a feature of the new VCE in all subjects, it was not expected that this would affect students' participation in year 12 mathematics. This has been found to be the case with the number of students enrolled in mathematics increasing between 1990 and 1993 (Ainley, Robinson, Harvey-Beavis, Elsworth & Fleming, 1994).

Participation of NESB students in mathematics

Williams (1987) claimed that NESB students were not disadvantaged in education with some unequivocal statements that there has been an accumulation of fact suggesting quite clearly that the children of immigrants achieve levels of participation in education above those of the majority. He did acknowledge some disadvantaging effects of ethnicity on achievement which he considered probably due to language problems. He also found that year 12 completion rates for NESB students were higher, certainly for majority groups, largely Greek and Italian immigrants.

Williams is supported by other data, including the yearly census of NESB students collected by the Victorian Ministry of Education. These figures consistently show an increase in the percentage of NESB students at each year level, peaking at year 12 (for example, see Directorate of School Education, 1993). This data does not show what they are participating in nor whether they are then going on to the courses of their choice and succeeding in them. An earlier study

showed the 'relative failure of students from Asian and European family backgrounds to achieve their first choice of institution 'although their overall participation in tertiary education was satisfactory (Anderson, Boven, Fensham & Powell, 1978, p. 251).

Studies such as these suggest that NESB students are doing well. In mathematics there is some contradictory evidence. The NSW testing program clearly showed that NESB students were achieving below ESB students. In a thoughtful analysis of this program Davies (1990) demonstrated that there was a problem for NESB students in mathematics related to their language skills. This supported Vlahonasiou (1981) who found Greek and Italian speaking students up to 18% behind their ESB peers on similar tests. There is no evidence to suggest that these students then start achieving at the same level as their peers in the final years of school. If anything, there is evidence both here and overseas to suggest that the gap may widen.

Leder, Rowley & Brew (1995) document the high achievement in mathematics of NESB students who have been in Australia less than seven years while noting that there were also a number of these students who do not perform well. Their study confirms the inconsistent results for bilingual students of mathematics. Clearly some are doing very well but it is also clear that many are not. Cummins theories in regard to bilingual students may provide some of the answers but a number of other factors are also operating including culture, parental background and socioeconomic status.

a	Both parents born in Australia	102.8	53.5%
b	Both parents born overseas, same country, ESB	7.4	3.8%
c	Both parents born overseas, same country, NESB	38.5	20.0%
d	Both parents born overseas, different countries, ESB	1.7	0.9%
e	Both parents born overseas, different countries, NESB	5.1	2.7%

This accounts for 81% of the 15-17 year-olds sample and assigning those in row (a) as ESB, gives 23% NESB and 58%

Predicting the composition of first year tertiary mathematics cohort.

To discuss the participation of the different groups in mathematics it is necessary to develop a theoretical model for what the population of first-year university mathematics students would look like if it reflected the ethnic composition of the population of about that age. There are two components to this—the balance of ESB born in Australia, ESB born overseas, NESB born in Australia and NESB born overseas—and the balance of ethnic groups within the NESB population. Predicting the NESB population is not simple and a number of measures have been used over time by various agencies. The approach adopted here is that the most reliable measure of whether students have grown up in a bilingual situation is to use data relating to their parents.

The students who studied first year mathematics in Victoria in 1994, should be largely representative of the 15-17 year old group in the 1991 census (Australian Bureau of Statistics, 1993). This group comprised 192.3 ('000) which gave the following results for Australian and overseas born:

Australian born	165.8	88.1%
Overseas born	22.5	11.9%
Not stated	4*	

* Allocated to stated categories on basis of those figures.

Recent immigration has tended to be about 70% NESB and 30% ESB. On this basis, about 8% of the sample were NESB, born overseas.

An estimate of the NESB students born in Australia in the sample can be made from data relating to their parents.

ESB. If the remaining 19% (comprising those with one parent born in an NESB country, unidentified birthplace for

parents etc) are assigned on the basis of these figures, the total NESB is 28% and ESB is 72%. This is consistent with data collected from schools which usually shows somewhere between 25-30% but higher than that suggested by the census.

For the total 12-25 Victorian population, the census found NESB was 23% although 33% had at least one parent born in a NESB country (Australian Bureau of Statistics, 1993). While the wording of the census questions relating to languages spoken was fairly unambiguous (Castles, 1991) the guide for completing these questions which used the phrase 'the language you use *most* to communicate in at home'. (Australian Bureau of Statistics, 1991, p. 17) would probably underestimate NESB students who at age 15-17 now interact mainly in English in their peer group and with siblings but who may have begun schooling with little or no English. On the other hand the data on NESB students collected by the Victorian Ministry of Education where NESB is defined as born in a NESB country or born in Australia with one or both parents born in a NESB country will tend to overestimate NESB students. Many NESB students born in Australia and overseas grow up in an environment where English and a LOTE are used on a regular basis and none of the data appears to estimate the extent to which this occurs.

From the census data, and given that the retention rate for NESB students has tended to be good with the percentage of NESB tending to increase with year of schooling, the estimate of about 28% NESB and 72% ESB for year 12 seems reasonable. From census and immigration data, it can also be assumed that about 8% of the NESB sample was born overseas and 4% of the ESB sample.

Designation	Number	Percentage	Predicted on census data
e	956	54	68
e1	99	6	4
ne1	526	29	8
ne2	200	11	20

Comparison with data collected from students studying mathematics in 1994

Students were assigned to four categories:

Born in Australia, ESB	e
Born overseas, ESB	e1
Born in Australia, NESB	ne2
Born overseas, NESB	ne1

Students were designated ne2 or ne1 if they recorded that they spoke a LOTE 'everyday' or 'nearly everyday' and on where they were born. A few were designated as 'e' where there was no collaborating evidence that they were NESB and some evidence that they were studying the language concerned (for example, an anglo name using Japanese regularly and doing an Arts/Science double degree). A few indicated that they were studying the language concerned.

It is likely that this process overestimated the number of ne1 and ne2 students as some are likely to be growing up in an environment where English is used regularly and may be the dominant language. This could be particularly true for groups such as the Sri Lankans where those migrating tend to have high levels of education achieved through English.

Results

1784 questionnaires were returned where e, e1, ne1 or ne2 could be designated. There was a reasonable return of questionnaires from all institutions with the exception of Monash. In general 1994 was a very difficult year for distributing questionnaires in universities as processes relating to the evaluation of teaching meant that students faced many questionnaires throughout the year. In summary:

This raw data should be treated with considerable caution as no allowance has been made for full-fee paying students. The breakdown of the main LOTE speakers is however interesting. These students were largely from those who would have been in year 8 in 1989 and year 12 in 1993. The data from the Ministry of Education schools relating to the number of LOTE speakers for these years and the corresponding numbers from the first year mathematics students in 1994 is shown below.

	Year 8 1989	Year 12 1993	ne2 1994	ne1 1994	TOTAL 1994
Greek	1585	1043	57	8	65
Italian	1020	527	51	3	54
Vietnamese	564	693	0	134	134
Macedonian	548	467	15	4	19
Chinese	526	593	9	185	194
Turkish	366	227	4	9	13
Arabic/Lebanese	366	306	11	16	27
Maltese	353	100	7	0	7
Spanish	258	231	2	14	16
Croatian/Serbian	250	322	11	6	17
Polish	97	103	4	7	11

Higher education statistics (Department of Employment Education and Training, 1993) suggest that it is likely that the only full-fee paying non-residents in these groups are Chinese speakers. Further figures are being sought but approximately 50% of the Chinese speakers could be non-residents. The net result is that Vietnamese and Chinese students are over-represented, especially in comparison to Greek speakers. The table also suggests some other groups may be particularly at risk of under-representation in mathematics based tertiary courses. The figures for Maltese speakers for example suggest many may not even be getting to year 12 and few are studying mathematics at tertiary level.

The backgrounds of high achieving first year tertiary mathematics students at one of the major universities has been found to be even less representative of the model predicted by the census data.

The languages listed are those where there were one hundred speakers or more in the year 12 sample. There are many smaller language groups not listed. The year 12 figures do not differentiate between those born in Australia or overseas so need to be compared with the total of ne2 and ne1 students studying tertiary mathematics in 1994.

NESB students born overseas are more over-represented and NESB students born in Australia more under-represented. The high achieving students appear to show some support for the Cummins hypothesis in that bilinguals in this group show high levels of literacy in both English and LOTE.

Conclusion

Preliminary results relating to the participation of NESB students in tertiary mathematics in Victoria show the need for caution in treating these students as a group. It would appear that high participation comes from students born overseas, not from NESB students born in Australia. Given the difficulties some universities have experienced in finding sufficient candidates for engineering and science courses in recent years, the figures highlight how important recent immigrants are to the scientific and technological health of

Australia. They indicate that much more needs to be done to ensure that NESB students born in Australia receive an adequate mathematics education. While support for Cummins' theories are so far limited in this study it does re-inforces the need for those concerned with the mathematical health of Australia to pay attention to language policy. As it has been argued elsewhere: 'Teaching Japanese to students who are already only semi-literate in two or more languages is a nonsense' (Thomas, 1994).

Most importantly these preliminary results indicate the danger of reporting participation data in a linguistically and culturally diverse society without close analysis of who is participating and in what they are participating.

References

- Ainley, J., Robinson, L., Harvey-Beavis, A., Elsworth, G., & Fleming, M. (1994). *Subject choice in years 11 and 12*. Canberra: Australian Government Publishing Service.
- Anderson, D. S., Boven, R., Fensham, P.J., & Powell, J.P. (1978). *Students in Australian Higher Education: A study of their social composition since the abolition of fees*. Sydney: University of New South Wales.
- Australian Bureau of Statistics (1991). *General inquiry guide: Census 1991*. Canberra: Author.
- Australian Bureau of Statistics (1993). *Victoria's young people*. Canberra: Author.
- Castles, I. (1991). *How Australia takes a census*. Canberra: Australian Bureau of Statistics.
- Davies, A. (1990). *Evaluation of the New South Wales 1989 basic skills testing program*. Melbourne: N.L.I.A. Language Testing Unit, The University of Melbourne.
- Department of Employment Education and Training (1993). *Selected higher education statistics*. Canberra: Author.
- Directorate of School Education (1993). *Summary statistics, Victorian Government schools*. Melbourne: Author.
- Leder, L., Rowley, G., & Brew, C. (1995). Second language learners: Help or hindrance for mathematics achievement. In R.P. Hunting, G.E. Fitzsimons, P.C. Clarkson & A.J. Bishop (Eds.), *Proceedings of the ICMI Regional Conference on Regional Collaboration in Mathematics Education* (pp. 425-434). Melbourne: Monash University.
- Thomas, J. (1994). Bilingualism, mathematics and a touch of politics. Paper presented at the 38th Annual Meeting of the Australian Mathematical Society, University of New England, Armidale.
- Thomas, J. (1995). Bilingual students and their participation in tertiary mathematics. In R.P. Hunting, G.E. Fitzsimons, P.C. Clarkson & A.J. Bishop (Eds.), *Proceedings of the ICMI Regional Conference on Regional Collaboration in Mathematics Education* (pp. 703-712). Melbourne: Monash University.
- Vlahonasiou, T. (1981). *Reading and number performance of Greek and Italian students*. Melbourne: Australian Council for Educational Research.
- Williams, T. (1987). *Participation in education*. Melbourne: Australian Council for Educational Research.