1982

The mathematical background of primary teachers in the Illawarra Region, 1962-1981

Dianne Snow
University of Wollongong

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THE MATHEMATICAL BACKGROUND OF

DIANNE SNOW

NOVEMBER, 1982

Submitted to the Department of Education, in partial fulfilment of the requirements for the award of a Bachelor of Arts (Honours) Degree.
"...so that he got out his pen-knife, and was trying experiments upon the sentence, to see if he could not scratch some better sense into it.—I've got within a single letter, brother Toby, cried my father, of Erasmus his mystic meaning.—You are near enough brother, replied my uncle, in all conscience.

—Pshaw! cried my father, scratching on, —I might as well be seven miles off.—I've done it, —said my father, snapping his fingers.—See, my dear brother Toby, how I have mended the sense.—But you have marred a word, replied my uncle Toby.—My father put on his spectacles,—bit his lip,—and tore out the leaf in a passion."

(From L. Sterne's The Life and Opinions of Tristram Shandy. Gentleman, 1759.)
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CHAPTER 1

The Problem in Context
Concern with the educational preparation of teachers in Australia is not a new phenomenon. The Western Australian Jackson Report of 1897 (1), the Victorian Director of Education's Report of 1902 (2), and the New South Wales Knibbs-Turner Report of 1904 (3), all indicated that the prevailing pupil-teacher system of education was inadequate, and recommended that teachers be trained professionally in institutions provided specifically for that purpose. With the establishment of permanent teachers' colleges in all Australian States by 1915 (4), it became clear that certain educational standards were required from any person preparing to teach in Government schools. The fact that these educational standards may alter over time does not vitiate the general concern with the quality of the preparation of teachers (5).

One such manifestation of concern was the introduction of a system of teacher certification based on appropriate performance in an examination (6). Two of the subjects common to these examinations over time in New South Wales are Grammar or English, and Arithmetic or Mathematics (7). New South Wales' Primary School Syllabuses show English and Arithmetic as the two subjects which have been consistently allocated the most amount of contact time per week (8). Because English has perpetually been rated the most contact time in all Syllabuses since 1916, it is not surprising that a major aim of New South Wales State education has been the 'inculcation' of literacy in the child (9). This has been stated explicitly - "English is the basis of the curriculum" (10) - and implicitly, as shown by recommended time allocations (11). Within the New South Wales Primary School Syllabuses, Arithmetic has always served a narrower functional purpose:
...the pupil should be able to...carry out the most common calculations of trade and business (12).

The overt vocational implications within this statement were, however, directed primarily at male students. Female students were guided into other vocations, and the Syllabuses attempted to direct this 'education for citizenship' by limiting or substituting the types of knowledge available to students of each sex:

...in Girls Departments, where a wide range of mathematical study is not so important as in the case with boys, and where studies of domestic concern claim particular attention, less time should be devoted to mathematics (13).

While females were not theoretically precluded from the study of any aspect of mathematics at State schools in New South Wales after 1925, different expectations in mathematics for each sex has become almost traditional (14).

Although minor variations have occurred in the content for primary school mathematics courses in New South Wales, it is only quite recently that anxiety about the subject has been displayed. Perhaps the major reason for this concern is awareness about the increasingly technological nature of our society, particularly since the 1960's. With this rapid technological development acting as a social stimulus towards the assessment of mathematics, attention has also been drawn to the nature of the mathematics being taught in schools - especially its applicability to society and the individual (15). Mathematicians and educators alike have generated a noticeable amount of commentary on the importance of understanding mathematics:

It is essential that children should understand as fully as possible the mathematics they are asked to learn (16).

These broad considerations of the 1960's soon crystallised into what has become a debate about the numeracy of teachers. A
comparison of the following three statements, all arising at the same Conference, gives an indication of this conflict. In 1975, participants of an A.C.E.R. Conference agreed "that the broad preparation given to the teacher of primary school ages should include a strong component of mathematics" (17). The Summary of the Working Groups' Report took this one step further:

Teachers are now generally familiar with the content areas of present curricula in mathematics (18).

Professional mathematicians at the same Conference, however, disagreed strongly with the Working Groups' opinion:

As a general rule, most of the sort of people who become primary school teachers are already averse to the intellectual rigour of mathematics, if not downright deficient in it (19).

It is a matter of importance that none of these opinions are evidenced, because within Australia there seems to wide acceptance in many quarters, of the view that primary teachers are indeed 'deficient' in mathematics.

The recent Report of the National Inquiry into Teacher Education appears to have accepted this idea, with the recommendation that "candidates for entry to pre-service courses (to primary teaching) should meet specified literacy and numeracy standards" (20). The implication here is that if candidates were sufficiently numerate in the first place, a standard for numeracy upon entrance to teacher education would be redundant. A concurrent New South Wales Report is more explicit in its acceptance of the presumption that primary teachers are mathematically deficient:

Many teacher education students would appear to have a limited background and a lack of confidence in mathematics (21).
It is also noticeable that what began as a concern with the general idea of 'deficiency' has, by 1980, expanded to incorporate features such as attitudes and background.

As well as those discussed previously, two other recent Reports utilise these ideas in a more extensive view of the numeracy of teachers. The rationale in both Reports for dissatisfaction with the competence of primary school teachers stems from an overwhelming concern about the numeracy of all Australians. Primary school teachers are viewed as educators who must lay the foundations for attitudes and knowledge in all students, and are thus also viewed as instruments who should effect desired change. The Australian Association of Mathematics Teachers' document states:

The Australian Association of Mathematics Teachers concurs with the Auchmuty Committee, and expresses its concern that teacher education, and mathematics teacher education in particular, must be viewed as a matter of national concern. The Association recognises that the effective teaching of mathematics is of fundamental importance to the continued existence and development of Australian society. The economy of the nation is dependent on a science-based technology, and this technology requires for its maintenance and development a steadily increasing level of mathematical, scientific and engineering knowledge from a significant proportion of the workforce (22).

The Myers' Report is the result of a national inquiry into the technological nature of Australian society. The mathematical education of primary school teachers was perceived as one aspect related to technological change within Australian society. Two basic assumptions of this Report are that teachers' attitudes affect students' attitudes, and that the knowledge held by teachers influences the knowledge attainable by students:

In particular the Committee noted and is concerned about the apparent lack of mathematical training of new primary-school teachers. If, as is commonly
accepted, many of the basic skills and inclinations towards subject areas are imparted in primary education, then a situation in which a high proportion of teachers has meagre mathematics education is likely to lead to a weakness on the part of their pupils in quantitative and analytical skills (23).

The current situation is assessed by both Reports as inadequate:

On reviewing courses in teacher education offered throughout Australia, we express concern at the level of mathematical competence of students both entering and graduating from such courses (24),

and

While the Committee would not wish to take an extreme position, it does believe that the present proportion of teachers with little mathematical education is too high and that attention should be given to changing the situation (25).

Because both Reports recommend changes in the present teacher education systems, it would seem both useful and important to examine the criterion used by each to arrive at the conclusion of 'inadequate'. Both documents relate competence and ability to the level of mathematics studied by teachers. The A.A.M.T. purportedly examines current teacher education programmes, although details are not included in the document itself. Any reader would thus have difficulty in gauging the feasibility of this assessment for the current situation. The Myers' Report, however, uses research commissioned for the Report to give evidence which pertains to Victoria:

Since 1976 the numbers of students entering primary-teacher training have fallen from 2038 to 1381 in 1979, but even so the proportion with no mathematics remained nearly constant. At the same time the standard of the entering students as measured by results in the higher school certificate examination as a whole fell significantly (26).
Both Reports also suggest that a level of competence is equable to levels of prior training. The A.A.M.T. document is concerned with such levels at two stages - upon admission to teacher education, and completion of teacher education. The Myers' Report only specifies the highest level which would usually be held by those entering teacher education programmes, i.e. complete high school training. The criteria of recognisable levels of mathematical education appears to be one useful index of degree of competence.

From this discussion it can be seen that the mathematical education of primary school teachers has become a matter of national concern even to bodies other than those usually associated with teacher education. However, when these bodies recommend far-reaching changes at a national level with an inadequate body of research to indicate the most productive direction of such change, an urgent need for further research is obvious. It would therefore seem a feasible, useful and urgent undertaking to examine the mathematical training of primary school teachers in States other than Victoria. The purpose of this thesis then, is to contribute to this area of research through an examination of those receiving teacher education at institutions in the Illawarra region, these being the University of Wollongong and the Wollongong Institute of Education. The following chapter will examine the best viable means of achieving this, through a review of the literature and an exploration of research already undertaken in the area of mathematics education.
CHAPTER TWO

Research and Literature Review
The three most recent inquiries into teacher education in Australia (1) have assumed that the mathematical background of primary teachers is relevant to the current mathematical knowledge held by teachers. However, most of the past research dealing with mathematical education has focused on other factors which have been perceived to be related to current mathematical ability. These factors include: teaching behaviour (2), teaching effectiveness (3), learning difficulties (4), I.Q. (5), age (6) individual differences (7), textbooks (8), educational environment (9), home environment (10), sex differences (11) and attitudes (12). The two variables which dominate the field of research into mathematical ability are sex differences in, and attitudes towards, mathematics. While no theory of mathematical education has been attempted, one can only assume that these two variables are perceived to be important aspects of any potential theory. This lack of any definitive theory in mathematical education has also resulted in a rather incoherent body of research which has aimed at discovering and establishing pertinent factors, rather than attempting to modify, expand, or replace existing theories.

Moreover, there is little attempt to distinguish between terms in common usage within the literature on mathematical education. For example, 'mathematical ability', 'mathematical achievement', 'mathematical performance', 'mathematical skill', and 'mathematical competence' are all terms which are used interchangeably to indicate some level of proficiency in mathematics. Perhaps part of the reason for this is that it is only quite recently that educators and researchers have indicated the belief that mathematics is not merely a functional tool based on a series of mechanical processes, but has...
an underlying theoretical structure which requires understanding as well as application (13). Whatever the reasons, there has been little attempt to distinguish between concepts which are the subject of research.

Several exhaustive international reviews of research into mathematical education (14) show that research is prolific for primary-age and secondary-age students. That research which does consider teachers usually concentrates on teachers' effects on students, rather than teachers' mathematical ability per se (15). Further, much of the research which does investigate the mathematical ability of teachers does so in contexts similar to research dealing with the mathematical ability of students. Attitudinal research is exemplified by Schofield and Start, who developed a multi-dimensional attitude measuring instrument. After applying it to teachers, it was concluded that "teachers' mathematics achievement did appear to be strongly related to a positive evaluation of the subject" (16). Similarly, in a study of two teacher training institutions in N.S.W., Southwell concluded from structured interviews and ability tests that "there is a definite high correlation between attitudes towards mathematics and mathematical skill" (17). It should be noted that this 'correlation' is not statistically defensible, but is based on impressions gained during interviews. In an examination of teachers at the Wollongong Teachers' College in 1962, Shaw discovered "a positive connection between failure in arithmetic and a negative attitude towards arithmetic" (18).

The other variable which dominates research into mathematical education was considered by Shaw also who found "a suggestion...that confirms the belief that boys are better than girls at arithmetic" (19).
An Australian Council for Educational Research project, conducted in all Australian States in 1955, also examined sex differences in mathematical ability. After an assessment of the skills in different syllabus subjects of all trainee teachers, it was found that for scores of mathematics tests, "a superiority of males to females is shown in all states" (20).

One of the factors considered recently to be potentially relevant to teaching ability, teachers' ability, and teacher effectiveness in mathematics, is that of the teachers' mathematical background. It has been utilised as an 'obviously' pertinent factor (21), sometimes it has been used to examine cursorily other factors (22), and infrequently it has been examined as a potentially important factor. In fact, the literature search for the present revealed only three research reports that investigate, rather than merely mention, the mathematical background of primary teachers. Of these, one briefly examines mathematical background as a minor factor of interest in terms of the current mathematical ability of student teachers. However, due to the unspecified method of measurement utilised in this research, results for this factor are of dubious value (23). The other two reports, however, dealt extensively with teachers' mathematical background.

The first is a survey conducted by Land in England in 1960, in which the attainments and qualifications of teachers' college students were investigated. This was achieved through tests for current skills and an analysis of high school qualifications. Unfortunately, no attempt was made to relate these, or any of the other factors examined, to each other. However, it was found that:
whereas nearly half the women students had not passed O-level mathematics, 284 men out of the 374 had passed (24).

It was also found that negative attitudes towards mathematics were expressed more often by females than males. Land's study contributes to the area of research in mathematical education by explicitly considering the fact that levels of past knowledge affect current knowledge, or constitute one factor which determines the level of knowledge attainable. Land's conclusion also had obvious ramifications at the time for the English teacher education system:

...mathematics and science graduates are not coming forward for training as teachers, ... (and) the training college problem is that those who are electing to train as teachers are reluctant to study mathematics and science (25).

Research conducted in Victoria a short time ago takes Land's ideas one step further by examining a multitude of factors and their association with scores on the performance test. Dettrick found that there were three useful predictors of current performance in mathematics by primary teachers, these being "Enjoyment of Mathematics, Sex of Teacher, and Years of Secondary School Mathematics" (26). 'Enjoyment of mathematics' accounted for a considerable amount of variance on the mathematical performance tests (27), while sex differences resulted in the conclusion that "mathematics performance was clearly lower for females and appears to confirm a trend which is known to exist in secondary schools" (28). An "urgent need for widespread and systematic inservice support for teachers in the area of primary mathematics" (29) was also concluded after analysis indicated that 59 per cent. of the items on the performance test were not mastered.

Both Land and Dettrick used two similar types of measuring devices to tap mathematical ability. One type was similar to the
typical tests devised by researchers investigating mathematical ability, and aimed at assessing current ability through appropriate performance in a test for mathematical skills. The problem of attempting to test for prior mathematical skill was overcome by using marks scored in final-year secondary school examinations. Land's categorisation was based on the level of pass in final-year mathematics, where people who had not attempted mathematics were allocated a level of 'none'. However, within this research report there is no indication of how those who failed this examination were categorised. Dettrick's method of categorisation was not specified in any great detail (30), but seems to be based on the number of years that mathematics was studied. That is, there were five different levels reported, ranging from less than Year 10, Year 10, Year 11, Year 12, to Higher School Certificate. It is unclear whether this "Highest level of Secondary Mathematics" was for mathematics enrolled in or mathematics passed. In addition, both Dettrick and Southwell considered final lower secondary mathematics relevant to secondary mathematical background for primary teachers. However, in N.S.W. mathematics was a compulsory subject for all students at this stage of schooling (31). It is only in the upper secondary years that mathematics became an optional subject for study. Thus, it can be assumed that students in N.S.W. had studied mathematics to the lower secondary stage of schooling.

Even though Dettrick has specified that an analysis of Tertiary mathematics studied by primary teachers in his sample would be forthcoming in a later Report (32), all of the research to date has examined mathematical background in terms of secondary mathematics only. According to the Myers' Report, the area of critical concern is that of the secondary mathematical background of primary teachers.
However, the A.A.M.T. views the period of teacher training as an equally critical area of concern, while several recent Reports on teacher education stress that teacher training is the period in which desirable skills and knowledge should be actively developed in all potential teachers (33). It would therefore be of considerable value to examine mathematical education for primary teachers in terms of both secondary and tertiary mathematics.

While those methods used for the measurement of mathematical background in previous studies are initially useful, future research would benefit from a more rigorous approach to categorisation.

It is interesting to note that one sphere of the Australian media utilised Detrick's research results to produce the following statement in the Australian:

Society has some responsibility for the poor preparation of primary teachers in that adequate standards of achievement have not been required in the past. That was a mistake and should be acknowledged but it does not exonerate the teaching profession from doing something about its own deficiencies now (34).

This press statement generalises from 1981 Victorian results to all Australian teachers either past or present, just as the Myers' Report generalises from a three-year Victorian trend to all Australian teachers over time. Research into the mathematical education of primary teachers is not yet forthcoming for any State other than Victoria or for any time previous to 1976. Further, there is a comparison here between current standards and past standards. While the Myers' Report assumed that past levels were 'better' than current levels, the Australian assumed that standards have always been inadequate. Research into teachers' mathematical ability has not yet produced any comparative data over time, although research into students'
mathematical ability has done so (35). Chapter One briefly suggested that standards have altered over time, if only because the professional preparation of teachers is an historically recent phenomena. It has also been stated that views about mathematical education have also changed historically. These two considerations certainly indicate the need for a cautious interpretation of results which are used to compare current levels or standards with past levels. Furthermore, it has been implied that the methods of measuring mathematical background utilised in past research may not be entirely applicable to N.S.W., due to developments in the education system which are peculiar to N.S.W. The paucity of research in this area also indicates that a review of literature other than research publications would be extremely useful in discovering which factors have influenced mathematical education in N.S.W. The second part of this Chapter will therefore review and assess an assortment of publications which contribute to the conceptual framework necessary for investigating the mathematical background of primary school teachers in this State.

Assessing the mathematical education of any teacher has two phases. In one context they must be viewed as students who have undergone an educational process in primary, secondary and tertiary institutions. They must also be viewed in the context of educators learning how to implement an educational process which need not necessarily be identical to that which they undertook as students. An analysis of the ways in which the N.S.W. education system has changed historically will aid in elucidating this.

Since its first inception in N.S.W., schooling has lengthened and undergone considerable other changes. Although the
first Government-sponsored school was established in N.S.W. in 1819 (36), it was not until the passage of the 1880 Public Instruction Act that the N.S.W. Government seriously attempted to provide a primary school education for all children in N.S.W. (37). However, it was not until this Act was amended in 1916 (38) that the 1880 Act was strictly enforced, thereby assuring a primary school education for all children between the ages of 6 and 14 years in N.S.W. After the 1880 Act and an inquiry into the state of education in N.S.W. in 1904 (39), attention was directed towards secondary education. Although fees were reintroduced for a short time in 1923 (40), fees for secondary education were abolished in 1911 (41), and secondary education became theoretically available to all children in N.S.W. However, because hidden costs for such things as textbooks, uniforms and fares remained in existence (42), it was not until the expansion of secondary school buildings ensued (43), combined with the abolition of the high school entrance examination (44), that secondary education became more realistically available for all children in N.S.W. With the establishment of secondary education for the masses rather than the privileged few by the 1950's, primary schools had definitely become preparatory rather than terminal institutions. One obvious characteristic then of the N.S.W. education system is that it has a history of expansion and change partially dependent on financial exigencies, and that even though change may have occurred conservatively and slowly (45), the Department of Education increasingly assumed responsibility for the education of its population.

These structural changes in the education system have been accompanied by changes in the goals of education. Although there was a brief accentuation on individualism in the early 1920's (46), in
the earlier part of this century both primary and secondary education were characterised by the goal of producing 'good citizens'. One aspect of such citizenship was vocational training for gainful employment in the workforce (47). With the reorganisation of secondary education in 1912, secondary schools were instituted with "distinct vocational aims", and therefore the Department of Public Instruction (now the Department of Education) considered it "essential to know the probable occupations of boys and girls, so that the right class of school may be established in a given locality" (48). This trend of supplying Domestic schools for some females, Junior Technical schools for some males, and academic high schools for the majority of remaining students, continued until the 1957 Wyndham inquiry into education recommended that secondary education be reorganised to generally provide a common lower secondary education for all students (49). This was enacted in 1962, when the length of lower secondary education was also altered from three to four years (50). Instead of a five-year secondary education, the educational plan now consisted of six years for a complete secondary education. However, concern with meeting labour market demands were, and still are, evident in secondary education. The Myers' Report is a current example, wherein schools are expected to cater for the technological changes in society by supplying students who are educated in subjects with a related emphasis.

With this distinct vocational training, education for males until the early 1960's included the acquisition of knowledge and skills which would be useful in the workforce (51). In addition to this, males required "training in moral and civic duties that will form a basis for future citizenship" (52), whereas education for
females was patterned on the following statement issued by the Department of Public Instruction in 1916:

In Girls' Schools the course will have been modified to admit of the acquirement of knowledge and skills that will afterwards be useful in domestic and family pursuits (53).

This knowledge differentiation was overtly based on the subjects studied at school. Within Domestic schools the academic knowledge was minimal, whereas sewing, cooking and childcare subjects abounded (54). At Junior Technical schools academic knowledge was also minimal, but skills necessary for a variety of trades were offered (55). At the Academic high schools, there was greater equality between the knowledge offered to both sexes. However, males at Technical schools who had studied one language or less at the Intermediate level were compelled to sit for the Mathematics I and II subjects at the Leaving Certificate, between 1953 and 1962 (56). No such compulsion existed for females. Any Departmental compulsion for males or females to study a subject merely because they were male or female disappeared with the reorganisation of secondary education in the 1960's, but gender stereotyping of subjects remained (57).

From the 1960's on, but particularly in the 1970's, education has ostensibly been geared towards the individual and society as two separate but related entities, compared to the previous assumption that both were the same. More recent Reports of the Minister for Education have therefore typically included such statements as:

The aims of primary and secondary education focus the role of education upon guiding the individual development of the child towards perceptive understanding, mature judgement, responsible self-direction and moral autonomy (58).
With this has come a 'new' philosophy about the means of achieving this goal:

In education the traditional emphasis has shifted from the students' memorisation of facts and the acquisition of skills to a teaching of the understanding of broader based concepts, principles and theories (59).

This 'new' philosophy has affected all aspects of the syllabus, including mathematics. It is clear from primary and secondary syllabuses for N.S.W. that both content and the intentions underlying mathematical education have altered. Although goals of mathematical education in primary and secondary schools remained relatively static in the first part of the century (60), a new approach to mathematics was being considered in the 1950's and applied in the 1960's. It has already been indicated that within the 1960's and 1970's educators and mathematicians began to stress the necessity of understanding mathematics. Primary school educators were directed to label Arithmetic as Mathematics from 1965 onwards (61). Secondary syllabuses reflected this by adding an aim which was not obvious in previous syllabuses:

The course aims to...foster an understanding of the nature and significance of Mathematics (62).

Primary level educators received a more explicit explanation of this "new mathematics". Department of Education mathematics textbooks issued for primary teachers of the 1960's include lengthy discussions of the nature and purpose of mathematics. These replaced previous textbooks which emphasised bodies of knowledge that had to be acquired and the mechanical skills necessary for their acquisition (63). Reports of the Minister for Education in the early 1960's are rife with notations on the new methods of mathematics which were being introduced to primary schools and the results of discussions of
advisory committees on mathematics (64). Once this "new mathematics" became established in primary schools, educators turned their attention in the 1970's to the importance of developing "literacy and numeracy understandings, skills and attitudes" in primary children (65). A substantial body of Australian research into students' numeracy skills was also produced within this period (66).

Syllabus changes also occurred in secondary mathematics, invariably as an accompaniment to alterations in the length of schooling, and sometimes as a result of revised beliefs about mathematical education. The provision of various 'levels' of mathematics available for study in secondary schools further complicates such changes. While the goals of primary mathematics altered over time, with congruous changes in content of courses, some secondary mathematics syllabuses retained identical content while supposedly altering goals; while others noticeably changed content but retained similar goals (67). It therefore comes as no surprise that researchers producing comparative studies of secondary students' mathematical ability have regarded syllabus changes as an important confounding factor in data analysis (68).

The 'new' view of mathematics evident in the 1960's suggests that attitudes towards this subject may have changed. Desire for the development of positive attitudes to numeracy in students implies that students are perceived to display negative attitudes towards mathematics. Another substantial body of international research typically reports negative attitudes towards mathematics, particularly for females (69). It has also been suggested that the number of mathematical experts available in any given period may affect the status, and thus the desirability, of studying mathematics (70). Research conducted in the early 1970's
on the number of mathematical experts available in Australia revealed that in 1972 there were twice as many mathematicians who were "qualified by international standards to conduct honours courses and supervise research students" in Universities as there were in 1968 (71). However, the concluding remarks in this research report suggest that while the status of mathematics in Australia has changed in the 1970's, the degree of change from a position of "relative insignificance" is not able to be specified (72). It would thus appear that in reality the status of mathematics to students has altered very little over time.

An increasing awareness of the concepts underlying mathematics and a desire to increase the status of mathematics is strongly suggested by these statements from the 1960's and 1970's, which have been incorporated as educational goals within N.S.W. syllabuses. However, these syllabuses display additional goals. A dual goal of the N.S.W. education system since 1919 has been the awarding of various credentials to students. This was based on appropriate performance in an examination and was distinguished by a system of progressive certification (73). In 1912 the Minister of Public Instruction declared that "an unbroken chain leads link by link from the Infants' School to the University" (74). Progression through this educational hierarchy was based on varying methods of certification. In 1911 "the Qualifying Certificate was instituted as the basis of entry to high school" (75). Success entitled the student to proceed to some form of post-primary education, and primary schools were now preparatory institutions for later schooling, rather than terminal institutions which provided an induction into adult life. In 1922 the Qualifying Certificate examination was discontinued, to be replaced by a "High School and Bursary
Examination" (76). It was not until 1943 that a new procedure for high school selection became operative:

Entrance to secondary schools is now determined by the results of a combination of factors - the child's primary school record as shown on his card, and recommendations of school principals ..., and the results of intelligence tests (77).

Post-primary schools prior to World War II were called Continuation schools, and their ultimate goals differed in accordance with the type of school. High schools desired the acquisition of knowledge to ensure that students may either progress to tertiary education or be admitted to "the professions" (78). The goal of all other Continuation schools was the gaining of a "Certificate" (79). It was not until 1925 that the "common goal" of all post-primary schools became the Intermediate Certificate, which was awarded after the completion of a three-year course at secondary school (80). Even though it was realised as early as 1913 that a system of certification led to the 'teaching of examinations', substantial changes in certification system which encouraged altered forms of teaching did not occur in N.S.W. State schools until the 1970's (81).

Entrance to Teachers' Colleges and Universities (the 'final link in the chain') was also based on this system of certification. When the high school system was reorganised in 1912, the Intermediate Certificate became the official basis of selection to the Teachers' College in N.S.W. (82). However, until the 1930's, Reports of the Minister of Public Instruction optimistically proclaimed that more and more teachers' college students were completing a full secondary course of study before entering the College (83). The trend for increasing credentialism at teachers' colleges has continued ever since. In 1945 the Leaving Certificate was set as the minimum requirement for gaining a teacher education scholarship, and one could
not attend a teachers' college unless a teacher education scholarship was granted. It should be noted however, that performance at the Leaving Certificate did not have to be of matriculation standard (84). Evening classes were then instigated in 1950 to provide free courses which were specifically "designed to meet the needs of students who desire to improve their qualifications to teachers' college entrance standards" (85). By the 1960's, aggregates had become an additional criteria for selection to teachers' colleges, together with possession of a Higher School Certificate (86).

The certification process continued within the teachers' college itself. Originally teachers obtained certification through classification after two years probationary employment (87). This was then altered to a system of certification awarded by the Department of Education, immediately following completion of the prescribed two-year course of study at teachers' college and upon condition of a recommendation from the teachers' college (88). With the introduction of the three-year training courses at Teachers' colleges in 1969, this system was again changed to provide a Diploma of Teaching after satisfactory completion of the course of study (89). Additional years of study in the teachers' college system of awarding certificates were invariably accompanied by syllabus changes (90).

Even though the majority of primary teachers in N.S.W. are trained at, and certified through, N.S.W. Teachers' colleges (91), some are trained at Universities. The development of this 'binary' system of teacher training was instigated in N.S.W. by Alexander Mackie at the Sydney Teachers' College, when primary school teachers were in great demand. Secondary teachers pursued an undergraduate course at the University, followed by a Diploma in Education at the College, whereas primary teachers pursued the shorter courses at the
College (92). This dual training formed the basis of a trend which is still in existence today, i.e. where primary teachers are prepared for teaching in courses at a College which take less time to complete than those for secondary teachers at a University (93). In the 1960's the basis of this trend was rationalised under the assumption that secondary teachers require a 'specialised' and 'more diverse' preparation for teaching than primary teachers (94). This form of training was actively encouraged by the Department of Education, as Turner points out in a survey from 1943:

In general, the only teachers who have any close association with the university during their period of pre-service training are secondary school teachers... (This is) a consequence of the policy of the State Departments of Education regarding the training of teachers for their own secondary schools (95).

In 1970 it was reported that "the majority of those preparing for secondary teaching (still) obtain their academic and professional qualifications in universities" (96). However, teacher education scholarships are tenable at either Universities or Teachers' colleges, and primary teacher education may be undertaken at Universities if a scholarship is awarded, University entrance criteria are met and Departmental approval is obtained (97), or if the student pays their own fees and meets University entrance criteria. Because the majority of trainee primary teachers have held teacher education scholarships (98), the latter option would not usually be taken. Although the number of primary teachers holding a University Degree has steadily been rising, the proportion is still quite small (99). Increasing numbers of primary teachers with University Degrees could well be an outcome of a policy which was introduced by the Department of Education in 1962, where the number of primary teacher education scholarships tenable at universities were deliberately increased (100).
In 1962 there were five times the number of primary teachers studying at universities as there were in 1951 (101). However, the majority of primary teachers are still trained at teachers' colleges (102).

It is therefore evident that while courses changed within teachers' colleges, there were also different sorts of educational programmes available to prospective primary teachers at different types of institutions at the same time. The implication for mathematics education courses at tertiary level are that while changes in mathematics courses may have occurred within teachers' colleges, there was an additional difference in the types of courses available at any one given time. This is based on the common assumption that universities and teachers' colleges are different at least in respect of serving different utilitarian functions - teachers' colleges specifically provide for the professional preparation of teachers, where universities provide professional preparation for a multitude of vocations (103).

Another difference between these two types of tertiary institutions has traditionally been based on matriculation status. High school syllabuses have been conspicuous in their references to 'matriculation requirements', specifying that subjects for study in the upper secondary years should be chosen with a view towards University matriculation standards (104). Matriculation requirements are distinguished by two features - appropriate subjects and appropriate performance within these subjects. The Leaving Certificate was deemed equivalent to the University Matriculation Examination in 1913, and since then the final secondary examination has been granted matriculation status (105). Prior to 1936, appropriate passes in English, Mathematics and one foreign language were required for matriculation to any faculty of the only university
in N.S.W., Sydney University (106). With the passage of the University and University Colleges (Amendment) Act in 1936, the compulsion to include Mathematics and one foreign language was removed, and English has remained the only compulsory subject required for matriculation to date (107).

In 1962, aggregates were introduced as an additional index of ability for matriculation purposes (108). According to the Board of Senior School Studies, an aggregate is a 'mark' which "is obtained by adding the candidate's ten best unit scores...This is included because it forms the basis for both tertiary selection and entry to many areas of employment" (109). This implies that an aggregate is used as an index of general ability by both educators and the labour market. In a recent analysis of University entrance standards, Gibb discovered that 'appropriate performance', i.e. aggregates, has been declining for all Australian universities since 1968:

The clear implication of a higher percentage qualifying for admission to higher education from a school population that has an increasing proportion of the age group which itself has been increasing must be that standards of admission have declined, unless there has been an unexpected, undocumented and unlikely increase in scholastic aptitude of the entire group (110).

Varied forms of credentialism for teachers possess several implications for any research which compares aspects of the mathematical education for primary teachers over time. If matriculation standards are indeed declining in all universities, one would expect to see manifestations of this in any University data collected for study. Further, if primary teachers are usually trained at teachers' colleges which are subject to fluctuating entrance standards, yet may also be trained at universities where entrance standards are traditionally geared towards selecting the most able of the secondary school population (111), it would be realistic to suggest that any research
would reveal differences between those trained at each type of institution. It would also be reasonable to expect any comparative study to reveal additional differences between the educational standards of individuals from the same institution, due to altered forms of certification with the passage of time.

The nature of teacher education in teachers' colleges and universities has also been altered due to the changing administrative structure of the N.S.W. education system. Administrative decentralisation of primary and secondary schools in N.S.W. was completed by 1966 (112). In primary schools there has also been an increasing emphasis on school-based curriculum development instead of the previous centrally-supplied syllabuses (113). This holds at least one implication for primary teachers. Any prospective primary teacher would increasingly have to become an efficient administrator and curriculum-planner, in addition to all the other characteristics traditionally required of a teacher (114). It is therefore not surprising that the scope of primary teacher training now includes education for these new responsibilities (115). Although Mackie originated the blueprint for the 'new' professional preparation of teachers in teachers' colleges (116), it can be claimed that the scope of teacher training, particularly for primary teachers, has become more and more oriented towards professionalisation. This has been most obvious in the 1960's. In an attempt to increase the status of teaching, the Department of Education provided allowances for primary teachers to study externally at universities (117). While this was a deliberate ploy to encourage some prospective primary teachers to study at universities, it was also an attempt to encourage in-service training. From the 1950's on, in-service training has received progressively more attention, and has been considered as one of the
attributes of the "growing professionalism of teachers" (118).

Changes in the administration of tertiary education has also affected the scope of teacher training. Until the 1960's, the State employing authority for teachers was also the teacher training authority. Teachers were controlled by the Department of Education under the Minister for Education, although in N.S.W. the Public Service Board exercised additional authority over the employment of teachers and teacher training (119). However, as a result of recommendations made in the Martin Report (120), all teachers' colleges in Australia had become part of the new college of Advanced Education system by 1974 (121). This in turn produced several other changes. Whereas teachers' colleges were previously funded by the State Governments, entrance into the C.A.E. system meant shared funding responsibilities by State and Commonwealth Governments. Teachers' Colleges which had not previously been granted autonomy now become autonomous institutions - including the Wollongong Institute of Education (122). With this autonomy came further changes in the scope of the courses of study, wherein "programmes of teacher education...(became) fully tertiary in character" (123).

Another outcome of this rearranged administrative structure included universities. During World War II, a financial assistance scheme was introduced for courses of study in 'reserved' faculties at universities. After the War, this scheme was extended and a new scheme (the Commonwealth Reconstruction Training Scheme) was introduced in an attempt to rehabilitate ex-service people (124). The immediate effect of this was to substantially increase enrolment numbers at universities throughout Australia. Additional universities were then established in all Australian States, and for the first time,
Commonwealth funding contributed to the erection and maintenance of universities (125). By 1974 the Commonwealth had assumed sole responsibility for recurrent and capital grants to universities, under the condition that fees for study at universities were abolished (126). With the abolition of fees at universities, the previous Commonwealth Scholarship Scheme, based on academic merit (127), was replaced by the Tertiary Education Assistance Scheme, based on economic need. Since 1975 this T.E.A.S. award has been available to students at both teachers' colleges and universities, which has resulted in a decline in the number of teacher education scholarship holders at both teachers' colleges and universities (128). Although criteria for selection and admission to universities are met by universities as before, with autonomy the teachers' colleges have had to develop their own selection procedures. It is therefore entirely possible that the probable fluctuating entrance standards for teacher education scholarship holders has been largely replaced by a more stable selection criteria.

It is also possible that because of the abolition of fees, the composition of the student body in Australian higher education may have altered to include those who could previously not afford a University education or secure a Commonwealth scholarship. Although a 1976 study of the effect of the abolition of fees on the social composition of the student body in Australian higher education concluded that "the presence or absence of fees makes only a relatively small difference to the s.e.s. composition of the university student population" (129), it was also found for both universities and colleges, that females were less likely than males to attend tertiary institutions if fees had remained in existence. Statistics for all
Australian universities and the University of Wollongong (130) show that female participation has been steadily increasing, particularly in the 1970's (131).

Changing requirements for tertiary education indicate that there may have been accompanying changing standards in secondary examinations. Changing standards were obvious in respect of: the number of years required to complete both secondary and teacher education; the number of years of study required before an appropriate certificate was issued; and the different types of certificates that were issued over time. There is also some indication that standards for similar secondary examinations fluctuated. At least one of these possible fluctuations can be attributed to Departmental policy, where the Department of Education deliberately altered examination standards. For example, students were given the opportunity to repeat the Leaving Certificate examination of 1965 and 1966:

The last official Leaving Certificate Examination was held in 1965...At a repeat examination held in 1966 to allow candidates a further opportunity to pass the examination or improve their 1965 performance, 7429 candidates presented themselves for examination (132).

It is possible that inflated levels of mathematics or inflated aggregates could be exhibited in any research data collected for those who completed secondary education in 1966 due to this policy of allowing students to 'improve their 1965 performance'.

Anderson has offered an intriguing reason for what is considered to be a general decline in all secondary examination standards, using the rise of mass secondary education as a basis:

Over the years there has been a marked spread down the I.Q. scale among pupils commencing secondary
studies; in other words that while at the present time our first year intake may reasonably be regarded as of normal capacity, the general level of ability among enrolled students is not as high as it was at the beginning of the century...Teachers have for years been teaching pupils of average or even below average ability according to syllabuses which were designed for girls and boys of superior intelligence (133).

If this is a defensible observation, it indicates that by the 1950's a student population possessing a wider range of abilities than those in the early 1900's were completing secondary education. Any research comparing secondary performance historically might expect to see a more diverse pattern of abilities emerging from the 1950's onwards.

Evidence for fluctuating standards within subjects at the final secondary examination also suggests that performance within similar levels fluctuated, with some levels being mastered more frequently in one year than another. This occurred in Mathematics, as well as other subjects, as indicated by the following statement from a report of Examiners' comments:

Candidates seemed to do better in this Section than they usually do (1961, General Mathematics Paper) (134).

The reasons for fluctuations within subjects could range from those offered by Anderson, to different teaching methods of the subject, to different attitudes of examiners, and lie outside the scope of this study. It is sufficient to note that fluctuations did occur, and to take account of this factor while analysing the data collected for this investigation.

Another factor of relevance to the mathematical education of primary teachers is that while the nature and length of education has altered, the number of individuals being educated has grown enormously. This is particularly evident for primary and secondary schools after
World War II, when there was a rapid increase in birth rates (135). Enrolments at State schools in N.S.W. in the post-War years swelled not only because more children were commencing school, but also because children were staying longer at school. At least two factors contributed to this trend. First, the age of compulsory attendance at school was lowered from 7 to 6 years of age in 1939 (136), and raised from 14 to 15 years of age in 1943 (137). Second, a trend for more children to stay at school past the compulsory age limit became particularly evident by the 1950's (138). One outcome of this was that except for the 1970's and brief interspersing periods, there has consistently been a shortage of teachers in N.S.W. public schools. Sometimes this has reached crisis proportions, such as during World War I, World War II and the early 1950's (139). This problem has been dealt with by the Department of Education in several ways. One short-term plan was to introduce special courses for areas in which teachers were critically undersupplied, such as the three-month Hereford House course of training for rural schools, introduced in 1913 (140). In addition to this, the entrance age was lowered so that more people could immediately be employed as teachers' assistants (141). Further, people were temporarily employed without being "subjected to any entrance examination" (142). Several long-term plans were also enacted. The system of bonding student teachers was developed partially in an attempt to ensure that upon completion of teacher training, student teachers would immediately be employed in the teaching force (143). The Department of Education also executed a policy which aimed at raising the status of the teaching profession, by such means as mass media campaigns (144) and salary increases for teachers (145), in a bid to attract more students into teacher
training. Additional scholarships have also been granted in order to increase the number of potential teachers (146), while additional teachers' colleges have gradually been built to accommodate increased numbers of student teachers. The most rapid expansion of teachers' colleges occurred in the 1950's, as indicated by the following figures: - in 1919 there was only 1 teachers' college (147), by 1946 this had increased to 2 (148), by 1960 there were 6 (149), and by 1970 there were 10 (150). The intercession of Commonwealth Government funding to the States for teacher education was largely responsible for this, and was terminated in 1970 (151).

It was not until the 1970 Report of the Minister for Education was published that references to an undersupply of teachers in N.S.W. finally disappeared. Other sources stress that the trend of undersupply which was evident for approximately 50 years, has now been reversed except in some particular subject areas for secondary schools. One reason for this is that the birth rate has been declining since 1971 (152). This means that while the number of student teachers has usually been maintained at the previous high level, fewer children are enrolled at school. Even though class sizes and teaching hours are gradually being reduced (153), this oversupply is expected to continue. Another reason for this reversed trend is that because of the unstable economic climate in the 1970's, which appears to be continuing into the 1980's, fewer employed teachers are leaving the teaching service (154). This means that there are fewer vacancies for prospective teachers to fill. Employment prospects for teachers in the 1970's and 1980's are therefore characterised by fewer new vacancies being created, due to the declining numbers of children at school; and fewer vacancies existing from terminated employment, due to the unwillingness
of employed teachers to leave existing jobs (155). It may be no coincidence that the previous overwhelming concern with the quantity of teachers has been replaced in the 1970's by a major concern with the quality of teachers (156). It could well be that depending on the status of the profession different types of individuals with different levels of ability (and, by implication, different mathematical background) could be attracted to teaching. For example, it is feasible to suggest that when teaching has a higher professional status, is economically lucrative and offers a good chance of employment, students of greater ability would be attracted to teaching. Alternatively, it would also be feasible to suggest that in times of crisis and desperate shortages, scholarships could be offered to the majority of applicants, with scant attention being paid to abilities. Indeed, this has been stated as part of the selection process for those receiving teacher education scholarships:

If the acceptance rate is lower than that which has been estimated on the basis of past experience, further offers are made to applicants with lower aggregates until the quotas of awards for each of the various courses are filled (157).

With selection procedures specifying that standards of general ability may be lowered according to the dictates of supply and demand, one would indeed expect to see the academic abilities of trainee teachers fluctuating.

The shortage of primary teachers which was generally evident prior to the 1970's had yet another major impact on the teaching profession. Except for a brief period of the late 1930's and early 1940's, primary teaching has increasingly become a feminised profession. When teaching became 'professional' at the turn of the century with the establishment of teachers' colleges, male teachers
outnumbered female teachers (158). By the 1920's, however, female teachers outnumbered male teachers. Prior to World War II the Department of Education was deeply concerned about the large number of female teachers employed in the service, and subsequently took measures "which resulted in the employment of a greater proportion of men in the State teaching service, and in 1938 the excess in the number of women teachers, as compared with the number of men, was only 200" (159). One of these measures was a legislative provision which enabled the State to terminate the employment of married women teachers (160). The Department of Education's policy was fulfilled immediately after World War II, when male teachers finally outnumbered female teachers (161). Ironically this victory was short-lived, due to the increased demand for secondary education and the increasing numbers of students at schools after the War. When teachers of any sort were in demand in this period, females were encouraged to enter the teaching force, through measures such as teacher education scholarships being extended to include married women (167). By 1956 it was reported that "women tend to predominate slightly at the primary level" (163), and this trend has continued ever since (164).

Even though the teaching force has become increasingly feminised, there has generally been a continuation of the established trend for females to enter primary teaching and males to enter secondary teaching (165). One factor which has influenced this trend is that secondary teachers were usually trained at universities, which required attainment of matriculation standards. N.S.W. has a history of different matriculation standards for males and females. Although the first university in N.S.W. was opened in 1852 (166), it was not until 1871 that females were permitted to sit for the Matriculation
Examination (167). Furthermore, it was not until the late 1970's that females were equally represented with males in securing matriculation status (168). Compounding this is the tendency for female matriculants to be "less effectively used" than males (169), in that females are less likely to enter the 'more academically demanding courses at University' and more likely to enter 'less academically demanding courses' at college than males (170).

Another explanation for this trend has been offered by Power, who has described a theoretical process similar to the supply and demand account of changes in the teaching force given previously, by which an occupation becomes feminised. Power adds that when "employers are forced to seek female workers", few males are willing to enter this occupation, which has necessarily been accompanied by a decrease in status. This article also suggested that occupations such as education which "require an orientation to providing services for other people" (171), are considered to be eminently suitable for women. Previous assertions about the N.S.W. Department of Education having actively discouraged large numbers of females from entering the teaching force support, rather than contradict, Power's theory. While the Department of Education certainly indicated a concern that all teaching should not become the preserve of women, there were certain areas of teaching which were considered more suitable for females than males. Criteria for suitability was derived from attitudes towards education for females and towards females in general.

During the nineteenth century too much education was generally considered unsuitable for women:

Take this overwork in schools, of which we are warned, and ask if a mother will not be better for knowing when to interfere and take her daughters from it (172).
By 1918 the question of any schooling other than basic primary education was in the forefront:

The problem of dealing with the further education of girls is much more complicated than in the case of boys. It is known that every boy should ultimately play some definite part in the world's activities...On the other hand, the main sphere of women is centred in their homes and families (173).

Even though a contemporary commentator, Jessie Ackermann, accused parents of assuming that "it is bad for a girl's brain, or that the nervous system will break down, if studies are continued" in 1913 (174), educators shared similar misapprehensions. For example, the 1914 Report of the Minister of Public Instruction discussed the desirability of extending the four year secondary course, due to the inadvisability of subjecting female students to a 'heavy' workload (175).

Manifestations of sex-role expectations for student teachers have occurred in similar ways. If female student teachers wished to train at Universities in the earlier part of this century, Department of Education approval was obtained only after the provision of a Medical Certificate, because "the strain (of studying) is great" (176). Male students were not subject to this condition.

Another facet of role differentiation for student teachers occurred in the type of teacher training encouraged by the Department of Education. Although various forms of specialisation are now available, prior to the late 1960's there were generally three types of primary teacher training available: training in Small Schools, Infants or General Primary. Small School training was traditionally a male province (177), because the Department of Education wanted to ensure that it was represented in small communities by 'desirable' persons:
The country teachers sought are men with a high ideal of service and a deep sense of responsibility; men of broad tolerance and balanced judgement who will act wisely when the situation requires it (178).

Conversely, Infants or kindergarten training was traditionally a female domain:

In N.S.W. specialization for infants school work takes place in the second year of a two-year course at the Sydney Teachers' College for about 50 selected women students (179).

The assumption underlying this is that young children 'need' to be taught by a mother-figure - "a trained woman of sympathetic temperament" (180). Thus, Infants teaching would be considered a particularly suitable occupation for females.

The position of women within the teaching force reveals similar differentiations. Traditionally, female teachers have either been excluded from or given only limited access to the educational power structure. Controls on limited access have been established economically, politically and socially. First, social expectations of female subservience to and dependence on males have been reflected in the wage structure and employment of teachers. Some of these expectations are demonstrated by the attitude of the Public Service Board towards the employment of males and females. Although the following statement was directed towards all Public servants in 1920-1921, as the Public Service Board exercised authority over the employment of teachers, the statement is equally applicable to the teaching force:

It has been the practice to restrict the appointment of women to positions for which, generally speaking, they are particularly suitable...the majority of the officers now employed occupy positions which may appropriately be filled by them, and in which they do not enter competition to any marked extent with male officers...as a general rule, it is shown that women are physiologically unfit to carry responsibility at an age when men are improving and developing their capacity in this respect...a wage
shall be granted sufficient to meet the reasonable requirements of a man and his family or to enable him to make provision for his marriage and his future responsibilities as a citizen. No such considerations enters the fixing of wages for female labour (181).

Second, political sanctions such as the Married Women (Lecturers and Teachers) Act of 1932 also made it very clear that females were still expected to enact the traditional feminine role of financial dependence on males. This Act also indicated that when the supply of labour exceeded the demand, women were the first to be deemed redundant. Third, as one ascends the educational hierarchy, fewer females are found in either areas usually considered to be highly specialised or in positions of authority. For example, while male teachers predominate in secondary schools, males greatly dominate university teaching, particularly senior positions (102). Female teachers who have been allocated a position of authority are usually limited to being headmistress of an Infants Department or a Girls' Department within secondary schools. Rarely are females found as Headmistresses of entire Primary or secondary schools (183). There is also some evidence which suggests that within primary schools, females were often allocated responsibility for the lower (younger) classes, while male teachers were often allocated responsibility for higher (older) classes (184). Nor do females dominate the administrative bureaucracy - there has never been a female Director-General of Education.

These examples of sex-role stereotyping in the teaching profession reflect the wider position of women in society and indicate an important power relationship by which one group dominates another (185).
One implication from this discussion is that there is a tradition of differing fields of specialisation for primary teachers, based on gender. Although Small School training was excluded from courses of training in 1969, and either males or females could theoretically be trained in the General Primary or Infants courses (186), it is possible that the Infants field is still dominated by female trainees. Further, although the Department of Education preferred males for Small School training and females for Infants training, males and females were not 'officially' excluded from any form of training. It is entirely probable that the power relationship still exists, and that sex-role traditions influence the field of specialisation chosen during teacher training to such a degree that males would dominate the Small School area of training and females would dominate the Infants area of training in any study which examined this factor.

Another implication concerns sex-role stereotyping and mathematics. It has already been indicated that the Department of Education at one time encouraged males to study mathematics, while discouraging females. It has also been claimed that mathematics is now regarded as a sex-typed subject. This claim can be supported by evidence from as late as 1979, when the Williams' Report on education, training and employment was published with a recommendation that:

More girls be encouraged to continue their studies of mathematics and science as a means of extending the range of possible careers (187).

It has also been asserted that the majority of primary teachers are now female. If females are indeed reluctant to study mathematics; if females do not display as much mathematical ability as males in secondary schools and teachers' colleges (186); then one would
anticipate two trends in any data collected on the mathematical background or primary teachers. One is that female primary teachers would consistently have studied less mathematics than males. The other is that primary teachers as a whole would have studied little mathematics. If field of specialisation is added to these criteria, one would also anticipate small school trainees to have studied much more mathematics than infants trainees, and probably a little more than general primary trainees.

While it is claimed that traditional sex-role expectations are still apparent, over the past twenty years there have been considerable changes in these expectations. For example, the equalisation of teachers' wages (188) and the concern of educators with the number of females not studying quantitative subjects reflects some of these changes in attitudes. Indeed, it can be claimed that the 1960's and 1970's are also characterised by changes in females' perceptions of themselves. This contention is supported by research which compared female participation in mathematics subjects at the final secondary stage of Australian schooling, for 1964 and 1978. This study found evidence that there was an increase in the proportion of females studying mathematics in all Australian States (189). Interestingly, the tabulated ratios of males to females for N.S.W. and the A.C.T. in this study is footnoted for 1966 with the statement that:

The increases in the ratios recorded here are a consequence of the introduction of the Wyndham Scheme (190).

This suggests that for this period, one could anticipate a larger proportion of females studying mathematics at the final secondary stage of schooling. Other evidence which suggests females' disinclination
to study mathematics appears to contradict this, unless one assumes that the disinclination is manifested in the degree of difficulty of the course studied.

This literature review has established that there are several trends which should be considered in any study dealing with the mathematical education of primary teachers over time. Some of these trends are continuations of factors established decades ago, while others have only recently emerged. Continuing trends include: alterations in the length, nature and purpose of schooling which are invariably accompanied by syllabus changes; and increased participation in education past compulsory ages; maintenance of the 'binary' system of teacher training; changes in the scope and nature of pre-service teacher education; the increasing professionalisation of teaching; increasing industrialism and educational concern with meeting labour market demands; and alterations in educational policy due to financial exigencies of the State and the nation. Emergent trends include: administrative and structural alterations in education, particularly at the tertiary level; a decreased demand for new teachers; the feminisation of teaching; and slight alterations in sex-roles.

In addition to this, the preceding discussion has indicated that there is little research which has considered the mathematical education of primary teachers. In fact, only two major studies have been identified: a survey in England in 1960 and a study in Victoria in 1981. One result of this is that there are huge conceptual and methodological gaps which have not yet been bridged. The literature review was therefore undertaken in order to account for some of these conceptual gaps, and has indicated several additional factors which
could influence any research into the mathematical education of primary teachers. A factor common to both the research and literature reviews is that the sex of the primary teachers is expected to influence the degree of mathematical attainment. Finally, the literature review has indicated the following factors which are also relevant to any study of the mathematical education of primary teachers:

1. the period in which mathematical education was undertaken,
2. the type of institution at which teacher training was undertaken,
3. the type of course trained in, and
4. the field of specialisation trained in.

While this Chapter has identified and accounted for many conceptual gaps, no methodological framework which would cater for research into the mathematical education of primary teachers over time has been suggested. The following Chapter will therefore describe the methodological framework necessary for such an undertaking.
CHAPTER THREE

Methodological Framework
It is evident from the preceding research and literature review that the mathematical education of primary teachers is an area which is in need of further exploration. It is equally evident that for those areas which have been investigated, much research is still required in vast areas such as the cognitive domain. This thesis was therefore undertaken in a bid to investigate one particular area only - an area which has even less established research than others. The literature review in the first two chapters has revealed that mathematical background is often assumed to be relevant to the mathematical ability of primary teachers. Further, it has been established that comparisons have been made between the mathematical background or ability of current primary teachers and past primary teachers with little supporting evidence. The review of the research has shown that researchers are, for whatever reasons, reluctant to attempt structured analysis of mathematical background. It has been suggested one result of this is that there is little existing framework available for further research in this area. While the previous chapter provided the conceptual framework necessary for such an undertaking, the methodological framework remains unspecified. This chapter will therefore provide a methodological framework which will permit an investigation of the mathematical background of N.S.W. primary teachers over time.

METHODOLOGICAL BACKGROUND

The term 'mathematical background' may be taken to mean any number of things. The three studies which have examined this variable have different applications of the term, yet have used similar methods of measuring the variable. The 1960 English survey conducted by Land did not contain any explicit statement regarding 'mathematical background',...
but it appeared to be equated with the ability to achieve at a certain level. Individuals were categorised on the basis of the pass levels attained in the final year of secondary school, with an additional category for those who had not attempted mathematics (1). Dettrick investigated mathematical background in terms of the contribution it made towards current mathematical ability. Here, mathematical background was measured by the annual amounts of time that the individual had studied mathematics (2). Southwell's research, while briefly examining mathematical background as a factor of interest regarding the current mathematical ability of student teachers, is rather confusing in its mode of measurement. As the only explanation given regarding the basis of measurement was inadequate (3), features of categorisation were examined to aid in the development of some criteria for assessing mathematical background.

The above three studies indicate that there are at least two features which would enable some clarification of the mathematics available for study in secondary schools. These are the amount of time available for studying mathematics, and the type of mathematics available for study. The latter feature is only crudely distinguished in Southwell's and Land's research, but is indicated by the simple fact that mathematics courses are provided at different 'levels' in secondary schools. This suggests some degree of difference which is not based solely on the number of contact years. Mathematics syllabuses indicate that each level forms a hierarchy of difficulty. The lowest level is provided as a general background in mathematics and the higher levels are provided as introductions to a tertiary study of mathematics (4).

However, contact with any level of any subject does not
guarantee that this subject or body of knowledge will be mastered. It would appear that another criterion is necessary in order to distinguish between those who have become mathematically educated, and those who have remained mathematically uneducated. One method commonly employed by the Department of Education and other educational bodies to distinguish between successful and unsuccessful exposure to knowledge, has been appropriate performance in some form of examination or assessment. Appropriate performance is commonly called a 'Pass', whereas inappropriate performance is usually deemed a 'Failure'. It would therefore be assumed that 'failure' is generally equated with not having mastered a body of knowledge, which could reasonably be equated with not having studied the subject at all.

Education for teachers is not completed with the final year of secondary school, because Mathematical education may be continued at a tertiary level. Within teachers' colleges, two general types of mathematics have been available. One is a compulsory unit which has the dual aims of providing different methods of teaching mathematics, and developing an understanding of the mathematics which will be taught in primary schools. The other is designed specifically to increase the students personal mathematical knowledge in a manner similar to secondary mathematics courses. Some distinction then exists between courses provided to teach how to teach, and those provided to increase an individual's personal knowledge.

Within universities, the common pattern of study for primary teachers is a Bachelor of Arts Degree followed by a Diploma in Education (5). As with teachers' colleges, two broad types of mathematics courses are generally available for study. The Dip. Ed. commonly provided subjects in teaching methods, while the undergraduate Degree
may be comprised of any type of mathematics subjects offered within
the university. Similar to secondary institutions, tertiary
institutions assess students' performance in a subject through the
allocation of 'passes' and 'failures'. As the A.A.M.T. document
suggests, there does appear to be two distinctive stages of
mathematical education relevant to primary teachers - final secondary
mathematics and tertiary mathematics.

Although the three criteria - content, contact time and pass -
appear to be useful indicators of mathematical background, it has been
asserted that due to course and syllabus changes, these features are
not static. In order to make sensible comparisons of the mathematical
background of primary teachers over time, some method of equating
bodies of mathematical knowledge through syllabuses and within
institutions is required. Prior to discussing how this may be achieved,
it is necessary to define the period of time which will be investigated
in this thesis.

Although primary teachers actually employed in the workforce
would be the preferred population for study, the time limitation of
this study prevented use of the time-consuming methods involved in
obtaining such a sample. As the majority of primary teachers in N.S.W.
schools have consistently been supplied by N.S.W. teachers' colleges
over approximately the last sixty years, a sample of teachers' college
students appears to be the best viable alternative. It would be most
useful to investigate those student teachers who have successfully
completed a programme of teacher education. This is partly because
teacher education is not considered to be finalised until the appropriate
course of study has been completed, and partly to control for factors
such as 'drop-outs'. Employable primary teachers rather than employed
primary teachers would thus constitute the population to be investigated. Suitable periods for investigation can then be constructed using the year in which teacher training was completed as the typical finale of mathematical education for primary teachers.

However, there are many teachers' colleges within N.S.W. which supply employable teachers. Those trained in the Illawarra Region were chosen for several reasons. First, when the teacher education scholarship programme was the usual means of providing students for teachers' colleges, students were allocated to the teachers' college nearest to their home address (6). Any teachers' college investigated within the period when teacher education scholarships were abundant would therefore be atypical to the extent that it would reflect the environment in which it existed. Second, the time limitation on this study precluded the use of several samples, particularly as historical comparisons are involved. Third, a Regional investigation, though by definition on a small scale, will nevertheless make a valuable contribution to research in this area.

Because this study is examining those educated at teacher training institutions located in the Illawarra Region, the period under consideration would necessarily be limited to the period in which these institutions were actually educating prospective primary teachers. The Wollongong Institute of Education (formerly the Wollongong Teachers' College) has been in existence since 1962, and the University of Wollongong (formerly the Wollongong University College) has been conducting courses in primary teaching training since 1977. The period which will be investigated in this study will therefore range from 1962 to 1981.

This period entails several alterations in the education system
which were raised in the preceding Chapter. Secondary education in the 1960's is generally characterised by the introduction of an additional year of schooling and altered goals as a result of the Wyndham scheme. Accompanying this were changes in the secondary syllabuses, including mathematics. Secondary mathematics syllabuses were furthered with the 'new mathematics' introduced to high schools in the 1970's. Those trained as primary teachers in the earliest part of this study however, would have completed secondary education in the late 1950's, which utilised the pre-Wyndham syllabuses. The period under investigation therefore entails three different syllabuses for secondary schools. Further, in 1976, the Department of Education introduced the concept of 'no pass or failure in any subject' for secondary education (7). It is therefore apparent that all three criteria of mathematical background - content, contact time and pass - altered over the period under investigation.

Tertiary institutions were prone to similar alterations during this period. The W.I.E. courses of study underwent structural changes with the introduction of the three-year Diploma course in 1969 (8), and after autonomy was finalised in 1974 (9). Content and contact time were therefore fluctuating features for the Teachers' College within the period under study. In addition to this, the fields of specialisation available at the W.I.E. altered. Small school training was not available for study after 1969, whereas the infants and general primary fields were continuously available. While the University of Wollongong possessed comparatively stable courses of study, field of specialisation was affected to the extent that infants training only was available in 1977 and 1978, whereas general primary training only was available for 1979 to 1981 (10).
Due to the lack of description or definition of relevant variables in the literature on mathematical education, considerable discussion has been necessary. From this discussion, the following operational definitions will be utilised in this study:

**Mathematical Background** is defined as final year secondary mathematics passed, and mathematics passed in tertiary institutions, and is characterised by content and contact time;

**Cohort in which teacher training was completed** is defined as the year in which teacher training was successfully completed;

**Institution of which teacher training was completed** is defined as either the University of Wollongong or the Wollongong Institute of Education;

**Type of Training** is defined as the type of certification awarded after the completion of an appropriate course of study, i.e. Certificate, Diploma in Teaching, or Post-Graduate Diploma;

**Field of Specialisation** is defined as training in either small school, infants or general primary teaching; and

**Gender** is defined as the sex of the employable primary teacher.

The preceding discussion has indicated that the period under consideration is characterised by several types of change. It is also evident that to enable reasonable comparisons of the mathematical background of primary teachers over time, some method of controlling these changes is necessary. The following research design will stipulate the structure in which the relevant variables will be tested.

**RESEARCH DESIGN**

The research design possessed the following aims:

1. to develop a method of measuring the mathematical background of primary teachers over time,
(2) to establish a profile of the mathematical background of employable primary teachers who completed primary teacher training at institutions in the Illawarra Region, and

(3) to determine and evaluate the relationship between the mathematical background of employable primary teachers and four independent variables - namely, cohort in which teacher training was completed, institution at which teacher training was completed, field of specialisation, and gender.

Factors relevant to the construction of the measuring device have been nominated in preceding discussions. The following section will describe the construction of the measuring device.

The Measuring Device

While a survey of records would establish the percentage of employable primary teachers in the Region who possess no final secondary mathematics, the measuring device developed here is an attempt to utilise all available data and thus extend the kind of evidence offered in the Myers' Report. A device was developed utilising the three criteria, which would realistically measure mathematical background in the context of both secondary and tertiary mathematics between 1962 and 1981.

Determination of a pass in a subject is easily accomplished through inspection of relevant records, except for those completing secondary education after 1976. To overcome the problem of 'no pass or failure' here, it was necessary to establish at what point other educators considered a pass to be gained. Tertiary authorities consider to be a dubious pass (II). While Grade 3 was considered to be a pass for the statistical purposes of this study, this potentially inflationary factor will be taken into account during the analysis of results.
For secondary mathematical background, Mathematics syllabuses for 1953 to 1973 were examined in order to establish the types of mathematics available for study. The most striking feature of these syllabuses is that four different types of mathematics were always available in the final secondary years, and these subjects could only be studied over the full two years of upper secondary schooling. Of course, students could cease study of the subject any time within these two years, but this would result in no pass being obtained - and by prior definition this would equate with not having studied the subject at all. Detrick's method of classification by number of years studied is therefore pointless when investigating N.S.W. secondary mathematics. While contact time did not vary in view of the number of years available for final secondary study, it did appear to vary in the number of hours available for study. From the contact times which were specified in various syllabuses, it was clear that the amount of contact time for upper secondary mathematics varied depending on the 'level' of mathematics. Concurrently, the content varied depending on the 'level' of mathematics. It would appear that the Department of Education has conveniently provided an index of varying content and contact time, i.e. the level of upper secondary mathematics.

Although the level of mathematics can be utilised as an index for secondary mathematics, these levels appeared to alter with major syllabus changes, at least to the extent of having different titles. In order to examine the substance of these courses, content for highest level available to lowest level available was compared for syllabuses from 1953 to 1973. While some levels were found to be identical in different syllabuses, such as Levels IIF (1965) and Unit 3 (1973), and Levels IIIS (1965) and Unit 2 (1973), other levels differed considerably,
such as Level I (1965) and Unit 4 (1973). It appeared that the skills which were being developed in various syllabuses for the same level of mathematics were sometimes similar, or that one particular type of skill was emphasised more in one syllabus than another (12). Each syllabus, however, covered a wide range of skills, and it was often difficult to determine which was given priority. It was therefore necessary to equate levels generally across time on the basis of similarity, rather than to attempt to establish which skills were mathematically 'better' than others for the purpose of forming some hierarchy.

A final rank order scale was therefore constructed on the basis of obtaining a pass in one of the specified levels for secondary mathematics. Figure I portrays the final scale devised for secondary mathematics.

**FIGURE I**

**Categories of Final Secondary Mathematics Passed**

0 - No Leaving Certificate/Higher School Certificate Mathematics

1 - (1953) General OR Applied Mathematics/ (1965) III Level Mathematics/ (1973) 2 Unit A Mathematics


3 - (1953) Mathematics I AND Mathematics II/ (1965) IIF Level Mathematics/ (1973) 3 Unit Mathematics

4 - (1953) Mathematics I OR Mathematics II (Hons)/ (1965) I Level Mathematics/ (1973) 4 Unit Mathematics

An investigation of tertiary mathematics was then conducted. For the W.I.E., *Calendars* for the entire period were examined to establish the composition of courses available to prospective primary teachers. Aspects of 'methods' courses can be viewed as vertical enrichment of mathematical knowledge for some individuals who may not have the understanding of mathematics perceived to be necessary for primary school
teachers, or as horizontal enrichment for those who do possess the desired level of understanding. There is some difficulty however, in establishing at which point or for which individuals this type of course becomes horizontal or vertical knowledge. For this reason, and because this is only one part of methods courses, these courses were not included within the scale. 'Personal knowledge development' mathematics courses were then examined. Two types of this optional mathematics have generally been available for study at the W.I.E. The first is what may be called 'academic', and concentrated largely on developing understandings of various strands of mathematics, such as algebra. The other is more of an 'environmental' course, which aimed at developing an understanding of mathematics which can be applied to everyday living, such as elementary computing. Contact time varied enormously over the entire period for these courses, ranging from 78 hours to 182 hours. As content appeared to be sufficiently similar, and as those employed as educators in mathematics at the Institute indicated that there was little substantial change in these courses over time (Appendix A), two broad types of mathematics based on differences in content were established for the Institute. These types were labelled 'academic' and 'environmental' mathematics.

Greater difficulties were faced upon attempting to construct a method of categorisation for University mathematics. University Degrees could be comprised of any number of different types of subjects. Further, these subjects could range from those offered by Mathematics Departments to Statistics courses offered by the Psychology Department. This is particularly true of Arts Degrees, which seem to have been the most popular type of Degree held by primary teachers (13). Cooney's classification of mathematics available at the University level
appeared to be useful in dealing with this problem. Basically, Cooney found that there were three different levels of mathematics available at Universities - courses provided by Mathematics Departments which form of major sequence in mathematics; a one-year course of general introductory mathematics provided for students of the biological and social sciences; and service courses in statistics provided for students in the social sciences (14). For the University of Wollongong, Cooney's three types of available mathematics can be reduced to two types, because one-year introductory courses offered by the Mathematics Department are provided for any student, regardless of the major sequency of study (15). In other words, there is only one type of first year mathematics available at the University of Wollongong. Mathematics at the University was therefore categorised into two different types, and were labelled 'academic' and 'service' courses. Contact time for the service courses was ignored, for both Cooney and local professional mathematicians (Appendix B) considered the amount of service courses passed irrelevant to mathematical knowledge. However, for the academic courses, which provide a substantial study of mathematics, contact time was utilised to differentiate between those who had passed one year, two years, or three years of mathematics. Academic mathematics at the University was thus subdivided into three different categories. There are two reasons why this differentiation by contact time could not be utilised for the academic courses available at the Institute. First, there were extremely large differences in contact times between these institutions. At the University, the study of one coherent body of mathematical knowledge over three years would take a minimum of 616 hours, whereas at the Institute, a maximum of 182 hours is available for three years of study. Second, a study of mathematics at the University may
be terminated after one, two or three years of study. However, at the Institute, mathematics is only available in one unit which is now taken over a period of three years - once enrolled in, the entire course has to be completed before it is accredited to the student.

The mathematics component of Diploma in Education courses at both institutions was also excluded from the measuring scale, as it is similar to the compulsory unit of the non-graduate teacher training course at the Institute. That is, this component concentrates on understanding the current primary mathematics which will be taught in primary schools, and how to teach this mathematics, rather than increasing mathematical knowledge.

The final form of the tertiary measuring scale is portrayed in Figure 2.

**FIGURE 2**

*Categories of Tertiary Mathematics Available in Illawarra Region Tertiary Institutions*

**Institute**


**University**

A - SERVICE COURSES

B - One year of Mathematics )

C - Two years of Mathematics ) ACADEMIC COURSES

D - Three years of Mathematics )
While much attention was given to establishing a reliable form of measuring the mathematical background of employable primary teachers, an interview was also conducted with two professional mathematicians to ensure that the final scale was as valid as possible. Several points of value emerged from this interview. Perhaps the most important, in view of the development of the measuring scale, was that it was not reasonable, or even necessary, to attempt to equate mathematics between tertiary institutions in order to maintain a single ranking method of tertiary level. The idea of a matrix scale, which was suggested by one of the interviewed mathematicians, was therefore adapted for use (See Appendix B for a transcript of this interview, and resulting amendments to the original scale). This matrix version allows for a rank order scale of mathematics passed at secondary level, and different types of mathematics at tertiary level, i.e. 'academic', 'service' or 'environmental'. The final form of the combined secondary and tertiary measuring scale is shown diagrammatically in Figure 3.

FIGURE 3
Matrix of Alphanumeric Categories of Mathematics Passed at Final Secondary Level and Tertiary Level

<table>
<thead>
<tr>
<th>High School Categories of Mathematics Passed</th>
<th>Tertiary Categories of Mathematics Passed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0 0 X Y A B C D</td>
</tr>
<tr>
<td></td>
<td>1 0 X Y A B C D</td>
</tr>
<tr>
<td></td>
<td>2 0 X Y A B C D</td>
</tr>
<tr>
<td></td>
<td>3 0 X Y A B C D</td>
</tr>
<tr>
<td></td>
<td>4 0 X Y A B C D</td>
</tr>
</tbody>
</table>
For the purposes of this study then, the term 'mathematical background' is used to portray the quantity and the quality of mathematical knowledge which employable primary teachers have chosen to study, and have successfully completed. Mathematical knowledge is described in terms of content and contact time, and is limited to units of study which will increase mathematical knowledge per se rather than units which will increase skill in teaching mathematics. The measuring device has two stages - one which will permit measurement of upper secondary mathematics passed, and one which will permit measurement of 'total' mathematics passed at both upper secondary and tertiary levels. Although the tertiary levels were devised for institutions within the Illawarra Region, the mode of categorisation of mathematics courses could easily be extended to include courses provided at other tertiary institutions.

Sampling Procedures

Due to the enormous difference in the number of those trained as primary teachers between the Institute and the University, two different sampling procedures were used. For those completing teacher training at the University, where numbers were comparatively small, the entire population was used. The post-graduate Diploma population at the Institution was also used for the same cohorts as the University, even though this course was available one year prior to that at the University.

The number of those completing non-graduate training at the Institute was considerably larger than the post-graduate population, and a sampling frame of 40 employable teachers per cohort was adopted. However, the introduction of the three-year Diploma course presented a problem because for the first three years of its operation, less than 40 individuals completed this type of training. This problem was
compounded by the fact that while the three-year course was being phased in between 1971 and 1973, the two-year Certificate course was being phased out. This meant that for the years 1971 to 1973, two types of training were in existence, with large numbers of students completing the two-year course. In order to sample effectively from each type of course, the following sampling procedure was adopted. For the years 1964 to 1973, 40 students who had completed primary teacher training in the Certificate course were randomly sampled for each cohort (N = 400). For the years 1971 to 1973, the entire population of those completing the three-year Diploma course were used (N = 103). For the years 1974 to 1981, random sampling was again resumed with 40 students who had completed primary teacher training in the Diploma course being sampled per cohort (N = 320). Table I presents the sampled number of students for each type of training at both institutions, per cohort. (Table I on following page).

Sampling was achieved by consulting lists of 'graduates' available at each institution (16). A simple random sample from a finite population procedure was used for those cohorts where populations exceeded 40. The sample size was determined by consulting 'graduation' lists and arriving at a figure which would always exceed 10 per cent of the population. Sample sizes therefore ranged from 17% (1968, T = 226) to 32% (1964, T = 125) for the Certificate population, and from 20% (1977, T = 202) to 100% (1971, T = 30) for the Diploma population.

Methods of Gathering Data

All continuously available information on record cards, examination sheets and student files at both institutions were utilised. This information consisted of the trainee teacher's gender, level of
<table>
<thead>
<tr>
<th>COHORT</th>
<th>TYPE OF TRAINING AND INSTITUTION AT WHICH TRAINING WAS COMPLETED</th>
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<tbody>
<tr>
<td>1964</td>
<td>40</td>
</tr>
<tr>
<td>1965</td>
<td>40</td>
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<td>1966</td>
<td>40</td>
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<td>-</td>
</tr>
<tr>
<td>1981</td>
<td>-</td>
</tr>
<tr>
<td>400</td>
<td>423</td>
</tr>
</tbody>
</table>

**GRAND TOTAL 976**

* Indicates populations which were used; all other figures are samples only.

...
results were consulted for each of these individuals. While all aggregates were not finally available, due to uncontrollable factors such as married women students not recording maiden names, a large proportion were still available and were therefore utilised.

Data sheets were used for each cohort to record relevant information, and were later coded for data analysis, using the matrix in Figure 3 for categorisation.

Data Analysis Techniques

Both descriptive and inferential statistical methods were employed in this study. A profile of the mathematical background of employable primary teachers was constructed with descriptive statistics. Tests concerning nominated variables were limited to chi-square analyses, due to the nature of the data. The limitations of the data have two aspects. First, aggregates could not be utilised in the analyses of relationships, for reasons which will be specified in later discussion. Second, chi-square tests were applicable due to the type of measurement for mathematical background, which is at best on an ordinal level. Conservative tests which are meaningful were therefore preferred to violating assumptions underlying the more commonly-used parametric tests. However, the chi-square test in combination with the large sample in this study would result in a powerful statistical test, even though the exact power cannot be computed (17).

Although there is a commonly accepted assumption that chi-square tests must have no expected cell frequency less than 5, a variation of this assumption which has been stipulated by Siegel, was utilised in this study. It is assumed that when $K$ is larger than 2, and the degrees of freedom are therefore greater than 1, the chi-square test may be used if fewer than 20 per cent, of the cells have an
expected cell frequency of less than 5 and if no cell has an expected cell frequency of less than 1 (18). Where this assumption is used, the minimum expected cell frequency will be reported, together with the number of cells displaying an expected cell frequency of less than 5.

Roscoe has suggested that when the marginal frequencies are random for chi-square tests using contingency tables, the statistical test is one of independence (19). The questions raised in the previous Chapter will therefore be statistically tested through the following null hypotheses:

\( H_{O1} \) : The level and type of secondary and final mathematics passed and the type of teacher training course completed are independent.

\( H_{O2} \) : The level and type of secondary and final mathematics passed and the institution at which primary teacher training was completed are independent.

\( H_{O3} \) : The level and type of secondary and final mathematics passed and gender are independent.

\( H_{O4} \) : The level and type of secondary and final mathematics passed and the field of specialisation are independent.

\( H_{O5} \) : The level and type of secondary and final mathematics passed and the cohort in which the primary teacher was trained are independent.

\( H_{O6} \) : Field of specialisation during primary teacher training and gender are independent.

\( H_{O7} \) : Institution at which primary teacher training was completed and gender are independent.

Each statistical test was also performed for individual types of training courses, and then in the combinations of non-Graduates, Post-Graduates and Total Region. This was done in an attempt to further refine the type of information sought. The region of rejection for the null hypotheses was set at \( P = .02 \).
The Contingency Coefficient was then computed for each statistical test, in order to have some measure of correlation between the variables. Siegel has warned that the Contingency Coefficient is never able to attain unity, and caution must therefore be used in interpreting this figure. Although the upper limit of $C$ is often able to be computed, in this study it was usually impossible to do so because $K$ and $R$ were usually unequal (20).

Data analysis for the relationships between variables and the contingency coefficients was performed using the computer programme known as the Statistical Package for the Social Sciences (S.P.S.S.).

Data analysis for aggregates involved converting all raw scores to a common base to enable valid comparisons. The Conversion Table for Australian Matriculation Examinations (21) was used for transformation to standard scores with a mean of 500 and a standard deviation of 100. Unfortunately, aggregate scores could not be utilised in the analysis of relationships between variables, due to the large number of scores which were unable to be traced (20%). However, aggregates which were available were able to be meaningfully utilised in the discussion and interpretation of the results.

While the previous Chapter identified and described factors which are considered to be relevant to the mathematical background of primary teachers, this Chapter has delineated a structure in which these factors can be examined statistically. The following Chapter presents the findings of these statistical analyses.
CHAPTER 4

Results and Findings
4.1 Level of Secondary Mathematics Passed Compared With Type of Tertiary Course.

The number of employable primary teachers passing each level of final secondary mathematics is shown in Table 2, for each type of course and combined groups.

### TABLE 2


<table>
<thead>
<tr>
<th>TYPE OF COURSE</th>
<th>LEVEL OF FINAL SECONDARY MATHEMATICS PASSED</th>
<th></th>
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<tbody>
<tr>
<td></td>
<td>0 (%)</td>
<td>1 (%)</td>
<td>2 (%)</td>
<td>3 (%)</td>
<td>4 (%)</td>
<td>TOTAL (100%)</td>
<td></td>
</tr>
<tr>
<td>CERTIFICATE</td>
<td>55 (14)†</td>
<td>142 (36)</td>
<td>136 (34)</td>
<td>63 (16)</td>
<td>0</td>
<td>396*</td>
<td></td>
</tr>
<tr>
<td>DIP. TEACH.</td>
<td>49 (12)</td>
<td>111 (26)</td>
<td>211 (50)</td>
<td>49 (12)</td>
<td>2 (.5)</td>
<td>422*</td>
<td></td>
</tr>
<tr>
<td>POST-GRAD. DIPLOMA (INSTITUTE)</td>
<td>11 (16)</td>
<td>12 (17)</td>
<td>33 (47)</td>
<td>14 (20)</td>
<td>0</td>
<td>70</td>
<td></td>
</tr>
<tr>
<td>POST-GRAD. DIPLOMA (UNIVERSITY)</td>
<td>14 (17)</td>
<td>16 (19)</td>
<td>40 (48)</td>
<td>11 (13)</td>
<td>2 (2)</td>
<td>83</td>
<td></td>
</tr>
<tr>
<td>ALL NON-GRADUATES</td>
<td>104 (13)</td>
<td>253 (31)</td>
<td>347 (42)</td>
<td>112 (14)</td>
<td>2 (.2)</td>
<td>818*</td>
<td></td>
</tr>
<tr>
<td>ALL POST-GRADUATES</td>
<td>25 (16)</td>
<td>28 (18)</td>
<td>73 (48)</td>
<td>25 (16)</td>
<td>2 (1)</td>
<td>153</td>
<td></td>
</tr>
<tr>
<td>TOTAL REGION</td>
<td>129 (13)</td>
<td>281 (29)</td>
<td>420 (43)</td>
<td>137 (14)</td>
<td>4 (.4)</td>
<td>971*</td>
<td></td>
</tr>
</tbody>
</table>

† Percentages are rounded to the nearest whole figure, and therefore may not equal 100.

* There were 5 individuals (.5% of the total) for whom final secondary mathematics could not be ascertained; these being 4 from the Certificate course and 1 from the Dip. Teach. course.
It is clearly shown in Table 2 that for each type of course, either singularly or in combination, the modal level of final secondary mathematics passed was level 2, except for the Certificate course, where the modal level was 1. For each type of course, over 60 per cent. of individuals had passed either levels 1 or 2 final secondary mathematics. It is also obvious from this Table that less than 1 per cent. of the sample successfully completed the highest level of final secondary mathematics.

From the Victorian data contained within the Myers' Report, it is possible to compare Level 0 in Table 2 with another State. Between 1976 and 1979, over 70 per cent. of Victorian primary teachers had not passed any final secondary mathematics. This will be discussed further in Chapter 5.

4.2 Types of Mathematics Passed During Teacher Training Compared With Type of Course.

The number of employable primary teachers passing each type of tertiary mathematics is shown in Table 3, for each type of course. The reader is reminded that the alphanumeric categories consist of final secondary mathematics (first digit) and tertiary mathematics (second digit).
TABLE 3


<table>
<thead>
<tr>
<th>LEVELS OF MATHEMATICS PASSED</th>
<th>CERT.</th>
<th>DIP. TEACH.</th>
<th>POST-GRAD. (INSTIT.)</th>
<th>POST-GRAD. (UNI.)</th>
<th>ALL NON-GRADS.</th>
<th>ALL POST-GRADS.</th>
<th>TOTAL REGION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N (%)</td>
<td>N (%)</td>
<td>N (%)</td>
<td>N (%)</td>
<td>N (%)</td>
<td>N (%)</td>
<td>N (%)</td>
</tr>
<tr>
<td>O0</td>
<td>59 (15)</td>
<td>50 (12)</td>
<td>6 (9)</td>
<td>4 (5)</td>
<td>109 (13)</td>
<td>10 (7)</td>
<td>119 (12)</td>
</tr>
<tr>
<td>OA</td>
<td>-</td>
<td>-</td>
<td>5 (7)</td>
<td>8 (10)</td>
<td>-</td>
<td>13 (8)</td>
<td>13 (1)</td>
</tr>
<tr>
<td>OB,C,D</td>
<td>-</td>
<td>-</td>
<td>0</td>
<td>2 (2)</td>
<td>-</td>
<td>2 (1)</td>
<td>2 (.2)</td>
</tr>
<tr>
<td>OX</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>0</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>OY</td>
<td>0</td>
<td>1 (.2)</td>
<td>-</td>
<td>-</td>
<td>1 (.1)</td>
<td>-</td>
<td>1 (.1)</td>
</tr>
<tr>
<td>T0</td>
<td>137 (34)</td>
<td>107 (25)</td>
<td>2 (3)</td>
<td>2 (2)</td>
<td>244 (30)</td>
<td>4 (3)</td>
<td>248 (25)</td>
</tr>
<tr>
<td>TA</td>
<td>-</td>
<td>-</td>
<td>9 (13)</td>
<td>14 (17)</td>
<td>-</td>
<td>23 (15)</td>
<td>23 (2)</td>
</tr>
<tr>
<td>TB,C,D</td>
<td>-</td>
<td>-</td>
<td>1 (1)</td>
<td>0</td>
<td>-</td>
<td>1 (.7)</td>
<td>1 (.1)</td>
</tr>
<tr>
<td>TX</td>
<td>5 (1)</td>
<td>1 (.2)</td>
<td>-</td>
<td>-</td>
<td>6 (.7)</td>
<td>-</td>
<td>6 (.6)</td>
</tr>
<tr>
<td>TY</td>
<td>0</td>
<td>2 (.5)</td>
<td>-</td>
<td>-</td>
<td>2 (.2)</td>
<td>-</td>
<td>2 (.2)</td>
</tr>
<tr>
<td>20</td>
<td>112 (28)</td>
<td>183 (43)</td>
<td>4 (6)</td>
<td>2 (2)</td>
<td>295 (36)</td>
<td>6 (4)</td>
<td>301 (31)</td>
</tr>
<tr>
<td>2A</td>
<td>28 (.5)</td>
<td>-</td>
<td>26 (37)</td>
<td>37 (45)</td>
<td>2 (.2)</td>
<td>63 (41)</td>
<td>65 (7)</td>
</tr>
<tr>
<td>2B,C,D</td>
<td>-</td>
<td>-</td>
<td>3 (4)</td>
<td>1 (1)</td>
<td>-</td>
<td>4 (.3)</td>
<td>4 (.4)</td>
</tr>
<tr>
<td>2X</td>
<td>10 (3)</td>
<td>8 (2)</td>
<td>-</td>
<td>-</td>
<td>18 (2)</td>
<td>-</td>
<td>18 (2)</td>
</tr>
<tr>
<td>2Y</td>
<td>12 (3)</td>
<td>20 (5)</td>
<td>-</td>
<td>-</td>
<td>32 (4)</td>
<td>-</td>
<td>32 (3)</td>
</tr>
<tr>
<td>30</td>
<td>35 (9)</td>
<td>30 (7)</td>
<td>1 (1)</td>
<td>1 (1)</td>
<td>65 (8)</td>
<td>2 (1)</td>
<td>67 (7)</td>
</tr>
<tr>
<td>3A</td>
<td>-</td>
<td>-</td>
<td>5 (7)</td>
<td>6 (7)</td>
<td>-</td>
<td>11 (7)</td>
<td>11 (1)</td>
</tr>
<tr>
<td>3B,C,D</td>
<td>-</td>
<td>-</td>
<td>8 (11)</td>
<td>4 (5)</td>
<td>-</td>
<td>12 (8)</td>
<td>12 (1)</td>
</tr>
<tr>
<td>3X</td>
<td>15 (4)</td>
<td>6 (1)</td>
<td>-</td>
<td>-</td>
<td>21 (3)</td>
<td>-</td>
<td>21 (2)</td>
</tr>
<tr>
<td>3Y</td>
<td>13 (3)</td>
<td>13 (3)</td>
<td>-</td>
<td>-</td>
<td>26 (3)</td>
<td>-</td>
<td>26 (3)</td>
</tr>
<tr>
<td>40</td>
<td>0</td>
<td>1 (.2)</td>
<td>0</td>
<td>0</td>
<td>1 (.1)</td>
<td>0</td>
<td>1 (.1)</td>
</tr>
<tr>
<td>4A</td>
<td>-</td>
<td>-</td>
<td>0</td>
<td>-</td>
<td>0</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>4B,C,D</td>
<td>-</td>
<td>-</td>
<td>0</td>
<td>2 (2)</td>
<td>-</td>
<td>2 (1)</td>
<td>2 (.2)</td>
</tr>
<tr>
<td>4X</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>0</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>4Y</td>
<td>0</td>
<td>1 (.2)</td>
<td>-</td>
<td>-</td>
<td>1 (.1)</td>
<td>-</td>
<td>1 (.1)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>400 (100)</td>
<td>423 (100)</td>
<td>70 (100)</td>
<td>83 (100)</td>
<td>823 (100)</td>
<td>153 (100)</td>
<td>976* (100)</td>
</tr>
</tbody>
</table>

0 2 students from the Certificate course had passed some University courses prior to enrolling as trainee teachers.

* The 5 individuals who were not categorised at the final secondary stage were categorised in the 'Total' mathematics as 'O' at the secondary level.

N.B. "-" signifies that this course was not available at this institution, whereas 'O' signifies that the course was available, but no students passed this course.
Table 3 reveals that while the majority of non-Graduates did not pass any form of tertiary mathematics, the majority of Post-Graduate Diplomates did pass some form of tertiary mathematics, noticeably the 'service' courses. From this Table it can also be shown that there are many categories of mathematics which were either not passed at all, or had a minute proportion of students successfully completing them.

The likelihood of encountering a large number of 'empty' cells in any chi-square analysis is apparent from both of these Tables, especially for the combined final secondary and tertiary, or 'Total', mathematics passed. It is evident that these categories will have to be restructured to allow the most useful analyses of relationships. While the secondary mathematics categories could be altered by either combining levels 3 and 4 or omitting level 4 altogether, it would be of more use to devise a method of combining categories which is applicable to both stages of mathematical measurements. In other words, some criteria in addition to pass, content and contact time needs to be introduced in order to establish a viable alternative method of categorising mathematical background. Recalling the research into the mathematical background of primary teachers, it is noticeable that nearly all researchers have avoided decisions concerning how much or what sort of mathematics constitutes knowledge which could be deemed sufficient for primary teachers. Detrick provided some form of judgement by specifying a mastery level of 80 per cent. on the devised performance test (1). It will be remembered that the Myers' Report was ultimately concerned with 'the proportion of primary teachers who take no mathematics in the last years of high school'. Upon assessing
this situation, the Report then altered this to include 'no or little' mathematics:

The concern is not so much with the actual level of mathematics studied, although this is of course important, as with the possibility that school-teachers who choose not to take any mathematics or as little mathematics as possible in their last years of high school may not have much empathy for quantitative subjects (2).

There is obviously a differentiation between 'no' and 'little' here, for they are not considered one and the same thing - although the effects of each may be identical. 'No mathematics' in the final years of high school is easily understood, but 'little mathematics' is difficult to interpret unless it is placed in the context of levels of mathematics. At its minimum, 'as little mathematics as possible' could then be equated with the lowest level of final secondary mathematics available. When this is done, anything above this lowest available level would, by extension, be an acceptable and desirable level or amount of mathematical education for primary teachers.

In an attempt to gain further insight into levels of mathematics which are considered desirable for primary teachers, a questionnaire was devised and sent to the two regional institutions involved with the preparation and training of school teachers, which are the University of Wollongong and the Wollongong Institute of Education. The teaching staff of Education and Mathematics Departments at both institutions were asked to respond to these questionnaires. Analysis of responses indicated that local professional opinion varied to some extent (See Appendix A for a complete analysis of responses, and a discussion of the limitations of the questionnaire). A number of respondents,
usually mathematicians, revealed a tendency to think that many primary teachers are not even competent at primary level mathematics, let alone high school or tertiary mathematics. These respondents indicated that a basic competence at primary level needs to be established prior to fulfilling any ideal goals of a higher level of mathematical ability. However, nine respondents (35%) presumed that primary teachers need to be exposed to the study of mathematics for the entire six years of high school education in order to be competent teachers of primary mathematics. As with the Myers' Report, there is still a difficulty here in asserting which levels of mathematics are necessary to effect this. An additional eight respondents (31%) specified that some elementary level of tertiary mathematics was desirable for primary teachers. In fact, two respondents suggested that an elementary level of tertiary mathematical knowledge should be a prerequisite for any person seeking admission to a primary teacher education programme. The major conclusion drawn from this analysis was that local professional opinion generally agreed with two assumptions in the Myers' Report, these being:

1. that more exposure to mathematical knowledge should usually produce higher levels of mathematical competence, and
2. that primary school teachers should at least possess final-year high school level mathematical knowledge.

In addition to the questionnaire, opinions were offered in an interview with mathematicians employed at the University of Wollongong (Appendix B). These will aid in clarifying the problem encountered thus far in establishing some reasonable criteria for assessing what mathematical background may be deemed 'little' or
'sufficient' for primary teachers. Both interviewed mathematicians asserted that while a study of mathematics for the entire six years of high school education was an absolute necessity for primary teachers, the type or level of mathematics studied made a substantial difference to mathematical ability. Little differentiation was made between 3 or 4 level mathematics* passed at the secondary stage of schooling, and any coherent study of 'academic' mathematics at University level. All three types were classified as demonstrating "definite" mathematical ability. A pass in level 1 secondary mathematics was assessed as usually indicating that the individual was not "in the least bit interested in mathematics". The second level of final high school mathematics was discussed briefly, where it was stipulated that only 30 per cent. of those passing this level would be mathematically competent enough to pass University level mathematics. Finally, 'service' courses at the University level were considered to contribute only minimally to mathematical knowledge. The conclusions which can be drawn from this interview are that:

1. no final secondary mathematics or 'academic' tertiary mathematics can usually be equated with no mathematical ability,
2. level 1 secondary mathematics, either alone or in combination with 'service' courses, usually indicate little mathematical ability,
3. tertiary 'service' courses usually indicate little mathematical ability, and
4. levels 3 or 4 final secondary mathematics, and 'academic' type tertiary mathematics usually indicates definite mathematical ability.

*Current mathematics syllabus levels were cited in the interview; within the discussion above, these levels have been converted to those appearing in the scale devised for this study.
It would appear from this that while most types and levels of mathematics can be meaningfully integrated into other categories, the level 2 secondary mathematics does not seem to be able to be placed in any revised category. This problem can be solved by examining some of the reasons that different levels of mathematics are provided in the upper secondary stage of schooling. Previous discussion has indicated that besides functional or utilitarian purposes, upper secondary mathematics has been structured within two broad types. One type of mathematics has been constructed as a general course in mathematical knowledge, and has been designed for students who are not expected to continue studies in mathematics at a later stage. The Department of Education has described this type of course in the following manner:

It is planned as a terminal course, as it is not anticipated that students following the course will proceed to tertiary study in Mathematics (3).

Although the highest level of mathematics provided in upper secondary education was designed for "students with a special interest in mathematics" (4), the other broad type includes levels 2, 3 and 4 mathematics. It has been constructed with a view towards providing suitable introductions to a study of tertiary mathematics, as suggested by the following statement which has been consistently given in Mathematics Syllabuses:

The general aim is to...provide the mathematical background and techniques for...further studies in mathematics (5).
Thus, level 1 has been provided as a general terminal course, whereas levels 2, 3 and 4 are provided as bases for future studies in mathematics.

A revised categorisation of the scale devised for this study can now ensue in a meaningful manner by utilising the four sources which have just been discussed. 'No mathematical education' would include no final secondary mathematics and no tertiary mathematics. 'Little mathematical education' would include Level 1 secondary mathematics and/or 'service' or 'environmental' courses. 'Sufficient mathematical education' would include Levels 2, 3 and 4 at the secondary stage, or any tertiary 'academic' courses. The original categories and revised categories are portrayed diagrammatically in Figure 4 below.

**FIGURE 4**

Matrix Showing the Revised Categorisation of the Alphanumeric Categories of Mathematics Passed at Final Secondary and Tertiary Stages of Education.
While these are obviously not meant to be taken as absolute standards, the categorisation into 'no mathematical education', 'little mathematical education' and 'sufficient mathematical education' does provide a useful and reasonable basis for assessing the relationship between variables which have been perceived as relevant to the mathematical background of employable primary school teachers in New South Wales.

With the recategorisation of mathematical background, chi-square analyses can now be performed realistically. The various null hypotheses being tested in this Chapter will appear in the format of a major section for each hypothesis concerning the dependent and independent variables. Each of these major sections will present two hypotheses - one for final secondary mathematics, and one for final secondary and tertiary, or total, mathematics. Each hypothesis will also examine data in the groups which were indicated in previous discussions for the type of course completed. Tests for the nominated independent variables will be reported, which will be followed by a summary of the findings.

4.3 The Relationship Between the Type of Primary Teacher Training Course Completed and the Levels and Types of Mathematics Passed.

4.3.1 Type of Teacher Training Course Completed by Final Secondary Mathematics Passed.

\[
\begin{align*}
H_{01} & : \text{Category of final secondary mathematics passed and the type of teacher training course completed are independent.} \\
H_{11} & : \text{Category of final secondary mathematics passed and the type of teacher training course completed are related.}
\end{align*}
\]
Table 4 shows the frequencies of those who have completed a primary teacher training course in the Region and who have passed each category of mathematics.

TABLE 4


<table>
<thead>
<tr>
<th>TYPE OF COURSE</th>
<th>CATEGORY OF FINAL SECONDARY MATHEMATICS PASSED</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NONE N (%)</td>
</tr>
<tr>
<td>CERTIFICATE</td>
<td>55 (14)</td>
</tr>
<tr>
<td>DIPLOMA IN TEACHING</td>
<td>49 (12)</td>
</tr>
<tr>
<td>DIPLOMA IN EDUCATION</td>
<td>25 (16)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>129 (13)</td>
</tr>
</tbody>
</table>

\[ x^2 = 22.2439, \ 4DF, \ \alpha < .02, \ C = .11 \]

The result of the chi-square test was significant at the .02 level, and the alternative hypothesis specifying a relationship between the type of teacher training course completed and the levels of final secondary mathematics passed was accepted. However, the Contingency Coefficient suggests that the degree of association between these two variables is not particularly strong.

Although the chi-square test is unable to indicate the manner in which these two variables are related, an examination of Table 4 indicates that those completing the Post-Graduate
Diploma in Education courses are more likely to possess no final secondary mathematics than those completing either of the other courses. Simultaneously, the Diploma in Education group displayed the largest proportion of individuals who possessed a sufficient mathematical background.

If these courses of teacher training are viewed as a hierarchy of qualifications, with the Certificate course as the lowest and the Diploma in Education course as the highest, it is apparent that as a group, those with the least qualifications for primary teaching are the most likely to possess the least mathematical background. Further, the higher the qualification gained during teacher training, the more likely employable primary teachers in the Illawarra Region are to possess sufficient mathematical background - despite the finding that the largest proportion of individuals with no mathematical background at the secondary stage of education is also located in the Diploma in Education groups.

4.3.2 Type of Teacher Training Course Completed by Final Secondary and Tertiary, or Total, Mathematics Passed.

\[
\begin{align*}
\text{H}_{01}^2 & : \text{Category of total mathematics passed and the type of teacher training course completed are independent.} \\
\text{H}_{11}^2 & : \text{Category of total mathematics passed and the type of teacher training course completed are related.}
\end{align*}
\]
Table 5 shows the numbers of those who completed each type of primary teacher training course in the Illawarra Region between 1962 and 1981 and the categories of mathematics that they passed.

**TABLE 5**

Categories of Total Mathematics Passed by Those Completing Each Type of Primary Teacher Training Course in Illawarra Tertiary Institutions (1962 - 1981).

<table>
<thead>
<tr>
<th>TYPE OF COURSE</th>
<th>CATEGORIES OF TOTAL MATHEMATICS PASSED</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NONE (N) (%)</td>
</tr>
<tr>
<td>CERTIFICATE</td>
<td>59 (15)</td>
</tr>
<tr>
<td>DIPLOMA IN TEACHING</td>
<td>50 (12)</td>
</tr>
<tr>
<td>DIPLOMA IN EDUCATION</td>
<td>10 (7)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>119 (12)</td>
</tr>
</tbody>
</table>

\[ x^2 = 22.31584, \text{ 4 DF, } \alpha < .02, \quad C = .11 \]

The result of the chi-square test was significant at the .02 level, and the null hypothesis was rejected. As with the chi-square test for final secondary mathematics, the contingency coefficient reflects a low degree of association. However, Table 5 indicates that while a sufficient mathematical background was modal for each type of course, those completing the Post-Graduate Diploma in Education course possessed the largest proportion of employable
79.

primary teachers with a sufficient mathematical background. Conversely, those completing the Certificate course had the least mathematical background, with one-half of its population possessing no and little, or an inadequate, mathematical background at the completion of their teacher training course. Those completing the Diploma in Teaching course approximated the anticipated distribution through each category more closely than either of the other courses, although as with the Diploma in Education courses, the Diploma in Teaching course had more individuals with a sufficient mathematical background than expected.

There is also a similarity to the secondary mathematics passed, in that the higher the educational qualification gained during teacher training, the more likely the employable primary teacher is to possess an adequate mathematical background. A further comparison of Tables 4 and 5 indicates that while there is little difference between these two stages of education in the proportions of individuals in each category of mathematics for the Certificate and Diploma in Teaching courses, there is a large difference for the Diploma in Education course. For the Diploma in Education course, those with no mathematical background was reduced from 16 to 7 per cent. of the population when tertiary mathematics was included in the analysis. It can be shown from these Tables that while the majority of those completing the Diploma in Education courses who possessed no final secondary mathematics only possessed a little mathematics at the end of teacher training, a few more individuals possessed sufficient mathematical background at the end of teacher training as did those at the completion of final secondary education.
4.4 The Relationship Between the Institution at Which Teacher Training Was Completed and Levels and Types of Mathematics Passed.

4.4.1 Institution at Which Teacher Training Was Completed By Final Secondary Mathematics Passed.

\[ H_{0}^{1} \] : Category of final secondary mathematics passed and the institution at which teacher training was completed are independent.

\[ H_{1}^{1} \] : Category of final secondary mathematics passed and the institution at which teacher training was completed are related.

The number of those who passed each category of final secondary mathematics and who completed teacher training at each institution in the Illawarra Region are shown in Table 6.

### Table 6

<table>
<thead>
<tr>
<th>Institution</th>
<th>Category of Final Secondary Mathematics Passed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>None (N)</td>
</tr>
<tr>
<td>University</td>
<td>14 (17)</td>
</tr>
<tr>
<td>Institute</td>
<td>115 (13)</td>
</tr>
<tr>
<td>Total</td>
<td>129 (13)</td>
</tr>
</tbody>
</table>

TOTAL REGION: \( x^2 = 3.81753, 2 \text{ DF}, P = .1483 \)

ALL POST-GRADS.: \( x^2 = .18821, 2 \text{ DF}, P = .9102 \)
Both sets of chi-square results were not significant at the .02 levels, and the null hypothesis was retained. However, it can be shown from Table 8 that those who completed teacher training at the University were more likely than those at the Institute to have passed a sufficient amount of final secondary mathematics. At the same time, those who completed teacher training at the University were also more likely than those trained at the Institute to have passed no final secondary mathematics. Although the University had approximately one-third of its primary trained teachers in the no and little mathematical background categories, and approximately two-thirds of its primary trained teachers in the sufficient category, the Institute had nearly one-half of its primary trained teachers in the combined no and little mathematical background categories, and just over one-half in the sufficient mathematical background category.

4.4.2 Institution at Which Teacher Training Was Completed By Final Secondary and Tertiary, or Total, Mathematics Passed.

\( H_0^2 \) : Category of total mathematics passed and the institution at which teacher training was completed are independent.

\( H_1^2 \) : Category of total mathematics passed and the institution at which teacher training was completed are related.

The number of those who passed each category of final secondary and tertiary mathematics and completed teacher training at each institution in the Illawarra Region is shown in Table 7.
TABLE 7


<table>
<thead>
<tr>
<th>INSTITUTION</th>
<th>CATEGORIES OF TOTAL MATHEMATICS PASSED</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NONE N (%)</td>
<td>LITTLE N (%)</td>
<td>SUFFICIENT N (%)</td>
<td>TOTAL (100%)</td>
<td></td>
</tr>
<tr>
<td>UNIVERSITY</td>
<td>4 (5)</td>
<td>24 (29)</td>
<td>55 (66)</td>
<td>83</td>
<td></td>
</tr>
<tr>
<td>INSTITUTE (POST-GRAD.)</td>
<td>6 (9)</td>
<td>16 (23)</td>
<td>48 (69)</td>
<td>70</td>
<td></td>
</tr>
<tr>
<td>ALL INSTITUTE</td>
<td>115 (13)</td>
<td>266 (30)</td>
<td>512 (57)</td>
<td>893</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>119 (12)</td>
<td>290 (30)</td>
<td>567 (58)</td>
<td>976</td>
<td></td>
</tr>
</tbody>
</table>

TOTAL REGION : \( x^2 = 3.30079, 2 \text{ DF}, p = .1920 \)

ALL POST-GRADS. : \( x^2 = .34303, 2 \text{ DF}, p = .8424 \)

As with the chi-square tests for the categories of final secondary mathematics passed, neither of these results are significant at the .02 level. It therefore must be concluded that the institution at which teacher training was completed and the category of final secondary and tertiary mathematics passed are independent. However, Table 7 indicates some differences which are worth noting. Figures show that although a sufficient mathematical background is modal for both institutions, those completing teacher training at the University are more likely to possess a sufficient mathematical background than those completing teacher training at the Institute (8 per. cent difference). This is not the case for all groups at the Institute though, for when
the two Post-Graduate Diploma populations are examined in isolation, the figures reveal that those completing the Post-Graduate Diploma at the Institute are slightly more likely than those completing teacher training at the University to possess a sufficient mathematical background. However, those completing teacher training at the Institute are also minimally more likely to concurrently possess no mathematical background.

It should also be noted that of all individuals who have completed primary teacher training in the Illawarra Region between 1962 and 1981, 119 or 12 per cent. possess no mathematical background at the completion of teacher training; 290 or 30 per cent. possess little mathematical background; and 567 or 58 per cent. possess sufficient mathematical background at the completion of teacher training.

4.5 The Relationship Between Gender and Levels and Types of Mathematics Passed.

4.5.1 Gender By Final Secondary Mathematics Passed.

\[ 
\begin{align*}
\text{HO}^1_3 & : \quad \text{Category of final secondary mathematics passed and the gender of the employable primary teacher are independent.} \\
\text{H}^1_3 & : \quad \text{Category of final secondary mathematics passed and the gender of the employable primary teacher are related.}
\end{align*} 
\]

Table 8.A presents the numbers of males and females who passed each category of final secondary mathematics in each type of course.
### TABLE 8.A


<table>
<thead>
<tr>
<th>TYPE OF COURSE</th>
<th>CATEGORY OF FINAL SECONDARY MATHEMATICS PASSED</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NONE N (%)</td>
<td>LITTLE N (%)</td>
<td>SUFFICIENT N (%)</td>
<td>TOTAL (100%)</td>
<td></td>
</tr>
<tr>
<td>Certificate:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>8 (10)</td>
<td>28 (34)</td>
<td>46 (56)</td>
<td>82</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>47 (15)</td>
<td>114 (36)</td>
<td>153 (49)</td>
<td>314</td>
<td></td>
</tr>
<tr>
<td>Dip. Teach.:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>9 (10)</td>
<td>28 (31)</td>
<td>53 (59)</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>40 (12)</td>
<td>83 (25)</td>
<td>209 (63)</td>
<td>332</td>
<td></td>
</tr>
<tr>
<td>Post-Grad. Dip. (Institute):</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>2 (9)</td>
<td>4 (18)</td>
<td>16 (73)</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>9 (19)</td>
<td>8 (17)</td>
<td>31 (65)</td>
<td>48</td>
<td></td>
</tr>
<tr>
<td>Post-Grad. Dip. (University):</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>3 (18)</td>
<td>4 (24)</td>
<td>10 (59)</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>11 (17)</td>
<td>12 (18)</td>
<td>43 (65)</td>
<td>66</td>
<td></td>
</tr>
<tr>
<td>All Non-Grad.:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>17 (10)</td>
<td>56 (33)</td>
<td>99 (58)</td>
<td>172</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>87 (13)</td>
<td>197 (30)</td>
<td>362 (56)</td>
<td>646</td>
<td></td>
</tr>
<tr>
<td>All Post-Grad.:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>5 (13)</td>
<td>8 (21)</td>
<td>26 (67)</td>
<td>39</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>20 (18)</td>
<td>20 (18)</td>
<td>74 (65)</td>
<td>114</td>
<td></td>
</tr>
<tr>
<td>Total Region:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>22 (10)</td>
<td>64 (30)</td>
<td>125 (59)</td>
<td>211</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>107 (14)</td>
<td>217 (29)</td>
<td>436 (57)</td>
<td>760</td>
<td></td>
</tr>
</tbody>
</table>
Results of chi-square tests for the relationship between the gender of the employable primary teacher and the category of final secondary mathematics passed, for each type of course, are presented in Table 8.B below.

**TABLE 8.B**

Results of Chi-Square Tests : For Final Secondary Mathematics Passed, By Gender.

<table>
<thead>
<tr>
<th>TYPE OF COURSE</th>
<th>$x^2$</th>
<th>DF</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>CERTIFICATE</td>
<td>2.05936</td>
<td>2</td>
<td>.3571</td>
</tr>
<tr>
<td>DIP. TEACH.</td>
<td>1.44938</td>
<td>2</td>
<td>.4845</td>
</tr>
<tr>
<td>POST-GRAD. DIP. (INSTITUTE)</td>
<td>Not valid : 33% of expected cell frequencies were less than 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>POST-GRAD. DIP. (UNIVERSITY)</td>
<td>Not valid : 33% of expected cell frequencies were less than 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ALL NON-GRADS.</td>
<td>1.61480</td>
<td>2</td>
<td>.4460</td>
</tr>
<tr>
<td>ALL POST-GRADS.</td>
<td>.55041</td>
<td>2</td>
<td>.7594</td>
</tr>
<tr>
<td>TOTAL REGION</td>
<td>1.93925</td>
<td>2</td>
<td>.3792</td>
</tr>
</tbody>
</table>

For all groups except the individual Post-Graduate Diplomates, results of chi-square tests were not statistically significant at the .02 level. No significant relationship was established between the gender of the teacher and the category of final secondary mathematics passed. After combining the 'no
mathematical education' and 'little mathematical education' categories to form an indice of 'insufficient mathematics', chi-square tests were performed manually for the Post-Graduate Diploma groups. Because the population was used for data analysis, this seemed the best method of enabling an analysis of the relationship to ensue without threatening the basis of the data itself. The chi-square figures calculated for each of these groups were:

Institute - .432, 1 DF
University - .249, 1 DF

As with the other tests, these results were not significant at the .02 level, and the null hypothesis was retained.

Although the results of chi-square tests were not significant, Table 8.A indicates that for each type of course except the University Post-Graduate Diploma, females had a higher proportion of their own sex with no final secondary mathematics than males. For each type of course except the Certificate, males had a higher proportion of their own sex in the little mathematical education category than females. For each type of course except the Diploma in Teaching and University Post-Graduate Diploma, males also had a higher proportion of their own sex in the sufficient mathematical education category than females. However, the extent of these differences are quite small, and lie within a range of 1 to 10 per cent.

In addition to this, it can be shown from Table 8.A that over 50 per cent. of both male and female employable teachers passed a sufficient amount of final secondary mathematics, although Post-Graduate Diplomates of each sex have a higher proportion of employable teachers passing a sufficient amount of secondary mathematics than non-Graduates. Further, an interesting trend pertaining to the
'hierarchy' of qualifications is apparent. As this hierarchy is ascended from the Certificate to the Post-Graduate groups, a higher proportion of employable primary teachers possess a sufficient mathematical education. At the same time, Post-Graduate Diplomates have a higher proportion than any other type of course of each sex and both sexes combined in the no mathematical education category.

4.5.2 Gender By Final Secondary and Tertiary, or Total, Mathematics Passed.

\[
\begin{align*}
\text{H}_0^2 & : \text{Category of total mathematics passed and the gender of the employable primary teacher are independent.} \\
\text{H}_1^2 & : \text{Category of total mathematics passed and the gender of the employable primary teacher are related.}
\end{align*}
\]

The frequencies of males and females passing each category of total mathematics are shown in Table 9.A for each type of course, and are represented graphically in Figures 5 and 6.

Results of chi-square tests for the relationship between the gender of the employable primary teacher and the category of total mathematics passed, for each type of course, are presented in Table 9.B.
### TABLE 9.A

Categories of Total Mathematics Passed by Each Sex, For Each Type of Course in Illawarra Region Tertiary Institutions (1962 - 1981).

<table>
<thead>
<tr>
<th>TYPE OF COURSE</th>
<th>CATEGORY OF TOTAL MATHEMATICS PASSED</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NONE N (%)</td>
<td>LITTLE N (%)</td>
<td>SUFFICIENT N (%)</td>
<td>TOTAL (100%)</td>
<td></td>
</tr>
<tr>
<td>Certificate:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>9 (11)</td>
<td>28 (34)</td>
<td>46 (55)</td>
<td>83 (100)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>50 (16)</td>
<td>114 (36)</td>
<td>153 (48)</td>
<td>317 (100)</td>
<td></td>
</tr>
<tr>
<td>Dip. Teach.:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>8 (9)</td>
<td>27 (30)</td>
<td>55 (61)</td>
<td>90 (100)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>42 (13)</td>
<td>81 (24)</td>
<td>210 (63)</td>
<td>333 (100)</td>
<td></td>
</tr>
<tr>
<td>Post-Grad. Dip. (Institute):</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>0 (0)</td>
<td>5 (23)</td>
<td>17 (77)</td>
<td>22 (100)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>6 (13)</td>
<td>11 (23)</td>
<td>31 (65)</td>
<td>48 (100)</td>
<td></td>
</tr>
<tr>
<td>Post-Grad. Dip. (University):</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>2 (12)</td>
<td>5 (29)</td>
<td>10 (59)</td>
<td>17 (100)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>2 (3)</td>
<td>19 (29)</td>
<td>45 (68)</td>
<td>66 (100)</td>
<td></td>
</tr>
<tr>
<td>All Non-Grad.:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>17 (10)</td>
<td>55 (32)</td>
<td>101 (58)</td>
<td>173 (100)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>92 (14)</td>
<td>195 (30)</td>
<td>363 (56)</td>
<td>650 (100)</td>
<td></td>
</tr>
<tr>
<td>All Post-Grad.:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>2 (5)</td>
<td>10 (26)</td>
<td>27 (69)</td>
<td>39 (100)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>8 (7)</td>
<td>30 (26)</td>
<td>76 (67)</td>
<td>114 (100)</td>
<td></td>
</tr>
<tr>
<td>Total Region:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>19 (9)</td>
<td>65 (31)</td>
<td>128 (60)</td>
<td>212 (100)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>100 (13)</td>
<td>225 (29)</td>
<td>439 (57)</td>
<td>764 (100)</td>
<td></td>
</tr>
</tbody>
</table>
FIGURE 5
Histogram Showing Percentages of Males and Females Passing Each Category of Total Mathematics, for the Post-Graduate and Total Illawarra Region Courses (1962 - 1981).

FIGURE 6
Results of Chi-Square Tests: For Total Mathematics Passed, By Gender.

<table>
<thead>
<tr>
<th>TYPE OF COURSE</th>
<th>x²</th>
<th>DF</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>CERTIFICATE</td>
<td>1.82575</td>
<td>2</td>
<td>.3960</td>
</tr>
<tr>
<td>DIP. TEACH.</td>
<td>1.76814</td>
<td>2</td>
<td>.4131</td>
</tr>
<tr>
<td>POST-GRAD. DIP. (INSTITUTE)</td>
<td>Not valid: 33% of expected cell frequencies were less than 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>POST-GRAD. DIP. (UNIVERSITY)</td>
<td>Not valid: 33% of expected cell frequencies were less than 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ALL NON-GRADS.</td>
<td>2.23199</td>
<td>2</td>
<td>.3276</td>
</tr>
<tr>
<td>ALL POST-GRADS.</td>
<td>.20147</td>
<td>2</td>
<td>.9042</td>
</tr>
<tr>
<td>TOTAL REGION</td>
<td>2.29773</td>
<td>2</td>
<td>.3170</td>
</tr>
</tbody>
</table>

For all groups except the individual Post-Graduate Diplomates, results were not significant at the .02 level, and the null hypothesis was retained. Chi-square tests were performed manually for the Post-Graduate Diploma groups, after combining the no mathematical education and little mathematical education categories to form an 'insufficient' category. The chi-square figures calculated for these groups were:

- Institute - 1.12, 1 DF
- University - .282, 1 DF

As with the other tests, these results were not significant, and the null hypothesis was retained.

Percentages reported in Table 9.A indicate that although the results were not statistically significant, over 55 per cent. of both male and female employable primary teachers have a sufficient mathematical background at the completion of teacher training. It is also important
to note that for all groups except the University Post-Graduate Diplomates, females have a higher proportion of their own sex in the no mathematical background category than males. While the Dip. Teach. group has the lowest discrepancy between the sexes for no mathematical background (4%), the Institute Post-Graduate Diplomates have the greatest discrepancy between the sexes (13%) in this category. Differences between the sexes in the sufficient category were: minimal for the Dip. Teach. (2%), combined Non-Graduates (2%), combined Post-Graduates (2%), and Total Region (3%); in favour of females for the Dip. Teach. group (2%) and the University Post-Graduate Diplomates (9%); and in favour of males for the Certificate group (7%), Institute Post-Graduate Diplomates (12%), combined Non-Graduates (2%), combined Post-Graduates (2%) and Total Region (3%).

It is also of interest to note which sex exhibits the most extreme proportions in each of the categories. The lowest proportion of either sex in the no mathematical background category was exhibited by the Institute Post-Graduate Diploma males (0%), whereas the highest proportion in the no mathematical background category was exhibited by the Certificate females (16%). Except for the Non-Graduate courses which display minimal differences between the sexes, the little mathematical background category has the lowest proportion displayed by both male and female Institute Post-Graduate Diplomates (23%), and the highest proportion displayed by the Certificate females (36%). The lowest proportion found in the sufficient mathematical background category was for the Certificate females (48%), while the highest proportion was exhibited by the combined Post-Graduate Diploma males (69%).

features. First, for each of the Non-Graduate groups and the Total Region group, there is a maximum difference of only 2 per cent. between the final secondary mathematics and total mathematics stages of education, for proportions in each category of mathematics passed. Substantial differences between these two stages of education are evident for each of the Post-Graduate Diploma groups, particularly in the no mathematical background and little mathematical background categories. While differences in proportions at the total mathematics stage are quite noticeable for each sex in each individual Post-Graduate Diploma group and the combined Post-Graduate Diploma courses, the largest differences occurred in the female University Post-Graduate Diploma group. At the total mathematics stage for this group, there were 14 per cent. less in the no mathematical background category, 11 per cent. more in the little mathematical background category and 3 per cent. more in the sufficient mathematical background category.

Second, there is a similarity in the 'hierarchy' of courses for these two Tables. An increasing proportion of those deemed to possess sufficient mathematical background, and a decreasing proportion of those deemed to possess no or little mathematical background, is found as the hierarchical scale of qualifications is ascended.

4.6 The Relationship Between Field of Specialisation and Levels and Types of Mathematics Passed.

4.6.1 Field of Specialisation By Final Secondary Mathematics Passed.

\[ H_0^1 \] : Category of final secondary mathematics passed and the field specialised in during teacher training are independent.

\[ H_1^1 \] : Category of final secondary mathematics passed and the field specialised in during teacher training are related.
The frequencies of passes in each category of final secondary mathematics for those completing each field of specialisation are shown in Table 10.A, for each type of course.

### Table 10.A

Categories of Final Secondary Mathematics Passed By Each Field of Specialisation, For Each Type of Course in Illawarra Region Tertiary Institutions (1962 - 1981).

<table>
<thead>
<tr>
<th>TYPE OF COURSE &amp; FIELD</th>
<th>CATEGORIES OF FINAL SECONDARY MATHEMATICS PASSED</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NONE (N)</td>
</tr>
<tr>
<td>Certificate:</td>
<td></td>
</tr>
<tr>
<td>Small Schs.</td>
<td>4 (14)</td>
</tr>
<tr>
<td>Infants</td>
<td>25 (17)</td>
</tr>
<tr>
<td>General Pr.</td>
<td>26 (12)</td>
</tr>
<tr>
<td>Dip. Teach.:</td>
<td></td>
</tr>
<tr>
<td>Infants</td>
<td>17 (13)</td>
</tr>
<tr>
<td>General Pr.</td>
<td>32 (11)</td>
</tr>
<tr>
<td>Post-Grad. Dip. (Institute):</td>
<td></td>
</tr>
<tr>
<td>General Pr.</td>
<td>11 (16)</td>
</tr>
<tr>
<td>Post-Grad. Dip. (University):</td>
<td></td>
</tr>
<tr>
<td>Infants</td>
<td>3 (9)</td>
</tr>
<tr>
<td>General Pr.</td>
<td>11 (22)</td>
</tr>
<tr>
<td>All Non-Grads.:</td>
<td></td>
</tr>
<tr>
<td>Small Schs.</td>
<td>4 (14)</td>
</tr>
<tr>
<td>Infants</td>
<td>42 (15)</td>
</tr>
<tr>
<td>General Pr.</td>
<td>58 (11)</td>
</tr>
<tr>
<td>All Post-Grads.:</td>
<td></td>
</tr>
<tr>
<td>Infants</td>
<td>3 (9)</td>
</tr>
<tr>
<td>General Pr.</td>
<td>22 (18)</td>
</tr>
<tr>
<td>Total Region:</td>
<td></td>
</tr>
<tr>
<td>Small Schs.</td>
<td>4 (14)</td>
</tr>
<tr>
<td>Infants</td>
<td>45 (15)</td>
</tr>
<tr>
<td>General Pr.</td>
<td>80 (13)</td>
</tr>
</tbody>
</table>
Frequencies for the Total Region are presented graphically as proportions of the same field of specialisation passing each category of final secondary mathematics, in Figure 7 below.

**FIGURE 7**


Results of chi-square tests for the relationship between the category of final secondary mathematics passed and the field specialised in during teacher training are presented in Table 10.8 on the following page, for each type of course.

Results for all groups except the Total Region were not significant at the .02 level, and the null hypothesis was retained. The result for the Total Region was significant, and the alternate hypothesis specifying a relationship between the category of final secondary mathematics passed and the field of specialisation was
accepted. However, the contingency coefficient for this group indicates an extremely low degree of relationship.

An examination of Table 10.A and Figure 7 reveals several interesting trends for the Total Region group as well as the other groups. Total Region figures show that the Infants field of specialisation had the highest proportion of individuals in the no mathematical background category. This was not the case for the Infants field in the University Post-Graduate Diploma group,

**TABLE 10.B**

Results of Chi-Square Tests: For Final Secondary Mathematics Passed, By Field of Specialisation.

<table>
<thead>
<tr>
<th>TYPE OF COURSE</th>
<th>$x^2$</th>
<th>DF</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>CERTIFICATE</td>
<td>5.09011</td>
<td>4</td>
<td>.2782</td>
<td>.11265</td>
</tr>
<tr>
<td>DIP. TEACH.</td>
<td>1.99710</td>
<td>2</td>
<td>.3684</td>
<td>.06863</td>
</tr>
<tr>
<td>POST-GRAD. DIP. (INSTITUTE)</td>
<td>Only General Primary available</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>POST-GRAD. DIP. (UNIVERSITY)</td>
<td>2.64358</td>
<td>2</td>
<td>.2667</td>
<td>.17569</td>
</tr>
<tr>
<td>ALL NON-GRADS.</td>
<td>9.82219</td>
<td>4</td>
<td>.0435</td>
<td>.10893</td>
</tr>
<tr>
<td>ALL POST-GRADS.</td>
<td>2.19401</td>
<td>2</td>
<td>.3339</td>
<td>.11890</td>
</tr>
<tr>
<td>TOTAL REGION</td>
<td>12.25210</td>
<td>4</td>
<td>.0156</td>
<td>.11135</td>
</tr>
</tbody>
</table>

where the General Primary field had the highest proportion of those with no final secondary mathematics. Another trend is indicated by the Total Region figures, where those trained in the General Primary field noticeably had the largest proportion of employable primary teachers with a sufficient final secondary mathematical background.
All General Primary trainees in the Region also had the smallest proportion of teachers in the no and little mathematical background categories. Interestingly, Small Schools trainees had a completely different distribution of mathematical background to the two other fields - while 14 per cent. had no mathematical background, nearly 50 per cent. had a little mathematical background, and not quite 40 per cent. had a sufficient mathematical background. Although General Primary trainees had almost the same percentage of individuals in the no mathematical background category, the difference between Small Schools and General Primary trainees is extremely large in the sufficient category - 23 per cent. in favour of General Primary trainees.

The highest proportion of each separate group with no mathematical background at secondary level is found in the University General Primary trainee group, although for the Total Region this is found in the Infants field. Conversely, the lowest proportion of each separate group with no mathematical background is found in the Infants trainees at the University. The single group displaying the highest proportion of employable primary teachers in the sufficient mathematical background category is the Post-Graduate Diploma group at the Institute, who were all General Primary trained.

4.6.2 Field of Specialisation By Final Secondary and Tertiary, or Total, Mathematics Passed.

\[ H_{04}^2 \] : Category of total mathematics passed and the field specialised in during teacher training are independent.

\[ H_{14}^2 \] : Category of total mathematics passed and the field specialised in during teacher training are related.
The number of employable primary teachers from each field of specialisation who passed each category of final secondary and tertiary mathematics are shown in Table 11.A, for each type of course.

**TABLE 11.A**

Categories of Total Mathematics Passed By Each Field of Specialisation, For Each Type of Course in Illawarra Region Tertiary Institutions (1962 - 1981).

<table>
<thead>
<tr>
<th>TYPE OF COURSE &amp; FIELD</th>
<th>CATEGORIES OF FINAL MATHEMATICS PASSED</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NONE (%)</td>
<td>LITTLE (%)</td>
</tr>
<tr>
<td>Certificate: Small Schs.</td>
<td>5 (17)</td>
<td>14 (47)</td>
</tr>
<tr>
<td>Infants</td>
<td>27 (19)</td>
<td>50 (34)</td>
</tr>
<tr>
<td>General Pr.</td>
<td>27 (12)</td>
<td>78 (35)</td>
</tr>
<tr>
<td>Dip. Teach.: Infants</td>
<td>17 (13)</td>
<td>38 (30)</td>
</tr>
<tr>
<td>General Pr.</td>
<td>33 (11)</td>
<td>70 (24)</td>
</tr>
<tr>
<td>Post-Grad. Dip. (Institute): General Pr.</td>
<td>6 (9)</td>
<td>16 (23)</td>
</tr>
<tr>
<td>Post-Grad. Dip. (University): Infants</td>
<td>2 (6)</td>
<td>9 (28)</td>
</tr>
<tr>
<td>General Pr.</td>
<td>2 (4)</td>
<td>15 (29)</td>
</tr>
<tr>
<td>All Non-Grads.: Small Schs.</td>
<td>5 (17)</td>
<td>14 (47)</td>
</tr>
<tr>
<td>Infants</td>
<td>44 (16)</td>
<td>88 (32)</td>
</tr>
<tr>
<td>General Pr.</td>
<td>60 (12)</td>
<td>148 (28)</td>
</tr>
<tr>
<td>All Post-Grads.: Infants</td>
<td>2 (6)</td>
<td>9 (28)</td>
</tr>
<tr>
<td>General Pr.</td>
<td>8 (7)</td>
<td>31 (25)</td>
</tr>
<tr>
<td>Total Region: Small Schs.</td>
<td>5 (17)</td>
<td>14 (47)</td>
</tr>
<tr>
<td>Infants</td>
<td>46 (15)</td>
<td>97 (32)</td>
</tr>
<tr>
<td>General Pr.</td>
<td>68 (11)</td>
<td>179 (28)</td>
</tr>
</tbody>
</table>
Frequencies for the Total Region are presented graphically as proportions of the same field of specialisation passing each category of final secondary and tertiary, or total, mathematics, in Figure 8 below.

**FIGURE 8**


Results of chi-square tests for these two variables are presented in Table 11.B on the following page, for each type of course.

Except for the Total Region, all of these results were not significant at the .02 level, and the null hypothesis was retained. Rejection of the null hypothesis for the Total Region leads to the assumption that there is some relationship between the category of total mathematics passed and the field of specialisation. However,
the contingency coefficient reflects an exceedingly low degree of association between these two variables.

An examination of Table 11.A and Figure 8 reveals that for the Total Region group, each field of specialisation has a distinctly different pattern of total mathematical background, although each field has less than 1 in 5 individuals in the no mathematical background category. For Small Schools, the mode is little mathematical background, whereas for Infants and General Primary the mode is sufficient mathematical background. Indeed, as one progresses through Small Schools, to Infants, to General Primary training, the ratio of individuals in the no and little mathematical background categories

TABLE 11.B

Results of Chi-Square Tests: For Total Mathematics Passed, By Field of Specialisation.

<table>
<thead>
<tr>
<th>TYPE OF COURSE</th>
<th>$x^2$</th>
<th>DF</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>CERTIFICATE</td>
<td>5.69141</td>
<td>4</td>
<td>.2234</td>
<td>.11844</td>
</tr>
<tr>
<td>DIP. TEACH.</td>
<td>2.49697</td>
<td>2</td>
<td>.2869</td>
<td>.07661</td>
</tr>
<tr>
<td>POST-GRAD. DIP. (INSTITUTE)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>POST-GRAD. DIP. (UNIVERSITY)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ALL NON-GRADS.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ALL POST-GRADS.</td>
<td>2.11852</td>
<td>2</td>
<td>.3467</td>
<td>.11687</td>
</tr>
<tr>
<td>TOTAL REGION</td>
<td>12.25210</td>
<td>4</td>
<td>.0156</td>
<td>.11135</td>
</tr>
</tbody>
</table>
becomes progressively smaller, while the sufficient mathematical background category becomes progressively larger. For example, in the Total Region figures the sufficient mathematical background ratios change from 2 in 5 for Small Schools, to 2.5 in 5 for Infants, to 3 in 5 for General Primary. Conversely, while nearly 1 in 5 Small Schools trainees possessed no mathematical background, only slightly less than 1 in 10 General Primary trainees possessed no mathematical background.

However, it should also be noted that while the non-Graduate courses, both singularly and in combination, follow the Total Region's hierarchical trend for each field of specialisation, the Post-Graduate Diploma courses do not. Each Post-Graduate Diploma course, as well as the combined Post-Graduate Diploma courses, displayed a lower proportion of individuals in the no mathematical background category and a higher proportion of individuals in the sufficient mathematical background category, than any other course in the Region.

A comparison of Tables 10.A and 11.A reveals two other interesting features. First, differences in the proportions for each category of mathematics between the final secondary stage and the total stage of education for each of the non-Graduate groups are mainly a reflection of the five individuals who could not be classified at the final secondary stage. More noticeable and much more realistic differences occurred between these two stages of education for each of the Post-Graduate Diploma groups, particularly in the General Primary field of specialisation at the University. While the University Post-Graduate Diploma Infants distribution altered at the total stage of education in the no mathematical background category by 3 per cent., the little mathematical background category by 5 per cent., and the
sufficient mathematical background category by 1 per cent., the University Post-Graduate Diploma General Primary group showed a redistribution of 18 per cent., 13 per cent., and 4 per cent. The second feature which is indicated by a comparison of these two Tables is that the differences noted for the hierarchy of fields of specialisation at the final secondary stage of education are maintained at the total stage of education. That is, the Small Schools field had the largest proportions in the no and little mathematical background categories, and the smallest proportion in the sufficient category. The Infants field had smaller proportions in the no and little mathematical background categories, and a larger proportion than Small Schools in the sufficient category. The General Primary field had the smallest proportions in the no and little mathematical background categories, and the largest proportion in the sufficient category.

4.7 The Relationship Between the Year in Which Teacher Training Was Completed and Levels and Types of Mathematics Passed.

4.7.1 Year in Which Teacher Training Was Completed, or Cohort, By Final Secondary Mathematics Passed.

\[ H^0 \] : Category of final secondary mathematics passed and the year in which teacher training was completed are independent.

\[ H^1 \] : Category of final secondary mathematics passed and the year in which teacher training was completed are related.

Any tabulated form of data would be difficult to present in any comprehensible manner for all courses and all cohorts. Data is therefore presented graphically in Figures 9 to 15 on the following pages, for the proportions of those passing each category of final secondary mathematics in each cohort, for each type of course.
FIGURE 9


FIGURE 10

Percentage of Those Passing Each Category of Final Secondary Mathematics, Who Completed the Institute Post-Graduate Diploma Course (Primary Method) in the Illawarra Region (1977 - 1981)

FIGURE 11

Percentage of Those Passing Each Category of Final Secondary Mathematics, Who Completed the University Post-Graduate Diploma Course (Primary Method) in the Illawarra Region (1977 - 1981)

FIGURE 12
FIGURE 13
Percentage of Those Passing Each Category of Final Secondary Mathematics, Who Completed the Non-Graduate Primary Teacher Training Courses in the Illawarra Region (1964 - 1981)

FIGURE 14
FIGURE 15

Results of chi-square tests for each type of course are shown in Table 12.

TABLE 12
Results of Chi-Square Tests : For Final Secondary Mathematics Passed, By Cohort.

<table>
<thead>
<tr>
<th>TYPE OF COURSE</th>
<th>$x^2$</th>
<th>DF</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>CERTIFICATE</td>
<td>50.21338</td>
<td>18</td>
<td>.0001</td>
<td>.33546</td>
</tr>
<tr>
<td>DIP. TEACH.</td>
<td>Not valid: 33% of expected cell frequencies were less than 5.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>POST-GRAD. DIP. (INSTITUTE)</td>
<td>Not valid: 60% of expected cell frequencies were less than 5.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>POST-GRAD. DIP. (UNIVERSITY)</td>
<td>Not valid: 40% of expected cell frequencies were less than 5.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ALL NON-GRADS.</td>
<td>80.33233</td>
<td>34</td>
<td>.0000</td>
<td>.29904</td>
</tr>
<tr>
<td>ALL POST-GRADS.</td>
<td>Not valid: 27% of expected cell frequencies were less than 5.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL REGION</td>
<td>84.81605</td>
<td>34</td>
<td>.0000</td>
<td>.28343</td>
</tr>
</tbody>
</table>

* 6% of cells had less than the minimum expected cell frequency, where minimum expected cell frequency was 4.9
For the Certificate, All Non-Graduate and Total Region courses, the results of the chi-square tests were extremely significant. Although this indicates that there is some relationship between the category of final secondary mathematics passed and the year in which teacher training was completed, the contingency coefficients simultaneously indicate that the degree of the relationship is not exceptionally strong - although it is stronger for the Certificate course than the others. The problem with the chi-square tests which was encountered by the Dip. Teach. and Post-Graduate Diplomate groups, was a result of the extremely small number of individuals in the no mathematical background category. Manually calculated chi-square figures based on the categories 'insufficient' and 'sufficient' were as follows:

Dip. Teach. - 12.124, 20 DF,
Institute Post-Graduate Diplomates - .432, 1 DF,
University Post-Graduate Diplomates - .249, 1 DF, and
All Post-Graduate Diplomates - 1.605, 1 DF.

In all cases the results were not significant at the .02 level, and the null hypothesis was retained.

Figures 9 to 15 reveal that for each separate group the modal category was a sufficient mathematical background, except where little mathematical background became the mode for the Certificate, All Non-Graduate and Total Region courses in the cohorts 1966 to 1968, and for the Institute Post-Graduate Diploma and All Post-Graduate Diploma courses in 1981. These Figures also indicate that for each course, there were fluctuations through cohorts in each category of mathematical background.

For the Certificate course (Figure 9) there was a general
downward trend in the proportions of those possessing no mathematical background, ranging from 22% in 1964 to 5% in 1971. The little category fluctuated considerably, ranging from 35% in 1964, to 56% in 1967, to 13% in 1971 - and except for 1966 to 1968, inclined towards a downward trend. The cohorts 1966 and 1968 showed over 50% of those trained in the Certificate course with little mathematical background at the secondary stage of education. The sufficient category appeared to decrease from 1964 to 1968, while from 1969 to 1973 it generally appeared to increase.

The Diploma in Teaching course was quite different (Figure 10). There appeared to be an upward trend in the proportion of those possessing no secondary mathematical background, ranging from 7% in 1971, to 3% in 1977, to 18% in 1981. While 1974 showed a dramatic decrease in the proportion of those possessing no mathematical background, there was a congruent downward trend in the sufficient category, ranging from 76% in 1973, to 53% in 1981. A less noticeable trend for an increase in those with little mathematical background was also displayed in Figure 8, ranging from 24% in 1971 to 29% in 1981.

When the two Non-Graduate groups were combined (Figure 13), yet another pattern emerged. The proportion of those possessing no mathematical background certainly fluctuated, but in no apparent direction, and ranged from 23% in 1964, to 3% in 1977, to 18% in 1981. A slight downward trend in the little category was evident, except for an increase in the proportion of those in this category of secondary mathematics between 1966 and 1968. Of the proportion possessing a sufficient secondary mathematical background, there appeared to be a decrease from 1964 to 1968, fluctuations between 1969 and 1975, and a downward trend from 1975 to 1981.
University Post-Graduate Diplomates (Figure 12) showed an increasing proportion of individuals in the no secondary mathematical background category over the cohorts 1977 to 1981; fluctuations in no apparent direction in the little mathematical background category; and a slight downward trend in the sufficient mathematical background category, ranging from 75% in 1977 to 60% in 1981. The Institute Post-Graduate Diplomates (Figure 11) however, revealed a completely different pattern. The number of those possessing no secondary mathematical background fluctuated in no apparent direction; the proportion of those in the little mathematical background category ranged from 19% in 1977 to 0% in 1978, and dramatically increased to 57% in 1981; while the proportions of those in the sufficient mathematical background category dramatically decreased from 90% in 1978 to 28% in 1981. When the two Post-Graduate Diploma groups were combined (Figure 14), the no and little mathematical background categories fluctuated in no apparent direction, whereas the proportion of those in the sufficient mathematical background category generally decreased from 66% in 1977 to 53% in 1981.

The Total Region trends (Figure 15) were influenced by all the trends noted above. In the no mathematical background category, there was a decrease from 1964 to 1967, an increase in 1968, a decrease from 1969 to 1973, a seemingly stable period from 1974 to 1977, which was followed by another increase from 1978 to 1981. Within the little mathematical background category there was a sharp increase from 1966 to 1968, a decrease in 1969, and an apparent stable period from 1970 which continued to 1981, despite fluctuations for interspersing cohorts. For the sufficient mathematical background category, there was a decrease from 1964 to 1968, followed by two dramatic increases in 1969-1970 and 1970-1971, fluctuations from 1972 to 1975, and a general decrease from 1976 to 1981.
4.7.2 Year in Which Teacher Training Was Completed, or Cohort, By Final Secondary and Tertiary, or Total, Mathematics Passed.

$H_0^2$: Category of total mathematics passed and the year in which teacher training was completed are independent.

$H_1^2$: Category of total mathematics passed and the year in which teacher training was completed are related.

As with the data for final secondary mathematics passed, data for this hypothesis is difficult to present in tabulated form. Graphs of the proportions of individuals in each cohort passing each category of total mathematics are therefore presented in Figures 16 to 22 on the following pages, for each type of course.

FIGURE 16

Percentage of Those Passing Each Category of Total Mathematics, Who Completed the Certificate Course in the Illawarra Region (1964 - 1973)

Percentage of Those Passing Each Category of Total Mathematics, Who Completed the Institute Post-Graduate Diploma (Primary Method) Course in the Illawarra Region (1977 - 1981)
FIGURE 19
Percentage of Those Passing Each Category of Total Mathematics, Who Completed the University Post-Graduate Diploma (Primary Method) Course in the Illawarra Region (1977 - 1981)

FIGURE 20
Percentage of Those Passing Each Category of Total Mathematics, Who Completed the Non-Graduate Primary Teacher Training Courses in the Illawarra Region (1964 - 1981)
FIGURE 21
Percentage of Those Passing Each Category of Total Mathematics, Who Completed the Post-Graduate Diploma (Primary Method) Courses of Teacher Training in the Illawarra Region (1977 - 1981)

FIGURE 22
Results of chi-square tests for the relationship between the category of total mathematics passed and the year in which teacher training was completed are shown in Table 13, for each type of course.

**Table 13**

Results of Chi-Square Tests: For Total Mathematics Passed, By Cohort.

<table>
<thead>
<tr>
<th>TYPE OF COURSE</th>
<th>$\chi^2$</th>
<th>DF</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>CERTIFICATE</td>
<td>48.59403</td>
<td>18</td>
<td>.0001</td>
<td>.32913</td>
</tr>
<tr>
<td>DIP. TEACH.</td>
<td>Not valid: 33% of expected cell frequencies were less than 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>POST-GRAD. DIP.</td>
<td>Not valid: 60% of expected cell frequencies were less than 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(INSTITUTE)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>POST-GRAD. DIP.</td>
<td>Not valid: 40% of expected cell frequencies were less than 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(UNIVERSITY)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ALL NON-GRADS.</td>
<td>78.63269</td>
<td>34</td>
<td>.0000</td>
<td>.29532</td>
</tr>
<tr>
<td>ALL POST-GRADS.</td>
<td>Not valid: 27% of expected cell frequencies were less than 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL REGION</td>
<td>83.94722</td>
<td>34</td>
<td>.0000</td>
<td>.28142</td>
</tr>
</tbody>
</table>

Results for the Certificate, All Non-Graduate and Total Region courses were highly significant. Although this establishes some sort of relationship between the category of total mathematics passed and the year in which teacher training was completed, the contingency coefficients indicate that the degree of these relationships is not particularly strong - although it is stronger for the Certificate course than the others. As with the categories of final secondary mathematics passed, the small number of individuals in the no mathematical background category for most cohorts of the Dip. Teach. and Post-Graduate Diploma courses resulted in inconclusive tests.
Manually calculated chi-square tests for these groups, based on the two categories of 'insufficient' and 'sufficient' were all not statistically significant at the .02 level, and the null hypothesis was retained:

Dip. Teach. - 12.124, 20 DF,
Institute Post-Graduate Diploma - 60% of cells still invalid,
University Post-Graduate Diploma - 40% of cells still invalid, and
All Post-Graduate Diploma - 3.82, 4 DF

Figures 16 to 22 reveal that a sufficient mathematical background was the mode for all cohorts in each course, except where little mathematical background became the mode for the Certificate, All Non-Graduate and Total Region courses from 1966 to 1968, and the Institute Post-Graduate Diploma course in 1981.

A comparison of these Figures with the final secondary mathematics Figures, for each respective type of course, indicates that there is very little difference between proportions passing each category of mathematics in each cohort. These barely noticeable differences usually occur in the form of slight inflations in the sufficient mathematical background category or slight deflations of the no mathematical background category, at the total mathematics stage of education. For example, the sufficient category has a slight increase at the total mathematics stage for the cohort 1981, and the no mathematics category for the Certificate course is slightly deflated at the total mathematics stage for the cohort 1971. An inflated no mathematical background category is also evident at the total mathematics stage for some cohorts, but this is merely due to the inclusion of those five individuals who could not be categorised at the final secondary stage, but were categorised at the total mathematics stage.
Of all types of course, the Post-Graduate Diploma courses show the most noticeable changes between the final secondary and the total mathematics stages of education. For the University Post-Graduates, the no mathematical background category is deflated at the total mathematics stage in all cohorts except 1978 and 1981; the little mathematical background category does not alter; while the sufficient mathematical background category is inflated at the total mathematics stage for the cohorts 1979 to 1981. For the Institute Post-Graduate Diploma course, the only difference between these two stages is in the cohort 1979, where the little mathematical background category is slightly deflated and the sufficient mathematical background category is correspondingly inflated at the total mathematics stage. When these two courses were combined, the cohorts 1979 and 1980 displayed an inflated sufficient category and a deflated no category at the total mathematics stage of education.

4.8 The Relationship Between Gender and Field of Specialisation.

\[
\begin{align*}
\text{H}_0^6 & : \quad \text{Gender of the employable primary teacher and the field specialised in during teacher training are independent.} \\
\text{H}_1^6 & : \quad \text{Gender of the employable primary teacher and the field specialised in during teacher training are related.}
\end{align*}
\]

The numbers of males and females who specialised in each field available for primary teacher training in the Region are shown in Table 14.A for each type of course.
TABLE 14.A

The Field of Specialisation Which Males and Females Completed in Each Type of Primary Teacher Training Course in Illawarra Region Tertiary Institutions (1964 - 1981)

<table>
<thead>
<tr>
<th>TYPE OF COURSE</th>
<th>FIELD OF SPECIALISATION</th>
<th>SMALL SCHOOLS</th>
<th>INFANTS</th>
<th>GENERAL PRIMARY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Male N</td>
<td>Female N</td>
<td>Male N</td>
</tr>
<tr>
<td>Certificate</td>
<td></td>
<td>29 (97)</td>
<td>1 (3)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>DIP. TEACH.</td>
<td></td>
<td>-</td>
<td>-</td>
<td>12 (9)</td>
</tr>
<tr>
<td>POST-GRAD. DIP. (INSTITUTE)</td>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>POST-GRAD. DIP. (UNIVERSITY)</td>
<td></td>
<td>-</td>
<td>-</td>
<td>9 (28)</td>
</tr>
<tr>
<td>TOTAL REGION</td>
<td></td>
<td>29 (97)</td>
<td>1 (3)</td>
<td>21 (7)</td>
</tr>
</tbody>
</table>
Results of all chi-square tests are shown in Table 14.B for each type of course. The Post-Graduate Diploma course from the Institute is excluded because General Primary was the only field of specialisation available.

**TABLE 14.B**

Results of Chi-Square Tests: For Gender by Field of Specialisation.

<table>
<thead>
<tr>
<th>TYPE OF COURSE</th>
<th>$\chi^2$</th>
<th>DF</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>CERTIFICATE</td>
<td>144.55297</td>
<td>2</td>
<td>.0000</td>
<td>.51522</td>
</tr>
<tr>
<td>DIP. TEACH.</td>
<td>14.51932</td>
<td>1</td>
<td>.0001</td>
<td>.18814</td>
</tr>
<tr>
<td>POST-GRAD. DIP. (UNIVERSITY)</td>
<td>1.18225</td>
<td>1</td>
<td>.2769</td>
<td>.14836</td>
</tr>
<tr>
<td>ALL NON-GRADS.</td>
<td>154.81749</td>
<td>2</td>
<td>.0000</td>
<td>.39791</td>
</tr>
<tr>
<td>ALL POST-GRADS.</td>
<td>.23438</td>
<td>1</td>
<td>.6283</td>
<td>.03911</td>
</tr>
<tr>
<td>TOTAL REGION</td>
<td>152.68043</td>
<td>2</td>
<td>.0000</td>
<td>.36780</td>
</tr>
</tbody>
</table>

Results for the Post-Graduate Diploma courses were not significant at the .02 level, and the null hypothesis was retained. The results for the Certificate, Dip. Teach., All Non-Graduate and Total Region courses were extremely significant. For these courses it can be asserted that there is a relationship between the sex of the employable primary teacher and the field in which they specialised during teacher training. The contingency coefficient for the Certificate course shows a very high degree of association for these two variables; the Total Region shows a medium strength of relationship; and the Dip. Teach. course shows a low measure of association.
For the Certificate course, Table 14.A reveals that males comprised 97 per cent. of the Small Schools field, but were not even represented in the Infants field. While females constituted 76 per cent. of the General Primary field in the Certificate course, in the Dip. Teach. course they constituted 74 per cent. of the General Primary field. In comparison to the male representation in the Infants field for each of the Non-Graduate courses (0 and 9 per cent.), males in the Post-Graduate Diploma group at the University comprised 28 per cent. of the Infants field. It is therefore apparent that there is a trend in each individual course and all courses combined for males to greatly dominate the Small Schools field, and for females to dominate the Infants and General Primary fields of specialisation.

4.9 The Relationship Between Gender and the Institution at Which Teacher Training Was Completed.

\[ H_{07} \quad : \text{Gender of the employable primary teacher and the institution at which primary teacher training was completed are independent.} \]

\[ H_{17} \quad : \text{Gender of the employable primary teacher and the institution at which primary teacher training was completed are related.} \]

Results of chi-square tests for the Post-Graduate Diploma and all individuals within the Regional sample are shown in Table 15.

**TABLE 15**

Results of Chi-Square Tests: For Gender by Institution.

<table>
<thead>
<tr>
<th>TYPE OF COURSE</th>
<th>( x^2 )</th>
<th>DF</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALL POST-GRAD. DIPS.</td>
<td>2.57787</td>
<td>1</td>
<td>.1217</td>
</tr>
<tr>
<td>TOTAL REGION</td>
<td>.01626</td>
<td>1</td>
<td>.8985</td>
</tr>
</tbody>
</table>
Neither of these results was significant at the .02 level, and the null hypothesis specifying that the gender of the primary teachers and the institution at which teacher training was completed are independent was retained.

Table 8.A, concerning the categories of final secondary mathematics passed by each sex, for each type of course, indicates that females dominate all types of primary teacher training courses in the Illawarra Region. For every one male in each type of course, there have been the following number of females: Certificate course - 3.8; Diploma in Teaching (Primary) course - 3.7; Institute Post-Graduate Diploma course - 2.2; University Post-Graduate Diploma course - 3.9; All Non-Graduate courses - 3.8; All Post-Graduate Diploma courses - 2.9; and Total Region courses - 3.6. Differences between the ratio of females to males at each institution were quite small - for every male completing a primary teacher training course at the Institute there were 3.6 females completing the same courses, whereas at the University there were 3.9 females completing the primary teacher training course for every male completing the same course.

4.10 Summary of Findings.

4.10.1 Levels of Mathematics Passed By Those Completing Primary Teacher Training Courses in the Illawarra Region Tertiary Institutions (1964 - 1981)

- No more than 17% and no less than 12% possessed no final secondary mathematics.
- No more than 15% and no less than 5% possessed no final secondary or tertiary mathematics.
- No more than 36% and no less than 34% passed Level 1 secondary mathematics.
- No more than 50% and no less than 34% passed Level 2 secondary mathematics.
- No more than 20% and no less than 12% passed Level 3 secondary mathematics.
- No more than 2% passed Level 4 secondary mathematics.
- Of all individuals within the sample, 736 (75.41%) did not pass some sort of mathematics course at tertiary level.
- While 129 (13.21%) individuals had passed no final secondary mathematics, 119 (12.19%) had passed no final secondary or tertiary mathematics.
- Types of tertiary mathematics which were passed ranked in the following order, from highest to lowest: 'A' courses (University service courses), 'Y' courses (Institute academic courses), 'X' courses (Institute Environmental courses), and 'B', 'C', or 'D' courses (University academic courses). Expressed as a percentage of those passing any tertiary course, these were: 'A' = 46.67%; 'Y' = 25.83%; 'X' = 18.75%; 'B', 'C' or 'D' = 8.75%.

4.10.2 Adequacy of the Mathematics Passed By Those Completing Primary Teacher Training Courses in the Illawarra Region Tertiary Institutions (1964 - 1981)

Due to fluctuations which were evident between courses, figures for the Total Region and ranges will be summarised, unless otherwise indicated.

- 13.28% possessed no mathematical background, 28.94% possessed little mathematical background, and 57.78% possessed sufficient mathematical background at the final secondary stage of education.
- At the completion of teacher training courses, 12.19% possessed no mathematical background, 29.71% possessed little mathematical background, and 58.09% possessed sufficient mathematical background.

- Except for the University Post-Graduate Diploma course, females had a higher proportion of their own sex in the no mathematical background category than males. Conversely, except for the Diploma in Teaching and University Post-Graduate Diploma courses, males had a higher proportion of their own sex in the sufficient mathematical background categories than females.

- The Small School field of specialisation had the largest proportion in the no and little mathematical background categories, whereas the General Primary field had the largest proportion in the sufficient mathematical background category.

- The Institute had a larger proportion than the University in the no mathematical background category and an identical proportion to the University in the little mathematical background category, whereas the University had a larger proportion than the Institute in the sufficient mathematical background category.

4.10.3 The Relationship Between the Type of Primary Teacher Training Course Completed and Mathematics Passed

- Chi-square tests were significant at both the final secondary and tertiary stages of education.

  Trends included:

  - At both stages of education, those completing the Certificate course possessed the least mathematical background, while those completing the Post-Graduate Diploma in Education courses possessed the most mathematical background.
- Both the Diploma in Education and the Diploma in Teaching courses had a higher proportion of individuals with sufficient mathematical background than expected, while the Certificate course had a higher proportion of individuals with no and little mathematical background than expected.

- Differences between the two stages of education for proportions of individuals in each category of mathematics were non-existent for the Certificate course, minimal for the Diploma in Teaching course, and noticeable for the Post-Graduate Diploma in Education courses.

4.10.4 The Relationship Between the Institution at Which Teacher Training Was Completed and Mathematics Passed

- Results of chi-square tests were not significant at the .02 level, at both stages of education, and for all types of courses. Trends included:

- The Institute had 43% of all individuals in the no and little mathematical background categories, while the University had 35% of all individuals in these categories.

- The University displayed the largest proportion of individuals in the sufficient mathematical background category, but the lowest proportion of individuals in the little mathematical background category at the final secondary stage of education.

- The University displayed the largest proportion of individuals in the sufficient mathematical background category, while the Institute had the largest proportion of individuals in the no mathematical background category at the total mathematics stage of education.
- When Post-Graduate Diplomates at each institution were examined, the Institute had the largest proportion of individuals in both the sufficient and no mathematical background categories.

- A difference between the final secondary and total mathematics stages of education was noticeable for the University population only; with 13% less in the no category, 11% more in the little category, and 2% more in the sufficient mathematical background category at the total mathematics stage.

4.10.5 The Relationship Between the Gender of the Employable Primary Teacher and Mathematics Passed

- Chi-square tests were not significant for all types of courses at both the final secondary stage and the tertiary stage of education.

Trends included:

- For all groups except the University Post-Graduate Diplomates, females had a higher proportion of their own sex in the no mathematical background category than males.

- Proportions in the sufficient mathematical background category favoured males for the Certificate, Institute Post-Graduate Diploma, All Non-Graduate, All Post-Graduate Diploma and Total Region courses; whereas females were favoured for the Diploma in Teaching and University Post-Graduate Diploma courses.

- A difference between final secondary mathematics and total mathematics stages was almost negligible for the Certificate and Diploma in Teaching courses, but were noticeable for each Post-Graduate Diploma course, particularly for females.
The Relationship Between the Field Specialised in During Teacher Training and Mathematics Passed

- Chi-square tests for the Total Region were significant at the .02 level for both the final secondary and total mathematics stages of education.

- Chi-square tests for all other courses were not significant at the .02 level for either stage of mathematical education.

Trends included:

- The Infants field possessed the largest proportion of individuals in the no mathematical background category, for each course except the University Post-Graduate Diplomates (where General Primary had the largest proportion) and the Certificate course (where Small Schools had the largest proportion).

- The General Primary field possessed the largest proportion of individuals in the sufficient mathematical background category.

- The Small Schools field possessed the largest proportion of individuals in the little mathematical background category.

- The Certificate, Diploma in Teaching and All Non-Graduate courses displayed a pattern similar to the Total Region.

- A difference between final secondary and total mathematics stages of education was barely noticeable for the Certificate and Diploma in Teaching courses, except perhaps for the Small Schools field; whereas differences for each Post-Graduate Diploma course were quite noticeable, particularly for the General Primary field.
The Relationship Between the Year in Which Teacher Training Was Completed and Mathematics Passed

- At both the final secondary and total mathematics stages of education, chi-square tests for the Certificate, All Non-Graduate and Total Region courses were significant at the .02 level. Other courses had inconclusive results, and when the tests were computed manually with further revised cell structure, results were not significant at the .02 level.

Trends included:

- Fluctuations through cohorts were evident for each type of course.
- Different trends were evident for each type of course.

For each type of course, sufficient mathematical background was the mode in all cohorts, except for the Certificate, All Non-Graduate and Total Region courses in the cohorts 1966, 1967 and 1968, and the Institute Post-Graduate Diploma course in 1981.


- Differences between the final secondary and total mathematics stages of education were barely noticeable, except for some cohorts in the Post-Graduate Diploma courses.
4.10.8 The Relationship Between the Gender of the Employable Primary Teacher and the Field Specialised in During Teacher Training

- Results of chi-square tests were significant at the .02 level for all types of courses except the Post-Graduate Diplomates. Trends included:

- Post-Graduate Diploma courses were different from the Non-Graduate courses in patterns of field of specialisation for each sex.

- Males tended to dominate the General Primary field only slightly, but dominated the Small Schools field almost completely; while females tended to dominate the Infants field of specialisation.

4.10.9 The Relationship Between the Institution at Which Teacher Training Was Completed and the Gender of the Employable Primary Teacher

- Results of chi-square tests for both the Total Region and Post-Graduate Diploma courses were not significant at the .02 level. Trends included:

- Males were outnumbered by females in all types of courses, but the Institute Post-Graduate Diploma course had the smallest discrepancy between the sexes.

The following Chapter will discuss these findings in greater detail, and will relate them to the factors presented in the Chapters which dealt with the conceptual and methodological framework relevant to this study.
CHAPTER 5

Discussion of Findings
Due to the number of hypotheses tested in Chapter four, this Chapter will be presented in an identical format to the preceding Chapter of findings.

5.1 Level of Secondary Mathematics Passed

It has been previously determined that several assertions which were made in the Myers' Report provided the stimulus for this study. The most immediate of these was a statement regarding the number of Victorian primary teachers from 1976 to 1979 who had not studied any final secondary mathematics:

A second aspect of the studies, and the one perhaps of more concern in the long term, is the large proportion (more than 70%) of primary teachers who take no mathematics in the last years of high school (1).

For the purpose of this thesis, final secondary mathematics was defined as any optional mathematics passed during the upper secondary years of high school, i.e. mathematics passed in the Leaving Certificate or the Higher School Certificate. Of all employable primary teachers in the Illawarra Region between 1962 and 1981, the proportion which had not passed any final secondary mathematics was little more than 13 per cent. When each year was analysed separately, the proportions with no final secondary mathematics ranged from 6 per cent. in 1973 to 22.5 per cent. in 1964. When each type of teacher training course was analysed, the proportions with no final secondary mathematics ranged from 12 per cent. for the Diploma in Teaching (Primary) course to 16 per cent. for the University Post-Graduate Diploma in Education course. When each sex was analysed, the proportions with no final secondary mathematics were 10 per cent. for males and 14 per cent. for females. When each field of specialisation was analysed, the proportions with no final secondary mathematics ranged from 13 per cent. for General Primary to 15 per cent.
for Infants. When all these methods of viewing the data were combined, the lowest proportion of those passing no final secondary mathematics was located in the Diploma in Teaching (Primary) course in 1977 (2.5 per cent.) Regardless of the way in which the data was analysed, it is obvious that the proportion of employable primary teachers in the Illawarra Region between 1962 and 1981 with no final secondary mathematics did not exceed 22.5 per cent.

Therefore, while less than 3 out of every 10 Victorian primary teachers from 1976 to 1979 had 'taken' some final secondary mathematics, well over 7 out of every 10 employable primary teachers from 1962 to 1981 in the Illawarra Region had passed some final secondary mathematics. These comparisons derive from the slightly different bases of employed primary teachers in Victoria and employable primary teachers in the Illawarra. Yet, it can be maintained that since the majority of N.S.W. primary teachers have been trained in N.S.W. Teachers' Colleges and Universities since the 1930's these comparisons are tenable.

In the context of the Victorian findings revealed in the Myers' Report this study has shown that over the entire period that institutions in the Illawarra Region have been educating primary teachers, there is only a very small proportion of employable primary teachers who have not passed any mathematics in the final years of high school. Unless one wishes to adopt a stance which advocates that all primary teachers should possess some final secondary mathematics, it would appear that the rather extreme recommendations concerning the necessity for changing teacher education programmes to accommodate the large numbers of students with no final secondary mathematical background, which were made in both the Myers' Report and the A.A.M.T. document, are not applicable to the Illawarra Region. While it could well be that the Illawarra Region is not typical of much of Australia due to such factors
as the highly industrial nature of the community, it could equally be suggested that the findings for Victoria are in some way atypical of the nation. Differences between the Victorian findings and the findings of this study emphasise the need for further research in other localities.

5.2 Types of Mathematics Passed During Teacher Training

Because teaching methods have comprised part of the compulsory mathematics units available to prospective primary teachers in the Illawarra Region, only optional tertiary mathematics subjects were utilised in this thesis. The profile constructed in the previous Chapter revealed that only one-quarter of primary teachers trained in this Region proceeded to a successful study of mathematics during teacher training. The majority of these were students completing the Post-Graduate Diploma in Education courses. When the mathematics passed in the final years of high school and the mathematics passed at tertiary level were examined, there was little noticeable difference in the proportions of those with no mathematics between these two stages of education, except for the Post-Graduate Diploma groups. The inclusion of mathematics passed at tertiary level reduced the proportion of those with no mathematical background in both the Dip. Ed. courses from 16 per cent. to 7 per cent. and the proportion of males completing the Institute Dip. Ed. course from 2 to 0 per cent. However, for each other type of course, and for all courses combined, the inclusion of mathematics passed at tertiary level only made a maximum difference of 1 per cent. in the proportions of those with no mathematical background.

It is of interest to note that it can be shown from Tables 2 and 3 in Chapter Four that the higher the level of final secondary mathematics passed, the more likely the individual was to proceed to a
successful study of some type of tertiary mathematics. Of those who
passed each level of final secondary mathematics, the following
proportions proceeded to a successful study of some tertiary mathematics:

<table>
<thead>
<tr>
<th>Level of Final Secondary Mathematics</th>
<th>Proportion Proceeding</th>
</tr>
</thead>
<tbody>
<tr>
<td>No final secondary mathematics</td>
<td>12.4%</td>
</tr>
<tr>
<td>Level 1 final secondary mathematics</td>
<td>11.4%</td>
</tr>
<tr>
<td>Level 2 final secondary mathematics</td>
<td>28.3%</td>
</tr>
<tr>
<td>Level 3 final secondary mathematics</td>
<td>51.1%</td>
</tr>
<tr>
<td>Level 4 final secondary mathematics</td>
<td>75%</td>
</tr>
</tbody>
</table>

This suggests that attitudes towards mathematics do have a function in
the mathematics studied during teacher training, whether these attitudes
stem from greater ability and achievement in mathematics or some other
factor. The implications for teacher education programmes are: first,
that those who chose not to study mathematics in the final years of high
school, or who chose to study the lowest level of elective mathematics
available in high school, are very unlikely to compensate for this
apparent lack of mathematical knowledge by studying some type of
tertiary mathematics. Second, those who display high ability or
achievement in high school mathematics are the most likely to continue
achieving at a high level in mathematics during teacher training.

Although this may appear to be polarised, in fact most
employable primary teachers fell between these two extremes. Only a
very small proportion of employable primary teachers in this Region
have successfully completed the highest levels of either secondary or
tertiary mathematics available for study. Over the entire period of
1962 to 1981, only 0.4% had passed the highest level of final secondary
mathematics available, while only 0.02% had passed some mathematics
provided by Mathematics Departments at Universities. In fact, 'service'
or 'environmental' courses accounted for 65 per cent. of those completing
some tertiary mathematics. At the other end, only 12 per cent. had passed no final secondary or tertiary mathematics. This leaves the huge task of having to assess the mathematical ability of these 'middle-rangers', who constitute the majority of employable primary teachers in this Region.

The aims and purposes of the various secondary and tertiary mathematics courses were examined in order to establish some other criterion for comparing levels and types of mathematics. Both secondary and tertiary mathematics courses were found to be of two general types. One consisted of sophisticated mathematical knowledge whereas the other consisted of knowledge designed to be applicable to everyday life. On the basis of this, the various levels and types of mathematics were revised into the categories of 'no', 'little' and 'sufficient' mathematics. Sufficient mathematics consisted of those courses which offered sophisticated mathematical knowledge, while little mathematics consisted of those courses which offered general mathematical knowledge applicable to everyday life. It was assumed that those who had demonstrated the ability to master the sophisticated types of mathematics courses would possess enough mathematical knowledge for the purposes of teaching primary mathematics. It was also assumed that those who had only mastered the general types of mathematics courses need not necessarily possess enough mathematical knowledge for primary teaching.

Data analyses based on these revised categories revealed that over the entire period of 1962 to 1981, nearly 6 out of every 10 employable primary teachers in the Illawarra Region possessed a sufficient mathematical background. While this may be a positive indication that the majority of primary teachers trained in this Region possess sufficient mathematical knowledge to be competent teachers of primary
mathematics, it needs to be pointed out that this also means that at least 4 out of every 10 primary teachers trained in this Region were found to possess an inadequate mathematical background.

Some could argue that the measuring scale devised for this study is inappropriate since some of the levels and types of mathematics thought to be sufficient for the purposes of teaching primary mathematics include mathematics of dubious quantity or quality. This argument is valid on two grounds. First, when the measuring scale was devised some unease was felt about level 2 final secondary mathematics, for it had been pointed out (2) that only 30 per cent. of individuals passing this level of high school mathematics would be sufficiently competent to pass University mathematics. Although this criterion was not extended to competence in teaching primary mathematics, approximately 70 per cent. of individuals passing level 2 secondary mathematics were not considered to be competent enough to master more sophisticated mathematical knowledge. Professional mathematicians may like to take this matter up at some future date, and construct categories of mathematical background which are based on a more detailed assessment of secondary mathematical background, or demonstrated mathematical ability. Second, professional mathematicians may also like to construct more detailed categories of tertiary mathematics, for while those provided in this study certainly indicate general differences between types of courses, the development of a more detailed rank order scale at both secondary and tertiary levels would enable more sophisticated statistical analyses to be performed. This, in turn, may indicate more subtle differences or relationships which were not found in this study.

If nothing else, the inclusion of all those passing level 2 final secondary mathematics would tend to inflate the numbers of those
in the sufficient mathematical background category. A more realistic interpretation of the findings may find that fewer than 6 out of every 10 employable primary teachers in this Region possessed a mathematical background considered adequate for the teaching of primary school mathematics. This holds at least one implication for primary teacher education programmes in this Region. If, as has been maintained in the most recent Reports on primary teacher education, (3) an aim of primary teacher education programmes is to produce primary teachers who are sufficiently numerate to teach primary mathematics competently, then teacher education programmes in the Region must compensate for the deficiencies in mathematical education which have been illuminated by this study. One could suggest that the compulsory mathematics subjects within the primary teacher training courses which have been available at the Wollongong Institute of Education are geared towards the production of such numeracy. This is not entirely the case.

According to the Calendars published annually by the Wollongong Institute of Education, the compulsory unit of mathematics in the Certificate course had three major aims - to "acquaint students with methods of instruction in mathematics", to provide students with "...a historical background of the development of mathematics" and to improve students' "own mathematical ability" (4). For prospective Infants teachers, however, the aim of the compulsory unit of mathematics concentrated on teaching methods:

The course is designed to show an approach which will encourage the young child to gain an understanding of mathematics ... (5).

The Diploma in Teaching (Primary) and the Post-Graduate Diploma in Education (Primary) courses do not specify that the compulsory unit in mathematics aims at 'improving the students' own mathematical ability'.
It could be contended that instruction in such topics as 'the number system' or 'algorisms' would probably broaden a student's understanding of the mathematical knowledge already possessed. However, it would be rather meaningless to aim at improving mathematical ability per se through units of study which firstly devote at least one-half of their content to methods of teaching and learning mathematics, and which secondly have no more than 72 contact hours over two to three years. Despite the aim given for the Certificate course of training, the content of the compulsory units of all three types of teacher training courses available at the Wollongong Institute of Education over time are sufficiently similar to enable this assertion to be made for all types of primary teacher training courses.

Mathematicians from the University of Wollongong who were interviewed for this study did, however, indicate that "primary teachers need a review of what is being taught in primary schools" (6). It was pointed out that primary teachers who completed the Diploma in Teaching (Primary) course at the Institute would be 'better' at teaching primary mathematics than those who had no contact with this type of course, such as someone who completed a B.A. with a major in English or Psychology at the University of Wollongong. This statement should be considered in conjunction with the fact that the Post-Graduate Diploma in Education (Primary) provided by the University of Wollongong has never included a compulsory unit of any sort of mathematics, except perhaps under the guise of 'teaching methods' (7). This is not to say that the existing situation is desired by either educators at the University or others involved in pre-service teacher education courses (8). The reason given during the interview for the judgement that those completing the Diploma in Teaching (Primary) course would be better at teaching primary
mathematics than those at the University, was that contact with this course would result in prospective primary teachers who understood 'the ideas' and would 'therefore not be afraid of them'. What began as a concern with mathematical ability per se has been linked with attitudes here, and it has not been a function of this study to examine attitudes towards either mathematics or the teaching of mathematics.

Although the criteria used for this study necessarily led to the exclusion of compulsory mathematics units studied, interesting possibilities for further research are indicated. This is particularly so when one recalls that of the three most useful predictors of performance on a mathematics test, Detrick found that two were enjoyment of mathematics (attitudes) and years of secondary mathematics studied (mathematical background). If a major study modelled on Detrick's research was to be conducted in New South Wales, or any other State, the inclusion of non-compulsory tertiary mathematics passed and compulsory units of mathematics studied during teacher training may further illuminate the constituents of primary teachers' mathematical competency and their ability to teach.

5.3 The Relationship Between the Type of Primary Teacher Training Course Completed and the Levels and Types of Mathematics Passed

Differences in demonstrated mathematical ability, or mathematical background, were anticipated because of the difference in the general academic ability required of those attending Universities and teachers' colleges. Universities have traditionally been recorded as the pinnacle of education and have had less varied selection criteria than teachers' colleges. Results of chi-square tests indicated that there was indeed a statistically significant relationship between the levels and types of mathematics passed and the type of primary teacher training course completed.
The Department of Education has considered the length of the teacher education programme as part of the professional aspect of teaching. That is, the longer the period of teacher education, the more qualified an individual should be to teach. The three types of courses which have been available in the Illawarra Region may be considered as a hierarchy, ranging from the Certificate course as the least professional to the Post-Graduate Diploma in Education course as the most professional. Although the Diploma in Education group had the highest proportion of individuals (16%) with no mathematical background at the final secondary stage of education, after tertiary studies were completed this group had the lowest proportion of individuals (7%) with no mathematical background. Except for this difference, proportions of individuals in the other categories of mathematics remained similar between the two stages of education. A sufficient mathematical background was modal for those completing each type of course yet these proportions indicate that the higher the educational qualification obtained, the more likely each employable primary teacher is to possess a basic or sufficient mathematical education.

Potential differences in aggregates were considered to be relevant to mathematical background, where higher aggregates would accompany a high standard of mathematical passes. However, Tables 1 and 2 in Appendix C reveal that this was not the case in the Illawarra Region. Mean aggregates of those completing each type of course were as follows: Certificate, 566; Diploma in Teaching, 528; Post-Graduate Diploma in Education 540 (University) and 546 (Institute). Variances were similar for each Post-Graduate group and the Certificate group, while the variance for the Diploma in Teaching group was much smaller.
than the other courses. As well as this, the Diploma in Teaching group had the smallest standard deviation, which reinforced the conclusion that those completing the Diploma in Teaching (Primary) course consistently had the least academic ability of all primary teacher trainees in the Illawarra Region. In spite of this, those completing the Diploma in Teaching course did not display the least mathematical background. In fact, those with the highest mean aggregate simultaneously possessed the least mathematical background. It appears that general academic ability, as measured by aggregates, cannot contribute to an explanation about differences in mathematical education for these employable primary teachers. Although a complete range of aggregates was not obtainable for this study, the one-fifth of aggregates unavailable should not alter these conclusions to any great extent. On the other hand, if a complete sample of aggregates was obtained in future research, more sophisticated parametric statistical analyses could be performed with the data and different conclusions could well be reached.

If academic ability cannot contribute to an explanation of differences in mathematical background at this point, other factors such as the nature of the educational programme itself require investigation. The amount of educational contact time varied for each type of available course at least to the extent that the educational programmes consisted of two years for the Certificate course, three years for the Diploma in Teaching course and four years for the Post-Graduate Diploma in Education courses. The amount of contact time for mathematics courses concomitantly varied from 78 hours for the Certificate course to 182 hours for the Diploma in Teaching course, to 616 hours for a complete University mathematics course (see Appendix B). Nevertheless, this
variation was largely controlled by equating the context of various tertiary courses. It should also be mentioned here that an analysis of contact hours at tertiary level does not support the claim by the Australian Association of Mathematics Teachers that there is a decreasing amount of time being allocated for the study of mathematics in teacher education institutions (9).

With this control for varied contact times, differences in mathematical background still appeared in the analyses. It was previously asserted that tertiary mathematics made very little difference to the amount of mathematics passed except for the Post-Graduate Diplomates. Basic differences between courses were indeed reflected in the categories of final secondary mathematics passed. Despite the lack of research which could support or refute the speculation that different types of individuals with different mathematical inclinations are attracted to different types of primary teacher training courses, this study indicates the possibility of such an occurrence. Relevant data analyses suggest that those with the most secondary mathematical background choose to complete a course of training available at a university. One could also suggest that these individuals were more aware than the other groups of the importance of mathematics to primary teachers, because this group was the only one which made a substantial increase in the successful study of mathematics at the tertiary stage of education. Whether this possible awareness was self-induced, imposed by others, or both, is also a matter of speculation. Some commitment to the mathematics, suggested by the completion of a University Mathematics Degree, was quite uncommon in those sampled for this study. It is possible that those employable primary teachers who were educated at a university were not particularly inclined towards the study of large
bodies of mathematics.

Of course, the range of options available for study may also be relevant here. There was only one mathematics elective available for most of the time that the Certificate course was in existence. But there were two mathematics electives available for those completing the Diploma in Teaching course, and a wide range of options available for those completing the university courses. While this may account for some differences between the courses, it does not account for the noticeable discrepancies between the mathematics passed at the secondary stage of education.

Although the Post-Graduate Diplomates had the most mathematical background, those completing the Diploma in Teaching course possessed only a little less mathematics than the Post-Graduate Diplomates. It should also be remembered that the Certificate course was only available in the 1960's and early 1970's, and was totally replaced by the Diploma in Teaching qualification. As the 1970's were particularly characterised in many diverse areas by an increasing awareness of the importance of mathematics, it may well be that those completing the Diploma in Teaching course were responding to this 'environmental' condition. An analysis of the data on a year-by-year basis would be necessary to aid in clarifying this matter, and is treated in a later section of this Chapter.

Gender is another factor which is related to the different periods in which different primary teacher training courses were available and the mathematical education of those completing each course. Previous discussion suggested that the 1970's were also characterised by changing attitudes to women, by women themselves, society in general and educators. The increased mathematical background of those completing the Diploma in Teaching course may be partly attributable to wider female participation
in the study of mathematics. This will also be dealt with in a later section of this Chapter.

In conclusion, the analysis of this relationship has suggested that while general academic ability does not appear to contribute towards the different mathematical background of those completing each type of primary teacher training course in the Illawarra Region, there are other factors which could make a contribution. Whether differences are a result of different personality traits reflecting different educational goals, the increasing professionalisation of primary teaching, or attitudes towards women, remains a matter of speculation. Whatever the reasons, this study has established that the type of teacher training course completed is related to the mathematical background of employable primary teachers in the Illawarra. It was further established that the higher the educational qualification obtained, the more likely employable primary teachers in this Region are to possess an adequate mathematical education. These speculations have indicated a new and diverse area which could be investigated in future research on the mathematical education of primary teachers. Even though this single factor has been isolated as reflecting significant differences in mathematical background, it is entirely probable that differences are the result of a combination of factors. Indeed, if other factors are found to be significantly related to mathematical background, multivariate data analysis would be useful in future research.

5.4 The Relationship Between the Institution at Which Teacher Training Was Completed and the Levels and Types of Mathematics Passed.

Previous discussion has asserted that different types of teacher training courses have been available within this Region, and the different selection standards have been operative between universities and Teachers' Colleges. On the basis of these differences, it was
anticipated that the different teacher training institutions within the Region may have educated primary teachers with differing mathematical backgrounds. However, results of chi-square tests at both the secondary and tertiary stages of education indicated that there was no significant relationship between mathematical background and the institution at which teacher training was completed.

Trends were evident at each institution, despite the finding of a statistically insignificant relationship. In fact, when the categories of mathematics passed were dichotomised on an 'insufficient-sufficient' basis, resulting proportions within each category were quite surprising. At the secondary stage of education, a little more than half of the Institute sample had a sufficient mathematical background, yet approximately two-thirds of the University population had a similarly sufficient background. On the basis of this dichotomy, there was little alteration between the final secondary and tertiary stages of education. While these differences between institutions may sound dramatically different, in reality there has been one more person out of every ten with a sufficient mathematical background from the University course than the Institute courses.

Analysis of the three categories of mathematics at both stages of education revealed that those completing the University primary teacher training successfully utilised available tertiary mathematics courses to a greater extent than those completing the Institute primary teacher training. No difference occurred between the two stages of education for the Institute sample. This is not to say that those at the Institute did not study tertiary mathematics. Rather, the findings suggest that those with little secondary mathematics who attempted tertiary mathematics would have studied and passed environmental tertiary
mathematics. Those with the two highest levels of secondary mathematics, studied and passed academic tertiary mathematics. Thus, those with little secondary mathematics remained with only a little secondary and tertiary mathematics at the completion of the teacher training course. Employable primary teachers graduating from the University, however, did make noticeable alterations in their mathematical background during the course of University study. For example, twelve per cent. of University Diploma in Education graduates with no secondary mathematical background proceeded to a successful study of some tertiary mathematics. Usually these were the service courses, which resulted in a higher proportion possessing little mathematical background rather than none upon completion of teacher training. While a little mathematical background is still regarded as insufficient for the purposes of this study, a little mathematical education must surely be of more benefit to a primary teacher than no mathematical education at all.

Tables 1 and 2 in Appendix C, which provide a measure of general academic ability, indicate little difference between all persons completing the University primary teacher training course and those completing the Institute primary teacher training courses. Although a mean aggregate for those completing all the Institute primary teacher training courses was not computed, the mean aggregates for each type of training course at the Institute suggest that a calculated mean aggregate would be in the vicinity of the mean aggregate for the Institute Diploma in Education group. This mean aggregate was slightly higher than the mean aggregate for those completing the University Diploma in Education course. However, those completing primary teacher training at the University also showed a much larger variance than those completing any other type of course, which is indicative of extreme scores influencing the mean aggregate score. Conversely, the smaller variances for the Institute
course is indicative of a more homogeneous high ability group. While the preceding statement appears to be generally applicable to differences between the two institutions, the Diploma in Teaching (Primary) course shows the most tightly-knit group of persons with comparatively low academic ability. It would appear that once again, there is one type of primary teacher training course within the Region which does not conform to the patterns established by other courses. Further, this mean aggregate suggests that contrary to expectations, the granting of autonomy to this Teachers' College has not resulted in a more stable selection criteria - at least for those completing the Diploma in Teaching course.

Generally speaking, while employable primary teachers educated at the Institute had slightly less mathematical background, those at the Institute had slightly more general academic ability than their University counterparts. Previous discussion concerning the compulsory units of mathematics at the Institute in section 2 of this Chapter is also applicable here. Yet there was no statistical relationship established between the level and type of mathematics passed by those completing primary teacher training courses at each institution within the Region. Differences may not have occurred as a result of the relatively insignificant bases for expectations. While differences in selection standards have indeed been operative between these two types of institutions, both are tertiary institutions which require some measure of high academic ability for admission.

5.5 The Relationship Between Gender and Levels and Types of Mathematics Passed

Contrary to the expectations derived from most of the sources in the conceptual framework, the results of the chi-square tests for this relationship were not significant. Past research into differences
between the sexes in respect of both mathematical ability and achievement in mathematics has nearly always concluded that females tend to achieve at a lower level than males, and that females tend to hold more negative attitudes towards mathematics than males, particularly at the tertiary stage of education. Even the research conducted at the Wollongong Teachers' College in 1962 by Shaw resulted in the conclusion that although there was little difference between the sexes' mean I.Q., males tended to be more able arithmetically than females:

There is a suggestion in the results of this experiment (although the sample is small) that confirms the belief that boys are better than girls at arithmetic (10).

This study has shown that there has been proportionately fewer male employable primary teachers than female employable primary teachers with no mathematical background, and proportionately more male employable primary teachers than female employable primary teachers with a sufficient mathematical background, over the entire period of 1962 to 1981 in the Illawarra Region. However, detailed analysis revealed that while this may be the case for the whole group of primary teachers trained over the entire period, it is not the case for some specific groups completing different types of teacher training courses. The Diploma in Teaching (Primary) and particularly the University Post-Graduate Diploma in Education (Primary) groups displayed trends which were opposite to those displayed by the entire Region, while the Institute Post-Graduate Diploma in Education (Primary) group displayed a slightly exaggerated form of the trends for the entire Region.

Females trained in each type of course in the Region, except the University Post-Graduate Diplomates, had proportionately more of their own sex with no mathematical background than males. However other
categories of mathematical background showed different trends. While the Certificate course had proportionately fewer males than females with little secondary mathematics, and proportionately more males than females with sufficient mathematical background, these proportions were reversed for the Diploma in Teaching (Primary) course. That is, of those completing the Diploma in Teaching (Primary) course, there were proportionately more males than females with little secondary mathematics, and proportionately less males than females with sufficient secondary mathematics. When the mathematics passed during teacher training was included in the analysis, these trends remained the same for both courses.

The Post-Graduate Diploma in Education courses consistently displayed different trends to other primary teacher training courses, and the relationship between gender and mathematics passed was no exception. While both of these courses provided at each institution had identical proportions of each sex in the little mathematical background category at the total mathematics, or post-teacher training stage of education, each institution displayed contrary trends in the no and sufficient mathematical background categories. While those trained in this type of course at the Institute had proportionately more females than males in the no mathematics category, and proportionately less females than males in the sufficient mathematical category, those trained in this type of course at the University had proportionately less females than males in the no mathematical background category and proportionately more females than males in the sufficient mathematical background category. Both males and females completing each type of Post-Graduate Diploma course also had a much smaller proportion in the no mathematical background category than each sex completing the non-Graduate type of courses.
Previous Chapters proposed that differences in general academic ability, as measured by aggregates, may at least contribute towards accounting for these differences. However, Tables 1 and 2 in Appendix C indicated that of those completing each type of primary teacher training course, females consistently possessed a larger mean aggregate than their male counterparts. In fact, these Tables indicate that of all individuals completing primary teacher training courses in the Illawarra Region between 1962 and 1981, those displaying the highest mean aggregates were females who completed the Certificate course. This group also possessed the lowest variance, which suggests a relatively homogenous group with a high ability index. It is ironic that this group also possessed the least mathematical background of any group completing any primary teacher training course in the Region. This does not indicate a negative correlation, for the group with the most mathematical background * possessed a mean aggregate which was higher than some but lower than others. This certainly indicates that differences in mathematical background for males and females in this study cannot be even partially attributed to, or explained by, differences in general academic ability.

Before continuing the discussion about the relationship between gender and mathematics passed, it is of interest to comment further on the discovery that females consistently possessed a larger mean aggregate than males. As Tables 1 and 2 in Appendix C indicated, this was the case regardless of the type of primary teacher training course completed. The numbers and proportions of men and women in this study also showed that primary teacher training has been, and currently still is, a feminised area. Although this study does not provide comparative data from a period in which primary teacher training was male-dominated,

* Males completing the Institute Post-Graduate Diploma in Education course had the highest proportion with a sufficient mathematical background, and the lowest proportion with no mathematical background.
it appears that the findings of this study support Power's theory about feminised occupations. The aspect of this theory which is particularly relevant here is that when an occupation becomes feminised, large numbers of males do not attempt to enter this occupation. While some men may have made an active decision about this, it is probable that because primary teaching is feminised many men simply do not consider this profession as an option available to them. In addition to this, it would appear that for primary teachers trained in the Illawarra Region at least, those men who do enter this occupation are not as academically able as the women who enter this occupation. This implies that either all men are less able academically than women, or that men who are as academically able as the women in this study are choosing not to enter this occupation. It could also imply that women are more limited in career options than males. Historical evidence of male matriculation standards in N.S.W. appears to negate the first suggestion, which indicates that the other suggestions may be tentatively acceptable. The findings which support these contentions are as follows.

Of the twenty-one cohorts examined here, females possessed higher mean aggregates than males in twenty cohorts (Table 1, Appendix C). Further, when primary teachers of either sex were in great demand throughout most of the 1960's, both males and females displayed comparatively high mean aggregates, although female mean aggregates remained higher. When primary teachers were in less demand from the late 1960's onwards however, mean aggregates for each sex were comparatively lower than those of their predecessors. It appears that when primary teachers are in great demand in the Illawarra Region, individuals with high general academic ability pursue a primary teacher training course. And the converse also applies. Although the 1970's
have been characterised by the increasing professionalisation of the primary teaching profession, it seems that the prospect of employment may be an important determinant for the selection of a career as a primary teacher. Nevertheless, there have been more women competent academically in primary teaching in this region than men over the past twenty years.

These differences in academic ability between the sexes should be of interest to teacher educators. If males tend to possess a lower academic ability rating than females, educators may like to consider the suggestion that gender is a factor to be taken into account for selection procedures. Conversely, if generally lower aggregates are an acceptable selection criteria for males, there is an implication here that females completing primary teacher training courses in this Region are not being used effectively. That is, if low aggregates are just as acceptable as high aggregates in respect of selection for primary teacher training courses, there appears to be many females who could, or should, be pursuing a more taxing or demanding career. Although placed in a slightly different context, Radford's conclusions about female matriculants in the 1950's seem to still be applicable in the early 1980's (11).

In general, it was found that aggregates could not be utilised to explain differences between the mathematical background of men and women. Aggregates may not account for differences between the sexes in mathematical background because differences were quite small. It needs to be stressed that for each type of course and for all courses combined, differences in proportions between the sexes in each category of mathematical background were not large enough to warrant the conclusion that there was some relationship between gender and the level or type of mathematics passed. However, the preceding discussion has raised at
least four questions for consideration. First, why were there only minimal differences between the sexes, when previous research led to an expectation of larger differences? Second, why did some courses manifest trends which were exactly opposite to those expected on the basis of past research? Third, why did the Post-Graduate Diploma courses have noticeably different patterns of passes in mathematics to non-Graduate courses? And fourth, why were there contradictory patterns of passes in mathematics for Post-Graduate Diploma males and females at the two tertiary institutions in the Region?

Initially, the consistently high pass rates of females in this Region requires investigation. It was pointed out in the theoretical discussion that as recently as 1979, the Williams Report recommended that "more girls be encouraged to continue their studies of mathematics..." (12). Assuming that 'continuation' is applicable to the final years of secondary education, this implies that fewer women than men are perceived to participate in the study of final year secondary mathematics. The most recent research into mathematical differences between the sexes in Australian secondary schools compared, amongst other things, 1964 and 1978 participation rates of males and females in Year 12 mathematics. A change in female participation rates was suggested by the discovery that in each Australian State between 1964 and 1978, the proportion of female students studying Year 12 mathematics increased progressively. Ratios of males to females studying Year 12 mathematics in New South Wales changed from 2.4 in 1964 to 1.5 in 1978 (13). The data for non-Graduate courses collected for this study supports this trend, although females' pass rates in mathematics for this Region have consistently been higher than the N.S.W., or any other State's participation rates.

Up until 1971, the only course available to those completing
primary teacher training in the Region was the Certificate course. While 90 per cent. of men who completed this course had passed some level of final secondary mathematics, only 85 per cent. of women had done so. From 1971 onwards, the Diploma in Teaching course was available for prospective primary teachers, and while the proportion of males who completed this course and passed some level of final secondary mathematics was maintained at 90 per cent., the proportion of females who had passed some level of final secondary mathematics rose by 3 per cent. It is clear that the expectation of mathematics as a 'male' subject was not met in this study.

The remaining questions proposed a concern with contrary trends between males and females and between types of courses. It was found that differences in aggregates could not aid in illuminating either differences between the sexes or between types of courses. Another possible explanation may lie in the range of options available for study, particularly during teacher training. It was pointed out previously that University undergraduate Degrees offer a very wide range of options for study. At the Wollongong Institute of Education, the range of options in mathematics has only changed from one elective available in 1963, to two types of electives available from 1966. The differences between the final secondary and tertiary stages of education appear to reflect the differing natures of the two institutions, with those completing the Certificate course showing the least difference, and those completing the University Post-Graduate Diploma in Education course showing the most difference. However, most of the University difference is attributable to females, who revealed quite remarkable differences between the two stages of education (cf. Tables 8.A and 9.A). It may well be that the traditional male-orientation of the University
of Wollongong, as manifested in the types of Degrees available and Regional female participation rates (14) has provided those females who have attended this institution with more opportunity than those provided by other tertiary institutions to study such 'masculine' subjects as mathematics. A comparison with the Institute Post-Graduate Diploma in Education group supports this contention. A re-examination of the data sheets revealed that only 13 per cent. of females who completed the Post-Graduate Diploma at the University of Wollongong undertook an undergraduate Degree at some other University, whereas 30 per cent. of females who completed the Post-Graduate Diploma in primary teaching at the Institute undertook an undergraduate Degree at some University other than the University of Wollongong. Thus, those females who completed a Diploma in Education (Primary) at the University of Wollongong were more likely than females who completed a Diploma in Education (Primary) at the Institute to have obtained an undergraduate Degree from the University of Wollongong. Those in the University population were therefore also more likely than the Institute population to have been exposed to the variety of 'masculine' options offered at a male-oriented university, although there is no guarantee that the University population would have taken advantage of these options.

It should also be mentioned here that although there were noticeable differences in proportions in the categories of mathematics passed between the two stages of education for females from the University population, females who completed a Post-Graduate Diploma course at both institutions had proportionately more of their own sex in the sufficient mathematical background category than females from either the non-Graduate courses. This raises the possibility that obtaining a Degree or attending any university may be of relevance to the mathematical background
of female primary teachers in this study. While there is no research which has investigated the characteristics of females who attend different types of tertiary institutions, there is some evidence which indicates that the role of a university student in New South Wales tends to be identified as being compatible with typical 'masculine' traits (15). This suggests that females who do attend universities in N.S.W. may be different in some way to those who attend other tertiary institutions, or different to those who do not attend any tertiary institution. It would be quite feasible to propose that differences could be manifested in such ways as studying 'masculine' subjects more frequently than those females who attend other types of tertiary institutions. However, Table 8.A indicated that females completing each Post-Graduate Diploma course had a higher proportion than females completing non-Graduate courses in both the sufficient and no mathematical background categories. Winkler's research also indicated that there was little suggestion of conflict evidenced by female university students between retaining a sense of femininity and being a university student. It could well be that conflict is not evidenced by female university students because they either avoid masculine areas of study altogether, which would produce little conflict, or they enter traditional masculine areas such as mathematics, secure in their role as university student. It is also possible that there are certain prevailing 'environmental' conditions which would encourage females to study mathematics at tertiary level. Such conditions could include attendance at a tertiary institution which is more male-oriented than many other tertiary institutions, where females who attend have a high academic ability index, and where a range of options are available in the study of mathematics. This could indeed contribute to an explanation
regarding the comparatively lower proportions of passes by women who
completed the Certificate course in the 1960's, despite their
consistently high aggregates; the increasing participation in mathematics
of women who completed the Diploma in Teaching (Primary) course in the
1970's; and the high proportions of women who completed a Post-Graduate
Diploma course with sufficient mathematics, particularly at the
University of Wollongong. Although speculative, this account of
differences leads to interesting possibilities for future research in
the area of sex differences in mathematical education at tertiary
institutions.

Finally, it may well be that the Illawarra Region is merely
atypical in that such an unexpectedly large proportion of females
passed some sort of mathematics. The industrial and technological nature
of this Region may have led to an emphasis on technologically-oriented
subjects such as mathematics at both the secondary and tertiary levels
of education, and both sexes could therefore have been exposed to this
'environmental demand' during the process of education. This could
account for the unusually high pass rates in mathematics for both males
and females, while traditional expectations of different interests,
ability and achievement, and attendance at different tertiary institutions
could account for the minimal differences between the sexes which were
found in this study.

5.6 The Relationship Between Field of Specialisation and Levels and
Types of Mathematics Passed

The result of the chi-square test for combined courses within
the Region was significant, although results of chi-square tests for
each individual type of primary teacher training course were not. This
was the case at both the final secondary and total, or post-teacher
training, stages of education. Because there were only minimal
differences between these two stages of education in the distribution of proportions through the three categories of mathematics passed, this discussion will focus on the proportions at the total stage of education.

As far as the author has been able to determine, this variable has not been examined in any past research on mathematics. Discussion of relevant research and literature in previous Chapters anticipated differences in the frequencies of types of mathematics passed for each field of specialisation largely on the basis of gender. Because Small School training was traditionally a male field and Infants training has traditionally been a female field of specialisation, it was expected that Small School trainees would have passed much more mathematics than Infants trainees, and probably a little more than General Primary trainees. The results of this study were exactly opposite to those anticipated: Small School trainees had the highest proportion of individuals in the no mathematical background category, (except for the Certificate Course where Infants trainees had the highest proportion) and the lowest proportion in the sufficient mathematical background category. In fact, nearly 50 per cent. of those trained in the Small School field possessed only a little mathematical background upon completion of teacher training. It is of some consequence that the modal category of mathematical background for Small School trainees was a little mathematical education, yet the modal category for both Infants and General Primary trainees was sufficient mathematical education.

Differences between Infants and General Primary trainees were less marked. Nevertheless, Infants trainees had a higher proportion of individuals with no and little mathematical background, and a lower proportion of individuals with sufficient mathematical background, than
General Primary trainees.

An analysis of the relationship between field of specialisation and mathematics passed was not able to be carried out with sex as an additional factor due to the small number of individuals in some categories. Comparisons with two other chi-square tests indicate several interesting points. Initially, results of chi-square tests for the relationship between gender and field of specialisation for all those trained within the Region, the Certificate course, the Diploma in Teaching (Primary) course, and combined non-Graduate courses were extremely significant. It was found that males did indeed dominate the Small School field, while females dominated the Infants and General Primary fields of specialisation. Second, results of chi-square tests for the relationship between gender and mathematics passed were not significant. From these tests and a comparison of Tables 9.A, 11.A and 14, it can be argued that while gender is related to the field of specialisation, the mathematics passed by each sex does not appear to be a major contributing factor to the mathematics passed by each field of specialisation. In actuality, the areas which were dominated by females had proportionately more individuals with either some mathematical background or sufficient mathematical background than the area which was dominated by males. Even in the University Post-Graduate Diploma in Education (Primary) course, where males comprised nearly 30 per cent. of Infants trainees, this was found to be so.

One possible explanation for these differences in mathematical background may be found in variations between academic ability for those trained in each field of specialisation. Consistent with the conclusion of little noticeable difference in the mathematical background of those trained in the Infants and General Primary fields, Table 3 in Appendix C
indicated that there was also little noticeable difference between mean aggregates for these two fields. Of the twenty-one cohorts examined in this study, Infants trainees displayed higher mean aggregates in nine cohorts while General Primary trainees displayed higher mean aggregates in eight cohorts. Higher means fluctuated almost alternately year by year for these two types of training, and standard deviations were quite similar for all years and each field. It would therefore seem that while Infants trainees possessed a higher mean aggregate in one year, this was balanced by the General Primary trainees possessing a higher mean aggregate the next year.

However, in the four cohorts where training for Small Schools was available, there were noticeable differences. While the same balanced fluctuations appeared between Infants and General Primary trainees, those completing Small School training consistently exhibited a lower mean aggregate than either Infants or General Primary trainees of the same cohort. In addition to this, standard deviations and variances were comparatively small for the Small School trainees, which indicates that there were few extreme scores influencing the mean and that the Small school groups were relatively homogeneous in their lower mean aggregate scores. This does indeed suggest that individuals with the least academic ability were completing Small School training. It may be no coincidence that these individuals also possessed the least mathematical background of any other group who completed a primary teacher training course in the Region over the period 1962 to 1981. While the Department of Education expressed a preference for men who were ideally characterised by such virtues as 'balanced judgement' and 'a deep sense of responsibility' to teach in small schools in country areas, it appears that from the Illawarra Region at least, these characteristics were
coupled with comparatively low academic ability and an inadequate mathematical background.

It is possible that although Small School trainees in the period examined in this study undertook a two-year course of teacher training basically similar to other fields of specialisation at the time, this field may have carried on a tradition founded with the first teachers' training courses in the Teachers' College of N.S.W. Fundamental to this tradition was the dire necessity to staff one-teacher schools in remote areas as quickly and as efficiently as possible:

The great demand for teachers in the sparsely-populated parts made the provision of a full course (of training) impossible. Even had it been possible, it was doubtful if the type of candidate who applied for these schools would be willing to undergo a lengthy training (16).

Needless to say, the anomaly of expecting those receiving the least amount of teacher training available to teach effectively in such a highly specialised area was simultaneously recognised (17). However, exigencies ensured that of all teachers trained in N.S.W., Small School trainees remained the least qualified to teach for a considerable period of time. If the Small School field had a tradition of accepting differently-qualified students into a course of training which was quite inadequate for its purposes, then it is possible that remnants of this tradition still lingered on in the early 1960's.

Termination of this specialised field in the Illawarra Region appears to have had at least one side effect - the removal of the lowest academic ability group from primary teacher training courses in the Region. With this, a group with a predominantly inadequate mathematical background has also been removed from this Region. Mean aggregates and the profile of mathematical background for later groups of primary teachers trained
within this Region indicate that the type of individual previously being trained in the Small School field was not merely assimilated into other fields of specialisation, but was completely removed from the primary teacher training system in the Illawarra Region.

Although the 'worst offenders' are not currently in existence, differences that still exist between Infants and General Primary trainees are worth further commentary. A comparison of mean aggregates, standard deviations and variances for these two fields showed that differences in mathematical background cannot be even partially explained by differences in general academic ability. Gender does not appear to contribute to differences to any great extent either, although it is suggested that some differences may be due to the fact that Infants trainees, who possessed the least mathematical background of the two fields, also consisted of proportionately more females than the General Primary group. While there was no significant relationship between gender and mathematics passed, females did tend to generally possess a little less mathematical background than males.

It is highly probable that mathematical background is determined by a multitude of factors. While the field specialised in during teacher training has been established as pertinent in this study, the possibility that there is at least one combined effect should not be ignored. It should be remembered however, that both the field of specialisation and mathematical education examined in this study were determined by personal choice. (Although this choice was of course contingent upon options available at the time and place of teacher training.) While lying outside the scope of the data collected for this study, it would appear that those who chose to undergo training in the Infants field were also those who had slightly less mathematical background.
than those trained in the General Primary field. This is not meant to imply a causal relationship. Rather, it is meant to highlight the findings here that while a very large proportion of females have chosen to be trained in the Infants field, both male and female Infants trainees have also passed less mathematics, both qualititively and quantitatively, than those trained in the General Primary field. Similarly, but much more noticeably, while the Small School field was almost exclusively chosen for training by males, these same males also passed very little mathematics.

It is clear that the field of specialisation should be further investigated in order to determine whether the findings here are peculiar to the Illawarra Region, or are relevant to all primary teachers' mathematical education.

5.7 The Relationship Between the Year in Which Teacher Training Was Completed and the Level and Type of Mathematics Passed

Although there is no body of research which has examined the possibility of different mathematical backgrounds being held by primary teachers over time, much opinion has been offered about changing standards. As the first few Chapters of this thesis pointed out, these opinions are usually pervaded by comparisons with 'the good old days', where almost mythical standards of excellence were supposedly set and attained. While the study commissioned for the Myers' Report announced that there had been no change in the mathematical background possessed by Victorian primary teachers between 1976 and 1979, this study has indicated that between 1962 and 1981 in the Illawarra Region, there are differences between the mathematics passed by employable primary teachers and the year in which teacher training was completed. Of course, a partial explanation for this was given in the discussion of relevant literature, for it was expected that a certain amount of fluctuation in
passes would occur as a natural function of changes at least in teaching methods and examinations. However, results presented in the previous Chapter indicate that the differences between the proportions in each category of mathematical education for each year were due to more than these chance fluctuations.

For all individuals included in this study, there appeared to be little noticeable change over time in the proportions of those with no mathematical background. However, a general trend towards higher proportions in the sufficient mathematical background category, together with a trend of lower proportions in the little mathematical background category, were evident.

Within the framework of these general trends several years stand out as exceptionally different. 1966, 1967 and 1968 where characterised by well over 50 per cent. of individuals possessing only a little mathematical education. The year 1974 also saw a dramatic decrease in those possessing sufficient mathematical background, with a concurrent increase in those possessing little mathematical background. A slight inflation of the little and sufficient mathematical background categories was anticipated for the data between 1976 and 1981 due to the inclusion of all Grade 3 passes after 1975. While there was a general trend from 1962 to 1981 towards higher proportions of individuals in the sufficient category, the years 1976 to 1981 exhibited a trend exactly opposite to the general trend - i.e. a slight decrease in the proportions in the sufficient category, with a congruent increase in the little category. A considerably more pronounced downward trend for those in the sufficient category between 1976 and 1981 would probably have been sustained if a similar scaling system for the Higher School Certificate examinations had been retained over the entire period of this study.
A logical implication from this is that while in reality there may be proportionately fewer employable primary teachers in the Region with an adequate mathematical background of late, this does not necessarily result in increased proportions of those with no mathematical background. Rather, decreased adequacy is taken up as an increase in the numbers of those with only a little mathematical background. While a little mathematical background may not be ideal, it can be argued that a little mathematical education is certainly more useful than no mathematical education at all.

Controversy about the declining numeracy standards of primary teachers can now be dealt with for at least one region of Australia. Depending upon which end of the mathematical measuring scale is utilised, several conclusions can be drawn. One is that like the Victorian findings for 1976 to 1979, from 1962 to 1981 the Illawarra Region has exhibited a relatively stable proportion of employable primary teachers with no mathematical background. Unlike the Victorian findings though, the proportion of those with no mathematical background in the Illawarra has been comparatively small. Second, although there has been a slight decline in the numbers of those with an adequate mathematical background between 1976 and 1981, since the late 1960's progressively more employable primary teachers in the Illawarra Region have generally possessed an adequate or sufficient mathematical background. Data for all combined individuals within this study therefore offers little support to those who advocate alterations in teacher education programmes due to the inadequate mathematical education of primary teachers.

It is not surprising that an analysis of each individual type of teacher training course also revealed a noticeably different distribution of proportions for some years. From 1966 to 1968, the only
type of primary teacher training course available in the Illawarra Region was the Certificate course. In 1974, the only type of primary teacher training course available was the Diploma in Teaching (Primary) course. While general trends indicate for all individuals in the Region to 1973 are applicable to the Certificate course, this is not the case for the other courses. From 1971 to 1981, the Diploma in Teaching course displayed an increasing proportion of individuals in the no mathematical background category, a relatively stable proportion in the little category and a decreasing proportion in the sufficient mathematical background category. The years 1974, 1977 and 1978 displayed noticeably different proportions to preceding and succeeding years in the categories of mathematics passed. It was noted previously that for this course, there was little difference between final secondary mathematics passed and tertiary mathematics passed. The differences in these years can therefore be reasonably attributed to different final secondary mathematical backgrounds.

Different trends were once more manifested for the Post-Graduate Diploma courses. First, there were noticeable differences between proportions passing each category of final secondary mathematics and tertiary mathematics. The University course revealed major differences between these two stages of education in 1979 and 1980, where the no mathematical background category was deflated and the sufficient category was inflated at the tertiary level. Further, at the tertiary level there was a general trend towards a slight decrease in the sufficient category and a slight increase in the no mathematics category from 1977 to 1981, with 1978 standing out as a noticeably different combination of proportions within this trend. The Institute course revealed an unchanging pattern for proportions in the no mathematical background category, but wildly fluctuating proportions in the little and sufficient
categories, particularly in 1978 and 1981. Differences between proportions passing each category of mathematics at the final secondary and tertiary stages of education were less noticeable than the University course, but were still particularly evident in 1979 and 1980, where the little mathematical background category was deflated and the sufficient mathematical background category was inflated at the tertiary level.

From this discussion it can be seen that several years stand out as being exceptional. These years have been identified as 1966, 1967 and 1968 for the Certificate course and the Entire Region; 1974 for the Diploma in Teaching (Primary) course and the Entire Region; 1977 for the Diploma in Teaching (Primary) course; 1978 for the Diploma in Teaching (Primary), University and Institute Diploma in Education courses; 1979 and 1980 for both the University and Institute Diploma in Education courses; and 1981 for the Institute Diploma in Education course.

These noticeably different combinations of proportions of mathematics could be accounted for to some extent by differences in the general academic ability of individuals within these years. It would not be unreasonable to anticipate that within those years identified as possessing unusually large proportions of individuals in the no or little mathematical background categories, those same years would be characterised by comparatively low aggregates. However, Tables 1 and 2 in Appendix C show that this not the case. The years 1966, 1967 and 1968 were described as years in which there was a very large proportion of individuals in the little category and a very small proportion in the sufficient mathematical background category. Yet Table 1 (Appendix C) shows that for 1966 and 1967, these same individuals possessed a large mean aggregate, not only in comparison to other years for the Certificate course, but also in
comparison to any year for any other course. In addition to this, the small variances for these years indicate that the higher mean aggregates were not a result of inflation from extreme scores. This certainly shows that for 1966 and 1967, these individuals were a relatively homogeneous group with high academic ability.

Although mean aggregates for other years which were identified as noticeably different are not as large as those for 1966 and 1967, an examination of Tables 1 and 2 in Appendix C reveals no startling differences between the identified years and other years. For example, an unusually large proportion of individuals were located in the no mathematical background category in the years 1978 (Dip. Teach.) and 1981 (University Dip. Ed.), while no individuals were located in this category in 1978 (Institute Dip. Ed.). Mean aggregates for these groups in these years, however, were 525, 529 and 535 respectively, and reveal no overt differences which could justify an explanation of differences in mathematical background in terms of general academic ability. A comparison of standard deviations and variances for these years also shows that except for a slightly lower range of scores evidence for the Dip. Teach. course in 1978, differences were not very noteworthy. Even though all aggregates were not obtained for this study, it does not seem likely that a complete sample of aggregates would greatly affect these conclusions.

Cohorts which possessed comparatively large proportions of individuals with a sufficient mathematical background could be the result of different attitudes by educators within the relevant institutions. There is, however, no way of gauging this phenomena for secondary schools. An inspection of Calendars and Handbooks for each tertiary institution in the Region revealed that there were no explicit differences between years
in the encouragement of studying mathematics. However, the possibility that encouragement could have occurred during activities such as orientation or introductory sessions for potential primary teachers cannot be discounted completely.

Opinions elicited from mathematicians at the Wollongong Institute of Education indicated that student teachers within the 1970's were expected to be less competent mathematically than their 1960 counterparts (See Appendix A). If educators demonstrate different expectations towards different groups of students, it is quite possible that this would affect the students' perceptions of themselves. However, there are two factors which discount this idea at this point. Data from this study completely contradicted the mathematicians' expectations, for those completing teacher education courses in the 1970's were found to be more competent than those completing in the 1960's. As well as this, the University population continually revealed the highest proportions of individuals with an adequate mathematical education, even though they were educated in the 1970's. While other factors may be relevant to the unusually high competencies displayed by the University students, the fact that the teacher education courses were undertaken during the 1970's may have some bearing on their wider mathematical education.

Expectations of mathematicians at the Wollongong Institute of Education may not have been met for any number of reasons. It is possible that of the mathematically able students entering primary teacher training courses at this institution in the 1970's, it was the least mathematically able students who were electing to study tertiary mathematics - although data presented in Section 5.2 of this Chapter does not generally support this. It may also have been that the assumptions of this study and the assumptions of the mathematicians were incompatible.
While it is assumed here that mathematical background is at least one measure of mathematical competence, it is possible that mathematicians at the Institute have completely different perceptions of mathematical competence.

If differences in the proportions of those passing different categories of mathematics or not passing mathematics at all cannot be accounted for by changes in examination, marking systems, 'official attitudes' or differences in general academic ability, it could be postulated that differences occurred merely as a result of individual choice. It should be remembered that compulsory courses were excluded from the measuring scale in this study. Perhaps individual choice is influenced by any number of obscure factors, such as personality or teacher popularity; these, however, lie outside the scope of this study.

If in reality there are no other major intruding factors, this study has indicated that when primary teachers have been able to choose whether or not they will study mathematics, there has always been a group who have avoided the study of any type of mathematics. Further, it has been indicated that there have been isolated years which contain large proportions of individuals who possess little or no - an inadequate - mathematical background. In some of these isolated years, the proportion with an inadequate mathematical background actually constituted the majority of employable primary teachers in the Illawarra Region. Much attention has been given to the fact that between 1966 and 1968, an exceptionally large proportion of those primary teachers completing the only primary teacher training course available in the Region at the time possessed little mathematical background. Relief that this only occurred 'in the past' should not be voiced too loudly, for 1981 was the most recent year exhibiting the majority of employable primary teachers with
an inadequate mathematical background and was manifested by those completing the Institute Diploma in Education course.

Those involved in the education of primary teachers may like to note the relevance of these findings to recent suggestions about the imposition of a numeracy standard on all those wishing to enter a primary teacher education programme in Australia. Given the choice, the mathematical education of individuals within primary teacher education courses will vary year by year. Researchers into the mathematical education of primary teachers may like to note the applicability of this study to potential longitudinal research into the mathematical abilities of primary school teachers. While comparative studies on secondary students' mathematical ability over time have been conducted in Australia, no such studies have been attempted for primary teachers. Longitudinal data on 'current' mathematical ability which is collected in conjunction with the type of information sought in this study may reveal that there are ways and means of assessing 'current' mathematical ability in addition to standard performance tests.

5.8 The Relationship Between Gender and Field of Specialisation

Results of chi-square tests for this relationship were extremely significant for all groups except the Post-Graduate Diplomates. The reason for insignificant results for these two groups is that the General Primary field has been the only field available for prospective Post-Graduate primary teachers, except at the University where the Infants field was the only field available in 1977 and 1978.*

Choice between the field of specialisation for training was available for each other type of primary course, and the results for these courses were extremely significant. The findings for the analysis of this relationship indicated that females rarely chose to be trained in

*These assumptions are based on the 'methods' subjects recorded for each student on examination sheets.
the Small School field, and while very frequently electing to be trained in the Infants field, still comprised the majority of those trained in the General Primary field. On the other hand, males almost always opted for the Small School field but the Infants field was rarely chosen by them. It is evident that this exemplifies self-inflicted behavioural differentiation based on sex, due to the fact that fields of specialisation were ultimately decided upon by the trainee teachers themselves. In other words, both males and females appeared to be carrying out the traditional expectations for primary teachers - that females could teach the Infants classes because these young children 'need' a mother-figure; that small remote schools 'need' to be staffed by males capable of eliciting respect and obtaining control; and that teachers of young children in general should be female. Whether young children need a nurturing figure at school or whether small remote schools need male control are of little relevance to this study. It is important, however, that because of these sex-stereotypic expectations, some males who may have made excellent Infants teachers or some females who may have made excellent teachers in small remote schools, were excluded from these fields. The fact that a large proportion of males who successfully completed the Diploma in Education at the University were Infants trained bears testimony to the fact that males can be trained in this field and successfully pass the course of study.

Teacher educators may like to note that this study has shown that while most prospective primary teachers have chosen to enter the field of specialisation traditionally relevant to their own gender, there are a few rare individuals who have chosen to enter non-traditional areas. Of greater relevance to teacher educators is the fact that if
a field of specialisation such as Infants is made compulsory to both sexes, there are quite a number of males who will successfully complete the course of training.

5.9 The Relationship Between Gender and the Institution at Which Primary Teacher Training Was Completed

Because of the traditional male dominance within University study populations in Wollongong, New South Wales and Australia, it was anticipated that prospective primary teachers may dominate the University course of training in the Region. However, results of chi-square tests were not significant, and the null hypothesis specifying independence between these two variables was retained.

A possible reason for these findings not previously considered, is that from 1962 to 1976 there was only one institution in the Region at which primary teacher training could be undertaken - the Wollongong Institute of Education. Regardless of gender the majority of sampled teachers would have had to attend courses available at this institution if they wanted to complete a primary teacher training course in this Region. However, the commencement of Diploma in Education courses at the University made no significant difference to proportions of males and females undergoing primary teacher education at each institution. Actually, a very slight difference opposite to the expected direction of difference was manifested in the results with a higher ratio of females to males completing the University rather than the Institute primary training courses.

One likely explanation for this slight difference can be derived from a further comparison with those completing the Post-Graduate Diploma in Education course at the Institute. This course displayed the lowest ratio of females to males found in any course ever available in the Illawarra Region. At the risk of repetition, it is reiterated
that the University of Wollongong is predominantly a male-oriented university. Within such an educational environment, it would be highly possible to find men opting for masculine careers and women opting for traditionally feminine careers (18). Primary teaching of course falls within the range of feminine careers. As previously established, those completing a Post-Graduate Diploma in Education in primary teaching at the Institute were drawn from a wider range of universities than those completing the same course at the University. Males drawn from this wider range of universities in the first place, and who elected to undergo teacher training at an institution totally removed from their university environment in the second place, would possibly not have the potentially conflicting career choices that males being educated at the University of Wollongong would face. This could very easily account for the comparatively high proportion of males completing the Institute Diploma in Education course and the low proportion of males completing the University Diploma in Education course.

Despite the finding that there was no significant relationship between the institution at which teacher training was completed and gender, the possibility that sex-role stereotyping in respect of career choices at the University of Wollongong occurs was suggested in this section, which points the way to further research in the area of sex differences at this and other tertiary institutions.

Due to the large number of hypotheses which have been posited in this study, the following Chapter will offer a brief summary of the conclusions which have been drawn throughout the previous discussions.
CHAPTER 6

Conclusions
This thesis has systematically examined mathematical education for primary teachers in Australia, focusing on the mathematical background of employable primary teachers in the Illawarra Region between 1962 and 1981. The thesis did not enter any speculation about whether technological change is or should be relevant to education, nor did it attempt to dispute the nature of primary teacher education programmes. Rather, it utilised the assumptions made in recent Reports on teacher education in Australia, and proceeded from claims made in these Reports.

Due to the paucity of research in this area, a methodological framework was developed which suited the needs of comparisons over time for the relatively new factor of background in research into the mathematical education of primary teachers. Although utilised for the Illawarra Region, this methodological framework could easily be extended for use in other localities. While some traditional factors were examined in the context of mathematical education, several other new factors were introduced and analysed. Discussion of the findings has exposed several noteworthy features about the mathematical education of primary teachers, even for relationships which were found to be statistically insignificant. Implications for teacher education programmes were additionally explored. Flaws in this study and directions for future research in each area of concern have also been indicated throughout the discussion. The purpose of this concluding Chapter then, is to emphasise briefly those features considered to be of consequence to the mathematical education of primary teachers in Australia.

In comparison to the Victorian findings specified in the Myers' Report, very few primary teachers trained in Illawarra tertiary
institutions between 1962 and 1981 were found to have undergone no secondary or tertiary mathematical education at all. Because of the huge differences between the Victorian findings and the findings for the Illawarra Region, recommendations for changes in teacher education programmes would need careful consideration prior to implementation.

Differences in the mathematical background of those educated in each type of primary teacher training course between 1962 and 1981 in the Illawarra Region were evidenced in all findings. A significant relationship was established between the mathematics passed by the employable primary teachers and the type of primary teacher training course completed, and further analysis revealed that the higher the educational qualification obtained during teacher training, the more likely the employable primary teacher was to possess an adequate mathematical background. Explanations for these differences ranged from different types of individuals being attracted to different courses of training, to the increasing professionalism of primary teaching. As no other research has examined this variable in the past, this study has indicated that whatever the reasons for these differences, further research into this aspect of teacher training is certainly warranted - particularly if educational standards are to be compared.

Although there was no statistically significant relationship established between the mathematics passed by the employable primary teachers and the institution at which teacher training was completed, there was a trend for those completing primary teacher training at the University of Wollongong to possess more mathematical education than those trained at the Wollongong Institute of Education. As with several other factors, this variable has not been examined in past research,
and further research was recommended to establish its potential relevance to the mathematical education of primary teachers.

While no statistically significant relationship was established between mathematics and gender, it was discovered that an unusually large number of both male and female employable primary teachers from this Region have successfully completed some type of secondary and tertiary mathematics. Statistics for the Illawarra were considered unusual on the basis of comparisons with participation rates in Year 12 mathematics of each sex in both New South Wales and other States. Data from this study supported Moss' claim that there has been increased female participation in the study of secondary mathematics.

Whether employable primary teachers within this Region were trained in the Small School, Infants or General Primary field of specialisation, a significant relationship was established with the employable primary teachers' mathematical background. Contrary to some expectations, Small School trainees from the Region were found to possess the least mathematical background, while General Primary trainees were found to possess the most mathematical background. Explanations ranged from differences in general academic ability to the traditional role of the Small School trainee. As this factor has presumably never been researched in the context of the educational qualities of primary teachers, the need for further research in this area was stressed.

The relationship between mathematics passed by individuals within the sample of the year in which teacher training was completed was found to be statistically significant. A general trend towards more employable primary teachers in the 1970's and early 1980's possessing a sufficient mathematical background for the purpose of teaching primary
mathematics lent little support to those who insist that the education of primary teachers is experiencing a decline in the standard of mathematics. However, several years were isolated as being exceptional. Differences in general academic ability was discounted as an explanation, and it was proposed that personal choice influenced mathematical background. As this is the first comparative research in Australia for the mathematical education of primary teachers, further research was definitely indicated in this area.

Two hypotheses were also tested, which did not examine the mathematical education of primary teachers, but which were perceived to be potentially relevant for an explanation of mathematical differences. The first established a relationship between the gender of the employable primary teacher and the field of specialisation during teacher training. As anticipated from the claims frequently made, it was discovered that primary teaching in the Illawarra Region is a feminised occupation, with females dominating the General Primary and especially the Infants field, but with males dominating the Small School field. However, insignificant results were found for the relationship between the gender of the employable primary teacher and the institution at which teacher training was completed. Despite this finding, there was some speculation that sex-role stereotyping in respect of career choice was indicated for the University of Wollongong, and perhaps therefore also for other tertiary institutions.

Surprisingly, general academic ability was not able to account for any differences in the types of mathematics passed in all analyses of relationships except the mathematics passed by Small School, Infants and General Primary trainees. While this situation may be an accurate reflection of reality, it is possible that the incomplete sample of
aggregates in the study contributed to this. A complete range of aggregates in further research may not only aid in determining differences which could not be accounted for in this context, but would also enable more powerful statistical techniques to be utilised with the data. Moreover, while the chi-square statistic was both useful and relevant to the data analyses undertaken in this thesis, the multitude of factors found to be either obviously or potentially relevant to the mathematical education of primary teachers indicate the need for multivariate statistical analyses.

The two stages of education examined in this thesis reveal another aspect of the mathematical education of primary teachers which has not been documented in any available research. It was found that only one-quarter of those successfully completing a primary teacher training course in this Region availed themselves of tertiary mathematics courses. Despite the fact that one-quarter of the sample passed some type of tertiary mathematics, there was found to be little difference in the proportions of those with no, little or sufficient mathematical education when comparing these two stages of education. While it is possible that this may indicate a problem arising from the measuring device, the large differences between the two stages of education which were evidenced by those completing the Diploma in Education courses show that the measuring device was capable of measuring differences when they occurred.

Another major aspect of the measuring scale which was devised for this thesis concerns the general equation of secondary and tertiary mathematics over time. Past research which has compared the mathematical ability and mathematical education of secondary students suggested that syllabus changes were uncontrolled influences on findings. The
comparison of various mathematics syllabuses issued over time at both the secondary and tertiary stages of education was therefore undertaken in an effort to control this factor. While the method of comparison and equation appeared to be well-suited to its purpose, further refinement of the categories of mathematics devised for this study would be beneficial. This is particularly applicable to the tertiary level of mathematics. Prior discussion suggested that mathematicians may like to construct a measuring scale based on a more detailed assessment of demonstrated mathematical ability, i.e. mathematics passed.

Experts in the field for assessing the effects of various mathematical subjects on mathematical knowledge would be of great use here. Further, if these effects on mathematical knowledge were to be linked to the mathematical understandings necessary for those who are to teach primary mathematics, then a very realistic assessment of the mathematical knowledge held by primary teachers could be gained from an analysis of primary teachers' mathematical background. In turn, this would be of great benefit to curriculum-planners, who would have a measurable history of demonstrated mathematical ability for each student in a primary teacher training course. This mode of measuring mathematical ability would certainly aid teacher educators in their assessment of student teachers' current mathematical ability and employed primary teachers' current mathematical ability. It is incumbent upon teacher educators to utilise the knowledge gained in studies such as the one undertaken for this thesis, rather than planning changes on the basis of limited evidence or emotional propaganda.
APPENDIX A

Analysis of the Questionnaire
Two different questionnaires were devised and sent to the two regional institutions concerned with the preparation and training of primary school teachers, which are the University of Wollongong and the Wollongong Institute of Education (see the end of this Appendix for copies of these questionnaires). Both questionnaires attempted to establish some local professional opinion regarding the desired mathematical competency of primary school teachers. An additional aim of the questionnaire sent to the Institute educators was to discover and assess major alterations in the mathematics electives available at the Institute to trainee primary teachers.

Forty-four questionnaires (18 W.I.E.; 26 U. of W.) were sent to the teaching staff of Education and Mathematics Departments at the two institutions. After eight weeks, 26 questionnaires were returned. These were then categorised and analysed to assess whether the information could be utilised in this thesis. Analysis was dealt with in two parts - the general level of competency considered to be desirable in primary school teachers, and the nature of mathematics electives at the Wollongong Institute of Education.

**Desired Level of Competency**

All staff at both institutions were asked to respond to the following question:

What level of mathematical competency do you think primary school teachers should possess? Do you think that primary school teachers need to be competent only at what they are required to teach?

This question was perceived in two ways. One group indicated that a complete understanding of all that is required to be taught was desirable. The other group specified recognisable bodies
and levels of knowledge which should be possessed in order to understand what is required to be taught. While there was some overlap between these two types of responses, a general categorisation of answers was as follows:

1. "Don't know" or "unable to say"  \( (N = 4) \)
2. Stress on understanding mathematics itself  \( (N = 1) \)
3. Stress on the problems involved in the teaching of mathematics to young children  \( (N = 1) \)
4. Specification of some identifiable level of mathematical knowledge
   (a) Primary level at least  \( (N = 5) \)
   (b) "Much higher" than primary level  \( (N = 6) \)
   (c) High school level  \( (N = 1) \)
   (d) Tertiary level  \( (N = 8) \)
   \( (T = 26) \)

While no extreme differences of opinion were noticed between institutions, there were major differences between Departments. Mathematicians at both institutions were inclined to specify both content and levels, which was undoubtedly due to their familiarity with the area. Education staff were more inclined towards general answers, usually nominating only levels or content. Where this occurred, mathematicians' responses were used to categorise similar Education responses.

Of the 26 responses, 20 specified some easily recognisable level of knowledge. Fifteen of those categorised into recognisable levels agreed that "much" more than primary level was desirable. For those specifying primary level at least, answers tended to be quite general and indicated that some respondents were very unfamiliar with mathematics. However, qualifying statements made in conjunction with other responses in this category revealed a different
perspective:

I would be more than happy if they (primary school teachers) were competent in the areas being taught.
(Mathematician, W.I.E.)

This explicitly reveals an attitude which was often implied or suggested by a noticeable number of mathematicians, regardless of the category of response. Mathematicians tended to think that many teachers today are not even competent at primary level - and therefore a basic competence at this level needs to be established prior to fulfilling any ideal goals of greater mathematical competency.

The six respondents who stated that a level "much higher" than primary level was desirable, all basically supported the following statement:

Even with a static syllabus, there is a need for the teacher at least to have an idea of what is 'behind and beyond' a particular point.
(Mathematician, U. of W.)

For the nine respondents who specified other identifiable levels of knowledge, all presumed that teachers at least need a complete high school exposure to mathematics in order to be competent teachers of primary mathematics. All of the eight respondents who specified a tertiary level of knowledge emphasised that while a major study of mathematics at University level was not necessary, some elementary tertiary level was desirable. In fact, two respondents suggested that an elementary tertiary level of mathematical knowledge should be a prerequisite for any person seeking admission to a primary teacher education programme.

It is of interest to note that over half of the respondents also placed a strong emphasis on the ability to teach
mathematics, noting other influences such as favourable attitudes towards the subject. While teaching ability is obviously an important factor, this thesis is based on the Myers' Report assumption that while one may know how to teach, one also needs an adequate grasp of what is to be taught. As Chapter Two of this thesis points out, there is much research devoted to the 'how' and little to the 'what'.

One conclusion which may be drawn from this analysis is that many respondents assume that more exposure to mathematical knowledge should generally produce higher levels of mathematical competency. This can be related to the Myers' Report, which is based on a similar assumption. Further, of those specifying some recognisable level of exposure, answers of the majority of respondents support the Myers' Report suggestion that primary school teachers should at least possess a complete High school level of mathematical knowledge.

The Nature of Mathematics Electives at the Wollongong Institute of Education

Relevant members of staff at the W.I.E. (N = 18) were asked to respond to two questions, which aimed at assisting in the discovery of any alterations in the content of available mathematics electives. This information served as one source of judgement for possible effects on the reliability of the scale devised to measure levels of mathematics attained by trainee primary teachers.

Not all Education Department members were able to respond to these questions, due to unfamiliarity with the electives. Therefore, only Mathematics' Department responses were analysed. The first question about mathematics electives was:

In your opinion, and from your own experience, has the mathematics elective component of the Dip. Teaching (Primary) altered its content through the years? If your answer is 'yes', could you briefly explain in what way change has occurred.
All five respondents stated that the content had been altered in the mathematics elective programme. Three respondents indicated that there had been a general trend away from advanced academic mathematics towards the ability to understand and apply the mathematics being studied. The other two respondents specified that the content varied according to the interests of lecturers and students.

The second question was posed in an attempt to assess the general effects of alterations on student mathematical competency:

In your opinion, would someone who had completed the mathematics elective course in the Dip. Teaching (Primary) programme in the 1960's generally be as competent mathematically as someone who had completed the same type of elective in the 1970's? Please explain.

Answers to this question varied. One respondent avoided a judgement by indicating that there are now two types of electives available - academic and environmental. Two respondents felt that students from the 1960's would have been more competent. This greater competence, however, was not attributed to the W.I.E. programmes, but rather to the levels of competence trainee teachers possessed upon admission (i.e. due to a "sounder background from school"). Alternatively, two respondents thought that generally, students from both the 1960's and 1970's would be equally competent.

Responses to these question indicate several interesting points. First, all respondents agreed that there had been alterations in mathematics electives, yet none noted that these alterations influenced students' competencies. From this it can be assumed that while content may have altered over time, outcomes did not. These responses were useful for developing the measuring scale (see Appendix B). Second, responses to these questions indicate that there are
differing opinions regarding criteria for competency. As an extension of differing criteria, the third point is that those assessing the scale devised for this thesis will probably show varied and opposing reactions.

**Limitations of the Questionnaire and Suggestions For Improvement**

The major limitation of this study was the low response rate (59%). The reasons for this could range from staff being on leave to mathematicians not feeling sufficiently knowledgeable about teacher education. However, there is only one improvement in the design of the questionnaire itself which may elicit more responses. A clearer cover sheet could have specified that opinions were desired even if the potential respondent knew little about teacher education or mathematics. Further, the W.I.E. Education staff should have received the general questionnaire rather than the mathematics elective questionnaire, because Education respondents knew little about the content or implementation of the mathematics electives. This could not be established prior to receiving the information from the questionnaire, but would be improved if time allowed a second questionnaire to be designed.

The questions themselves could also be revised in the light of information received after sending the questionnaires to the institutions. It was discovered that the Dip. Teaching (Primary) is a three-year programme which was introduced in 1969. Before this, people completing the Primary course were not Diplomates, but were certified by the State Education Department after successful completion of the two-year programme. While respondents appeared to assume that the questions pertaining to changes in mathematics electives dealt with any type of non-Degree primary training, this assumption contains a certain amount of risk.
Several respondents noted that the general question concerning the desired level of mathematical competency was in two parts. Although these two parts were intended to complement each other, they appeared to be misinterpreted. Attention would be given to further clarification of the question if this questionnaire was to be used again. Several respondents also noted that it was difficult to state or assess what was meant by "competency". However, these respondents were quite able to describe what they assumed 'competency' to be, because provision was made for lengthy answers.

Expressed in more general terms, the advantage of this open-ended format was that respondents could give detailed observations and qualified responses which could otherwise have been interpreted in different ways. Furthermore, the categories established by using this format would enable construction of a closed questionnaire if desired.

In conclusion, none of the limiting factors appeared to seriously affect the validity of the responses. Certainly the information elicited was of the type which was desired and expected. Responses to questions concerned with the mathematics electives were utilised in developing the measuring scale, and therefore performed a useful function. Responses to the question concerned with the desired levels of mathematical competence were useful in establishing some Regional opinion where none was previously available. Once established, this opinion was useful as a Regional source for comparison with some assumptions in the Myers' Report.
TO: ALL MATHEMATICS AND EDUCATION TEACHING STAFF.

This questionnaire is an attempt to identify some local professional opinion about the mathematical training of Primary school teachers. I am primarily interested in your own professional opinion rather than Departmental or other group views.

The information obtained through this questionnaire will be utilised within an Honours thesis currently in progress at Wollongong University.

I would therefore very much appreciate you spending 5 minutes of your time in answering the attached questions, and sending the completed questionnaire to:

Dianne Snow,
Department of Education,
Wollongong University.

INSTRUCTIONS.

The first three questions are merely to establish a reference point for the last question. Please answer the open-ended question as thoughtfully as possible.

THANK YOU FOR YOUR TIME AND FOR YOUR PROFESSIONAL OPINION.
Q. (1) SEX: Male ________ Female ________

Q. (2) DEPARTMENT TEACHING IN: Mathematics ________ Education ________

Q. (3) HAVE YOU EVER BEEN INVOLVED IN THE PROFESSIONAL TRAINING OF PRIMARY SCHOOL TEACHERS? PLEASE IDENTIFY PROGRAMME IF YOU HAVE. ________

Q. (4) WHAT LEVEL OF MATHEMATICAL COMPETENCY DO YOU THINK THAT PRIMARY SCHOOL TEACHERS SHOULD POSSESS? DO YOU THINK THAT PRIMARY SCHOOL TEACHERS NEED TO BE COMPETENT ONLY AT WHAT THEY ARE REQUIRED TO TEACH? PLEASE EXPLAIN.
MATHEMATICS ELECTIVES AT THE WOLLONGONG INSTITUTE OF EDUCATION,

TO: ALL TEACHING STAFF IN THE MATHEMATICS AND EDUCATION DEPARTMENTS.

This questionnaire is an attempt to gauge major alterations in mathematics elective courses for the Dip. Teaching (Primary) programme at your Institution. I am particularly interested in establishing whether there were/are any major differences in these courses from the date of the Institute's establishment as a Teachers' College, to the current time.

The information obtained from this questionnaire will be used as one source of validation for one aspect of an Honours thesis currently in progress at Wollongong University.

I would therefore very much appreciate you spending 15 minutes of your time in answering the attached questions, and then sending the completed questionnaire to:

Dianne Snow,
Department of Education,
University of Wollongong.

INSTRUCTIONS.

The first three questions are merely to establish a reference point for the last three open-ended questions.
Please answer the open-ended questions as thoughtfully as possible.

THANK YOU FOR YOUR TIME AND PROFESSIONAL OPINIONS.
Q. (1) SEX: Male__________ Female__________

Q. (2) DEPARTMENT TEACHING IN: Mathematics__________ Education__________

Q. (3) IN WHAT YEAR DID YOU BEGIN TEACHING IN THIS DEPARTMENT? ______

Q. (4) IN YOUR OPINION, AND FROM YOUR OWN EXPERIENCE, HAS THE MATHEMATICS COMPONENT OF THE DIP. TEACHING (PRIMARY) ALTERED ITS CONTENT THROUGH THE YEARS? IF YOUR ANSWER IS 'YES', COULD YOU BRIEFLY EXPLAIN IN WHAT WAY CHANGE HAS OCCURRED.


Q. (6) WHAT LEVEL OF MATHEMATICAL COMPETENCY DO YOU THINK PRIMARY SCHOOL TEACHERS SHOULD POSSESS? DO YOU THINK THAT PRIMARY SCHOOL TEACHERS NEED TO BE COMPETENT ONLY AT WHAT THEY ARE REQUIRED TO TEACH? PLEASE EXPLAIN.
APPENDIX B

Revision of the Measuring Scale Via An Interview
The purpose of the interview was to elicit information from professional mathematicians in order to correct any serious faults in the devised scale. The author developed the scale with a background of little high school mathematics and only social science service courses at tertiary level, and considered it necessary to check a personal perspective against the perspective of those with more knowledge of both high school and tertiary mathematics. Therefore the interview was held with two mathematicians employed at the University of Wollongong as lecturers and course co-ordinators of mathematics. As the author considered the mathematicians' views on mathematics to be more reliable than her own, several of their suggestions were adopted and the scale was revised.

After the following transcript of the interview, there is a discussion concerning some of the views expressed by the mathematicians, and of the revisions which were made to the scale as a result of the interview.

Transcript of the Interview

(An introductory section on who the Interviewer was and the general purpose of the interview was not recorded. Further, as there were several interruptions during the interview itself, only that which was pertinent to the development of the measuring scale was transcribed. At the beginning of the interview, both mathematicians were given a copy of the rank order scale developed prior to that meeting. A copy of this may be found at the end of the transcript of the interview.)

Mathematician (1): So you're going up the levels...It looks like you're saying that someone who's done a service course is going to be more competent with the mathematics that's relevant to primary school teaching...

Interviewer: I'm interested in mathematical knowledge attained rather
193.

than relevance to primary school.*

M (1): What they are teaching at primary school,...someone who had
studied 3 or 4 Unit at high school and was competent at it and understood
it, would have seen all the mathematics they need to be competent
teachers of primary school. As far as the content of the course, anything
above that is a bonus.

M (1): When you start saying if someone's got a 4, or if someone's got
a 6, and has done one service course at the University...I guess you're
going to double number these.

Int: That's one of the questions I wanted to ask you. Whether you thought
that the final (I'm looking at it in two stages),

M (1): It seems to me that if you are going to rank order these people,
a 4 is much better than a 6. The level of mathematics attained as far
as relevance to what's going on in the primary school syllabus, from
almost anything a 4 would be better than a 6.

M (2): A 3 would be better than a 6.

M (1): Or even a 5.

Int: That would be alright if people had done one of these (high school
level) plus those (university level).

M (1): So what you want is a first subscript for levels 0 through 4, and
then you tack on these afterwards. So that a 4.6 is better than a 3.6
maybe. But to some extent the first thing gives you rank ordering for
how they came in, and the second one is what they've done after that.

M (2): That's right.

M (2): I think that if you look at the level of maths as taught at the
primary school, which is really, I imagine anyway, very fundamental
arithmetic, getting them used to numbers, getting them used to doing
simple additions, subtractions and multiplications, and perhaps towards
the end some elementary problem-solving. Anyone who could handle, very
competently, and understand what they were doing, even say fourth year
mathematics of high school would probably turn out to be someone who
could handle the material when they had to go out and see them again at
primary school level...But what you hear people talking about is that
Miss such-and-such failed maths at high school, and here she is teaching
my daughter...which is what people are concerned about.

*This is of interest, because both mathematicians continued to discuss
mathematical knowledge in terms of relevance to primary school teaching.
M (2): The difference in competence as a primary school teacher of mathematics between someone who's done Maths III at university and someone who's got 3 Unit Maths at the Higher School Certificate with a good result - the difference in their ability to teach basic primary school mathematics I don't think is going to be greatly changed between these two levels. Because they will have the ability with 3 Unit Maths to do the job well.

M (1): What you need to be a competent teacher of maths is some confidence. Most of the people you talk to don't like maths, they were never very good at maths, and so they're not very confident teaching it. And as a result they pretty much have to do what the book says. They are very limited, they can't take a chance on anything that's not in the book. Someone who's done say, a 3 Unit course and has been successful, and is confident about what they know about mathematics, that would probably be sufficient background to even be willing to adjust something in the book...Confidence is the big thing. I think if you almost rank order them on that (high school), I don't think these things (tertiary) make very much difference.

M (2): That's right.

Int: That's the assertion I started the whole thesis under. There was an assertion made that primary school teachers need at least complete high school maths to be competent teachers...

M (1), (2): What they need is a specific course, something above high school level, for teachers, to teach them what are the basic ideas behind primary school maths...So they're not actually doing a methods course in teaching, they're not actually learning it for the first time, but they're being instructed in what they should be teaching...Teachers need a review of what is being taught in primary schools...Most people don't understand the ideas and therefore they're afraid of them.

Int: That's the compulsory unit of the Dip. Teach.

M (2): Probably on that basis then we're saying that the Dip. Teach. people are going to be considerably better qualified to teach maths at least at primary level, than say, someone who's a psychology or English major here...We've got evidence from one of our staff who's teaching the psychology students, about their very poor basic ability...This is a problem. And then what happens of course is that this compounds, because
they're not teaching with a breadth of knowledge themselves to these individuals who then come on to high school, who then come on to Uni., and then they go out again without any background in mathematics, and the cycle is a downward spiral.

M (1): I can't get away from it being as much attitude as it is specific bits of information that you have...You can sort all of these into backgrounds, but you can't tell the good from the bad from background alone.

Int: I know that, but there's been a lot of research done into teaching ability and attitudes, and competence as an outcome of that. But there's been very little done on this type of thing, while there's been a lot of statements made...

M (1): So all you're going to come out with is that primary school teachers of mathematics are poorly trained, and here's the evidence based on this sample. And that's all that you could say...that this is the background profile of primary school teachers.

Int: That's what's needed because that's what's lacking.

M (2): But it's even difficult on that basis to ascertain whether they are good or not. Someone who happens to be pretty good, who's done very little mathematics but who's dedicated could well go to the trouble of learning it privately anyway. And you have the other sort of side where someone who never liked maths and is afraid of it, he's going to go into the classroom and put his fears right through all the rest of the class that he teaches. There are all sorts of factors which need to be taken into account.

Int: (Restatement of Myers' Report assertions.)

M (1),(2): (Restatement that levels 0 - 4 are the most important, and anything else is a bonus.)

M (1): All you can say is 'this is the background'. Whether or not you can say that this is an indication of competence is another thing.

Int: But the assertion is that teachers are incompetent because they don't have the background.

M (2): That would have to be one of the major contributing factors.

Int: It's certainly a factor, and it's a factor which hasn't been looked at much in Australia.
M (1), (2): Tertiary maths becomes a secondary issue.

M (2): For someone who's got 3 Unit or 4 Unit maths, it becomes irrelevant as to what additional maths they do. Someone who does reasonably well, that shows a certain amount of competence and interest, because they probably wouldn't have done that level if they weren't interested in the first place. Someone who does 2 Unit A, from what we've seen here, it's extremely rare that anyone in that situation is the least bit interested in maths. But again you have to say are they not interested because they were more interested in English, but were still competent at maths, or because it was something they couldn't do and were afraid of maths.

M (2): Rather than having a long list, have a matrix arrangement... Then somewhere in that matrix you might have a jagged line where the basic levels of competence are. With 3 Unit maths it might be down the very first column, but with Intermediate or School Certificate maths it might be at the very end because no-one is competent at that level. But all that says is that is their mathematical ability. Whether it's their ability to teach it and communicate it back again is another thing.

Int: The other major problem is equating levels across time. I've used content and contact time...

M (2): I think you've done a good job there. The only thing I'd query is on the fourth level where you've got Maths I and II (Hons). I'd say Maths I and/or II (Hons),...because anyone who could handle Maths I could handle Maths II.

Int: And how about the University levels? The gradation of those?

M (2): I'd believe that maths plus service courses, I couldn't really distinguish between them.

M (1): I's prefer to pull out the service courses and put them to one side.

M (2): I think you can combine all service courses and put them as one.

M (1): I think that this fine tuning into subtle differences isn't necessary...But service courses should have some place somewhere.

M (2): As far as doing one, two or three service courses, the mathematics they have to do to understand that is to add and subtract numbers and do a little bit of fraction work.
M (2): I would put that rated as the first subscript. Any amount of service courses would rate as I, Maths I would be rated as 2, (etc) ...

M (1): Yes.

M (2): You may find when you talk to someone about these courses (Institute), they may slot in here (against University courses).

M (1): Yes, but I think if she does it this way (by list) and just continues on. You do get a difference between the University and the Institute by the level of numbers that they are. So if you take, say, the Environmental strand and that's 5, and then that's a 6, a 7, and an 8 (counting down the Institute column on the scale). Then by the next digit you can see whether or not they've gone to University or to Teachers' College. So you get an 0.5.

M (2): But what I was suggesting that might be able to be done is if you're setting it up in a scale system like this, you've got 1, 2, 3, 4, 5, going across the page. And you might be able to say on the evidence, it looks as though if you draw this line, everyone on the left hand side of the line is going to be poor, and everyone on the right hand side of the line is going to be good.

M (1): Yes, but she's not making any judgements about good or bad. So all she wants to do is get the information out, so she wants some way of sorting it. So 0.5 says they did no High school maths but one thing at Teachers' College. A 1.3 did 2 Unit A and went up to second year at University. So that says that when you read these double digits the first one tells you where they were at high school, whether they went to the University or the Institute, and how much maths they've done.

M (1): The problem is, I don't think you are going to be able to say if I compare 0.5 and 0.1, which of those two is the best - I don't think you can rank order those.

M (2): The closest you can do it, to rank order them, is to run them along the graph. And so instead of having a lot of categories, you're going to have lots of combinations all being in an equal category.

M (1): It seems to me that 0.5 and 0.1 (a little bit of Uni., nothing before, a little bit of Institute, nothing before) - to rank order those would not be meaningful.

M (2): I think you're in a position where you have a lot less scales than you think you might have.
M (1): I think that you're going to find most people will be in one or
two boxes anyway.

M (1): How would you compare someone who'd done no H.S.C. maths and a
little advanced work at University level or Institute level? As far as
primary teaching is concerned, there's probably not a whole lot of
difference.

M (1): With a double subscript you could get any sort of information
you want...But as far as trying to rank order them, I don't know if that's
reasonable, without making some equations. Is someone who's done two
years at the Institute as good as someone who's done two years at Uni.? I
don't know. To try and rank order them and say you've done it
meaningfully I think is really nonsense.

M (2): In the long run, it's not just the level, because you have to
look at the person's performance within that level...At 4 Unit, you've
got to assume that the person's pretty competent in the first place.
3 Unit, we reckon 90% of them are competent, there's 10% of them get in
there by error. 2 Unit, as far as mathematical ability is concerned,
we would say there's probably about 30% who are worthy, 70% are not.

M (1): (After questioning the interviewer about accessible information).
We have graphs...that show that aggregates are the best single indicator.
Second best is level result in maths, certainly for maths. If you have
that information available...if you come along and said I can give you
a profile of primary school teachers and if you left out all of stuff
about University...If you rank zero through 4 on high school and take
the aggregates, and I'll take the level passess in mathematics in each
one of those. If you did those three things and bring those figures
back, we could look at them and say we've got an idea of how many of these
are competent at mathematics and how many aren't, within fairly narrow
limits...And to some extent it also tells you this - are the good people
really going into primary school teaching.
Original Rank Order Scale

0 - Intermediate/School Certificate ONLY
1 - (1953) General OR Applied Mathematics/ (1965) III Level/(1973) 2 Unit A ONLY
2 - (1953) Maths I OR Maths II OR Maths III/ (1965) IIS Level/(1973) 2 Unit ONLY
3 - (1953) Maths I AND Maths II/ (1965) IIF Level/(1973) 3 Unit ONLY
4 - (1953) Maths I AND Maths II (HONS)/ (1965) I Level/(1973) 4 Unit ONLY

University

6 - 1 Service Course
8 - 2 Service Courses
9 - 3 Service Courses
10 - Maths I
11 - Maths I AND 1 Service Course
12 - Maths I AND 2 Service Courses
13 - Maths II
14 - Maths II AND 1 Service Course
15 - Maths II AND 2 Service Courses
16 - Maths III

Institute

5 - SS Maths I (Environmental)
7 - SS Maths II (Environmental)
8 - SS Maths III (Environmental)
8 - SS Maths I (Advanced)
10 - SS Maths II (Advanced)
11 - SS Maths III (Advanced)
Views Expressed By The Mathematicians

Several noteworthy views emerged during the interview. First, although the mathematicians viewed mathematical knowledge in relation to relevance to the primary school teacher, both mathematicians agreed that the scale was one measure of mathematical ability. While a continual concern with teaching competence was displayed, it was evident that mathematical ability and the ability to teach mathematics were viewed as two separate issues which were able to be individually identified. Neither of the mathematicians were able to use level of mathematics passed as a single indice of teaching ability. Judgements concerning a basic level of competence to teach mathematics in relation to level of mathematics passed were always accompanied by qualifying statements. For example:

Someone who had studied 3 or 4 Unit at high school and was competent at it and understood it,

and

Someone who does reasonably well, that shows a certain amount of competence and interest.

Second, it was obvious that there is no one point at which one could establish a division between 'good' and 'bad', 'competent' and 'incompetent', or 'able' and 'not able'. One mathematician presented two different opinions about the one level of mathematical attainment - the Intermediate level may be sufficient to ensure competent teaching of primary mathematics, and "with Intermediate or School Certificate mathematics it might be at the very end because no-one is competent at that level". This is an indication of the difficulty involved in establishing one point where mathematical level attained could be categorised into sufficient, competent or able. During the interview it was suggested that by obtaining three types of information, a judgemental profile could be constructed. However, one type of
information was not usually available on the records used for data collection. "Level result in maths", such as percentile ranks or marks, were not recorded until the 'new' system based on the notion of 'no failure' was introduced.

Third, both mathematicians agreed that the part of the compulsory mathematics units which is directed towards developing an understanding of mathematics at the Institute is a very useful and necessary course for prospective primary school teachers. Although the interviewed mathematicians may use different criteria to those in the Myers' Report, both sources assume that few prospective primary teachers have 'sufficient' mathematical ability. Thus this type of course was viewed as vertical enrichment for some individuals who may not have the understanding of mathematics perceived to be necessary for primary school teachers, or as horizontal enrichment for those who do possess the desired level of understanding. As noted previously, there is some difficulty in establishing at which point, or for which individuals, this type of course becomes horizontal or vertical knowledge. For this reason these courses were not included within the scale, although they were certainly considered in the discussion of results within the main body of the thesis.

Revision of the Measuring Scale

On the basis of the interview, and a re-examination of the content and contact time available for tertiary mathematics at the two Regional institutions, the scale was revised in the following manner.

First, the high school levels were revised by substituting (1953) Mathematics I AND/OR Mathematics II (HONS) for Mathematics I AND Mathematics II (HONS), as was suggested in the interview. Rank 0 was also altered to 'no Leaving/Higher School Certificate Mathematics',


because it was not able to be assumed that individuals who had not completed a Leaving/Higher School Certificate level of mathematics had always completed Intermediate/School Certificate mathematics. With the new category, overseas students and Special Admissions students could be categorised as 0.

Second, a matrix version was devised as an alternative to the original scale with vertically-graded ranks. One of the major questions which prompted the interview was where people who had no high school mathematics, but some tertiary mathematics, could be ranked. That is, regardless of the type of mathematics passed at tertiary level, whether final attainment would outweigh previous non-attainment at the Higher School Certificate level. Both mathematicians agreed that Service courses involved little mathematical knowledge, and could therefore not be ranked above some of the high school mathematics. Further, both mathematicians knew little about the mathematics available at the Institute, and one mathematician considered the attempt to equate mathematics between institutions as "nonsense". As time would not permit additional interviews between University and Institute mathematicians, content and contact time were re-examined in order to assess the usefulness of equating levels between institutions.

For the original scale, content was the major indice for equating courses between institutions. No two courses were identical, but they appeared to be sufficiently similar to enable broad equations to be made. A re-examination of content showed that broad generalisations could still be made, although the nature of combinations of courses available at the University, as well as the differences between 'service' type courses between institutions, made this a difficult task. In order to further differentiate between courses, contact time was then examined.
Recent calendars for both institutions were used to establish the following contact hours as a guide. Time was established on the basis of 26 teaching weeks per year at the W.I.E., and two one-session subjects per 14 week teaching session at the University.

**University**

Service Courses - Range from 84 hours for one course, to 336 hours for four courses.

- Maths I = \((6 \times 14 \times 2) = 168\) hours.
- Maths II = \((2 \times 4 \times 14 \times 2, \text{ and Maths I}) = 392\) hours.
- Maths III = \((2 \times 4 \times 14 \times 2, \text{ and Maths I and II}) = 616\) hours.

**Institute**

Special Studies Mathematics (Environmental) = \((3 \times 26 \text{ for 5 semesters}) = 182\) hours.

Special Studies Mathematics (Advanced) = \((3 \times 26 \text{ for 5 semesters}) = 182\) hours.

(N.B. Institute mathematics is calculated by complete courses, because this is the only form in which it is available to students for study.)

While the University contact hours remained relatively similar over time, the same cannot be said for the Institute mathematics electives. While content for the Institute courses may have been similar, contact hours varied enormously - for example, (1963) Special Studies Mathematics had only 78 contact hours for the entire course, whereas the 1978 version of this course had 182 contact hours.

This indicates that it would be difficult, and perhaps even unreasonable (as suggested in the interview), to attempt to equate courses between institutions on the basis of contact hours alone. While it is true that the same statement could be made for the Institute courses over time, content at least has been similar enough to permit comparisons for the same institutions. It was therefore decided that because of the difficulties involved in rank ordering based on one indice which
fluctuated noticeably and another which has remained relatively stable, a matrix version would be the most reasonable method of categorisation.

As mentioned in the previous paragraph, and as indicated in the questionnaire concerning mathematics electives available at the Institute over time (see Appendix A), content for the two types of electives has altered little over time. At least, they have not altered to the extent where a completely different category was necessary for each new course name. The types of mathematic elective courses available at the Institute generally fell into two broad categories - applied or instrumental mathematics, and academic mathematics. If the University Maths I, II and III courses were all slotted into one category, similar categorisation into two broad types of mathematical knowledge could be assumed. In fact, it is anticipated that if statistical computations are thwarted by small frequencies in any category for the University statistics, additional computations could be achieved with such a combination in a meaningful manner.

Therefore, while content and contact time were still utilised to equate tertiary and high school levels over time, and high school levels by rank order, these indices were not used to rank tertiary mathematics between institutions. From this, categories for tertiary mathematics were devised as follows on the next page.

A - Service Courses
B - Mathematics I
C - Mathematics II
D - Mathematics III

    (1970) Mathematics A or B/
    (1978) Special Studies Mathematics (Environmental)

INSTITUTE

Y - (1963) Special Study Mathematics/
    (1964) Mathematics/(1966) Mathematics I/
    (1968) Mathematics II/
    (1970) Advanced Mathematics A or B/
    (1974) Advanced Mathematics/
    (1978) Special Studies Mathematics (Advanced)

This method permits categorisation by type of mathematics studied, amount of mathematics studied and place where the mathematics was studied, as one mathematician pointed out in the interview. Combined with the original high school ranks, this double digit form of categorisation is indeed useful for sorting purposes without having to rank high school and tertiary mathematics, or tertiary mathematics between institutions. The final form of the measuring scale is therefore shown on the following page.
Categories of Mathematics Passed For High School and Regional Institutions

0 - No Leaving Certificate/ No Higher School Certificate Mathematics

1 - (1953) General OR Applied Mathematics/(1965) III Level Mathematics/ (1973) 2 Unit A Mathematics


3 - (1953) Mathematics I AND Mathematics II/(1965) IIIF Level Mathematics/ (1973) 3 Unit Mathematics

4 - (1953) Mathematics I OR Mathematics II (HONS)/ (1965) I Level Mathematics/(1973) 4 Unit Mathematics


A - Service Courses
B - Mathematics I
C - Mathematics II
D - Mathematics III

The alphanumeric version of this scale is shown below.

Matrix Showing Categories For Level of Mathematics Passed At High School And Tertiary Institutions

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APPENDIX C

Tables of Aggregates
## TABLE 1


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<th>TYPE OF COURSE</th>
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</table>

* All aggregates are transformed scores with a mean of 500 and a standard deviation of 100.

| INSTITUTION AT WHICH COURSE WAS COMPLETED | FEMALES | | | | MALES | | | | ALL PERSONS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N | \( \bar{X} \) | \( \sigma \) | \( \sigma^2 \) | N | \( \bar{X} \) | \( \sigma \) | \( \sigma^2 \) | N | \( \bar{X} \) | \( \sigma \) | \( \sigma^2 \) |
| University 1977 | 4 | 561 | 61 | 3671 | 3 | 544 | 120 | 14438 | 7 | 562 | 67 | 4458 |
| Institute 1977 | 8 | 537 | 41 | 1637 | 3 | 576 | 52 | 2722 | 11 | 548 | 45 | 2014 |
| University 1978 | 16 | 530 | 65 | 4231 | 6 | 526 | 81 | 6533 | 22 | 528 | 68 | 4586 |
| Institute 1978 | 6 | 540 | 60 | 3543 | 3 | 525 | 40 | 1566 | 9 | 535 | 52 | 2659 |
| University 1979 | 7 | 560 | 50 | 2532 | 1 | 502 | - | - | 8 | 553 | 51 | 2591 |
| Institute 1979 | 9 | 549 | 51 | 2588 | 9 | 526 | 53 | 2817 | 18 | 537 | 52 | 2677 |
| University 1980 | 12 | 567 | 51 | 2606 | 3 | 530 | 31 | 1459 | 15 | 560 | 50 | 2487 |
| Institute 1980 | 4 | 611 | 82 | 6736 | 5 | 528 | 31 | 965 | 9 | 565 | 71 | 4910 |
| University 1981 | 18 | 534 | 64 | 4105 | 2 | 487 | 37 | 1405 | 20 | 529 | 63 | 3961 |
| Institute 1981 | 7 | 554 | 57 | 3194 | 0 | - | - | - | 7 | 554 | 57 | 3194 |
| University All Years | 57 | 545 | 60 | 3612 | 15 | 523 | 71 | 5041 | 71 | 540 | 63 | 3920 |
| Institute All Years | 34 | 553 | 57 | 3304 | 20 | 534 | 47 | 2166 | 54 | 546 | 54 | 2919 |
TABLE 3

(a) Infants and General Primary

| TYPE OF COURSE | FIELD SPECIALISED IN | INFANTS | | GENERAL PRIMARY | | ALL PERSONS | | |
|----------------|-----------------------|---------|---|-----------------|---|---------|---|
|                | N         | X       | 0 | N         | X       | 0 | N         | X       | 0 |
| CERTIFICATE:   |           |         |   |           |         |   |           |         |   |
| 1964           | 11        | 598     | 25  | 605       | 26       | 606  | 24  | 579       | 37        | 603  | 24  | 585    |
| 1965           | 17        | 627     | 44  | 1930      | 22       | 609  | 34  | 1189      | 39        | 617  | 39  | 1559   |
| 1966           | 12        | 612     | 10  | 95        | 20       | 625  | 33  | 1097      | 32        | 620  | 27  | 746    |
| 1967           | 14        | 623     | 10  | 108       | 22       | 616  | 14  | 197       | 36        | 619  | 13  | 169    |
| 1968           | 13        | 527     | 29  | 838       | 22       | 538  | 33  | 1083      | 35        | 534  | 32  | 996    |
| 1969           | 13        | 526     | 29  | 932       | 24       | 543  | 62  | 3826      | 37        | 537  | 53  | 2788   |
| 1970           | 16        | 553     | 45  | 2065      | 19       | 518  | 38  | 1463      | 34        | 532  | 43  | 1856   |
| 1971           | 6         | 539     | 17  | 294       | 23       | 538  | 32  | 1044      | 29        | 538  | 30  | 873    |
| 1972           | 11        | 520     | 33  | 1108      | 21       | 523  | 76  | 5817      | 32        | 522  | 64  | 4113   |
| 1973           | 7         | 526     | 34  | 1129      | 21       | 517  | 25  | 650       | 27        | 519  | 27  | 748    |

DIPLOMA IN TEACHING:

| 1971 | NOT ABLE TO DISTINGUISH FROM RECORDS* | 29 | 527 | 36 | 1290 |
| 1972 | ALL STUDENTS WERE INFANTS TRAINED     | 24 | 532 | 28 | 775  |
| 1973 | ALL STUDENTS WERE GENERAL PR. TRAINED | 31 | 526 | 44 | 1927 |
| 1974 | 8 | 528 | 31  | 960 | 15 | 521  | 42 | 1751 | 23 | 524 | 38 | 1429 |
| 1975 | 6 | 538 | 29  | 844 | 31 | 532  | 27 | .710 | 37 | 533 | 27 | 715  |
| 1976 | 6 | 550 | 41  | 1704 | 23 | 518  | 33 | 1117 | 29 | 525 | 37 | 1347 |
| 1977 | 11 | 506 | 57  | 3269 | 17 | 500  | 44 | 1937 | 28 | 504 | 47 | 2176 |
| 1978 | 8 | 512 | 16  | 241  | 19 | 528  | 45 | 2065 | 27 | 523 | 40 | 1579 |
| 1979 | 12 | 534 | 29  | 867  | 21 | 545  | 44 | 1969 | 33 | 541 | 39 | 1558 |
| 1980 | 15 | 528 | 30  | 875  | 20 | 535  | 32 | 1054 | 35 | 532 | 31 | 963  |

*For other statistical purposes, these were assumed to be General Primary trained.
(b) Certificate Course, When Small School Training Was Available

<table>
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<tr>
<th>YEAR OF TRAINING</th>
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<th></th>
<th></th>
<th></th>
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<td>GENERAL PRIMARY</td>
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<td>N X 0 0</td>
<td>N X 0 0</td>
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<td>5 587 12 140</td>
<td>11 598 25 605</td>
<td>21 610 24 586</td>
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<td></td>
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<tr>
<td>1965</td>
<td>8 596 15 215</td>
<td>17 627 44 1930</td>
<td>14 616 41 1644</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1966</td>
<td>5 618 5 23</td>
<td>12 612 10 95</td>
<td>15 627 38 1459</td>
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<td></td>
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<tr>
<td>1967</td>
<td>9 610 17 292</td>
<td>14 623 10 108</td>
<td>13 621 10 95</td>
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<td>All Years</td>
<td>27 603 17 299</td>
<td>54 617 29 870</td>
<td>63 618 30 926</td>
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</tr>
</tbody>
</table>
REFERENCES
CHAPTER ONE


(4) Cited in HYAMS, B.K., Teacher Preparation in Australia, A.C.E.R., Victoria, 1979, P. 40.


(6) For example, N.S.W. Department of Education, Syllabus of Examination of Teachers, Government Printer, Sydney, 1926.


(9) In the early nineteenth century this was to be achieved primarily by religious instruction, which indicates a dual aim of moral education. In the late nineteenth century there are indications of education for citizenship through a nondenominational, but still essentially religious form of education. With the New Education in the earlier part of the twentieth century, academic and vocational instruction became the medium of education for citizenship, wherein the acquisition of literacy skills were of major importance.


(10) N.S.W. Department of Public Instruction, Course of Instruction for

(11) Timetables, either specific or recommended, are printed in each version of the N.S.W. Department of Education Primary School Syllabuses.

(12) N.S.W. Department of Public Instruction, Course of Instruction for Primary Schools, 1916, P. 13.

(13) Ibid.

(14) There is a substantial body of literature on different expectations; e.g. CLEMENTS, M.A., 'Sex Differences in Mathematical Performance: An Historical Perspective', Educational Studies in Mathematics, Vol. 10, 1979, Pp. 395 - 422, in which there is a comparison between British and Colonial Victorian developments in mathematical education, particularly for females; Report by a Study Group to the Schools' Commission, Girls, School and Society, A.G.P.S., Canberra, 1975, in which there is an Australia-wide assessment of sexism in Australian schools. Amongst other things, a concern with sex-typed subjects, including mathematics, was manifested.

(15) N.S.W. Department of Education, Curriculum for Primary Schools, Government Printer, N.S.W., 1963.


(21) CORREY REPORT, Report of the Committee to Examine Teacher Education in N.S.W., Teacher For Tomorrow, Government Printer, N.S.W., 1980, P. 199.


(25) MYERS' REPORT, 1980, P. 90.

(26) Ibid.
CHAPTER TWO.


(10) E.g. SHAW, J., 1963.


(12) A substantial body of research in this area also varies in its


(19) Ibid.


(22) E.g. Southwell, E.G., 1965.

(23) Categorisation is described as: those who passed General Mathematics at the Intermediate Certificate were grouped with those who failed Levels I and II at the Leaving Certificate, while those who passed Mathematics I and II at the Intermediate Certificate were grouped with those who failed General Mathematics at the Leaving Certificate; Southwell, E.G., 1965.

(24) Land, F.W., Recruits to Teaching. A Study of the Attainments, Qualifications and Attitudes of Students Entering Training Colleges,
217.

Liverpool University Press, Liverpool, 1960, P. 46.


(27) Ibid.


(30) Ibid.


(35) For example, within Australia there are two sets of major studies aimed at producing comparative data for all Australia students. Moss compared 1978 and 1964 data for 13-year olds and final-year students in secondary schools, to compare participation, attitudes and ability over time. Three studies (KEEVES, J.P. et al., 1977, 1978; BOURKE, S.F. et al., 1981) dealt with 10-year olds and 14-year olds to compare attitudes and ability over time, in addition to identifying areas which require remedial action; C.f. BOURKE, S.F. et al., 1981; KEEVES, J.P. et al., 1977, 1978; MOSS, J.D., 1982.


(40) (N.S.W.) REPORT OF THE MINISTER OF PUBLIC INSTRUCTION FOR THE YEAR 1923, Government Printer, Sydney, 1924.

(41) (N.S.W.) REPORT OF THE MINISTER OF PUBLIC INSTRUCTION FOR THE YEAR
1912, 1913.

(42) Oral evidence, in an interview conducted in 1980 with two people who completed their primary education in 1909 and 1914. Both individuals asserted that the reason they could not continue their formal education was because they lived in rural areas with no high schools nearby, and their respective parents could not afford the fares to the closest high school (even though the 1914 leaver was awarded a High School Bursary).

(43) The erection of secondary school buildings was quite slow, and was hampered by financial exigencies (such as the Great Depression). The following figures indicate the numbers of high schools in operation during the given years:

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of High Schools</th>
</tr>
</thead>
<tbody>
<tr>
<td>1915</td>
<td>10</td>
</tr>
<tr>
<td>1925</td>
<td>30</td>
</tr>
<tr>
<td>1935-38</td>
<td>38</td>
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<tr>
<td>1945-53</td>
<td>53</td>
</tr>
<tr>
<td>1955-87</td>
<td>87</td>
</tr>
</tbody>
</table>

Figures are from Statistical Tables presented in respective REPORTS OF THE MINISTER OF PUBLIC INSTRUCTION for the years cited.

(44) (N.S.W.) REPORT OF THE MINISTER OF PUBLIC INSTRUCTION FOR THE YEAR 1923, 1924.


(46) For example, the 1922 Course of Instruction for Primary Schools (N.S.W.) accentuates this facet of education, but was very quickly replaced by the previous syllabus which accentuated education for citizenship.

(47) For example, (N.S.W.) DEPARTMENT OF EDUCATION publications:

- Course of Instruction for Primary Schools, 1916, 1929, 1938;
- Course of Instruction for Junior Technical Superior Public (Day Continuation) Schools, 1915;
- Course of Instruction for Commercial Superior Public (Day Continuation) Schools, 1915;
- Course of Instruction for Domestic Science Superior Public (Day Continuation) Schools, 1915.


(51) Knowledge and skills specified for males included the ability to read 'intelligently, express himself clearly, carry out calculations for trade and business, have general knowledge of history, natural phenomenon and the earth, and have a skill of hand'; (N.S.W.) DEPARTMENT OF PUBLIC

(52) Ibid.

(53) Ibid.

(54) (N.S.W.) DEPARTMENT OF PUBLIC INSTRUCTION, Ibid; Course of Instruction for Domestic Science Superior Public (Day Continuation) Schools, 1915.


(56) Ibid.

(57) This has been claimed in many sources, such as the 1975 Report by a Study Group to the Schools' Commission.


(60) C.f. relevant syllabuses for both primary and secondary schools from 1916 to 1955.


(64) For example, the Cuisennaire-Gattengo method, introduced into N.S.W. primary schools in 1962; (N.S.W.) REPORT OF THE MINISTER FOR EDUCATION FOR THE YEAR 1962, 1964, P. 15.


(67) For example, identical content and goals were found in Levels IIF (1965) and Unit 3 (1973), Levels IIS (1965) and Unit 2 (1973), while dissimilar content and goals were found for Levels I (1965) and Unit 4 (1973); within relevant Mathematics syllabuses.

(68) MOSS, J.D., 1982.


(73) For an excellent survey of the inception and growth of this system of certification up to 1935, see ELLIOTT, W.J, Secondary Education in New South Wales, 1935.

(74) (N.S.W.) REPORT OF THE MINISTER OF PUBLIC INSTRUCTION FOR THE YEAR 1912, 1913, P. 33.

(75) Ibid.

(76) (N.S.W.) REPORT OF THE MINISTER OF PUBLIC INSTRUCTION FOR THE YEAR 1922, 1923, P. 7.


(79) (N.S.W.) DEPARTMENT OF EDUCATION, all 'Courses of Instruction' publications for the years 1915 and 1916, P. 4.

(80) WYNDHAM REPORT, 1960, P. 22.

(81) C.f. "Pupils entering the Fifth Class are sometimes made to feel that they are now studying English, Mathematics, History and Geography, not so much for the sake of understanding more about these subjects, but because they are to be examined in them", (N.S.W.) REPORT OF THE MINISTER OF PUBLIC INSTRUCTION FOR THE YEAR 1913, 1914, P. 33;
"With the restructured system the notion of different mark values for different levels of study will disappear. Students will be encouraged to choose courses out of interest and not in search of marks", (N.S.W.) REPORT OF THE MINISTER FOR EDUCATION FOR 1974, 1975, P. 10.

(82) (N.S.W.) REPORT OF THE MINISTER OF PUBLIC INSTRUCTION FOR THE YEAR 1912, 1913.

(83) E.g. (N.S.W.) REPORT OF THE MINISTER OF PUBLIC INSTRUCTION FOR THE YEAR 1918, 1919, P. 9; (N.S.W.) REPORT OF THE MINISTER OF PUBLIC INSTRUCTION FOR THE YEAR 1928, 1929, P. 5.

(84) (N.S.W.) REPORT OF THE MINISTER OF PUBLIC INSTRUCTION FOR THE YEAR 1945, 1946.


(86) Information obtained from the Student Enquiries Office, Wollongong Institute of Education.
(87) (N.S.W.) REPORT OF THE MINISTER OF PUBLIC INSTRUCTION FOR THE YEAR 1913, 1914, P. 10.


(89) DEPARTMENT OF EDUCATION AND SCIENCE, Teacher Education in Australia, A.G.P.S., Canberra, 1970.


(91) "The major source of supply of teachers" has constantly been reported as Teachers' Colleges in N.S.W. in Reports of the Minister for Public Instruction/Education - e.g. for the years 1929, 1932, 1939 and 1966. However, the 1972 Report of the Minister states that the major source of supply of teachers for primary schools are "teachers' colleges and Universities", P. 30.

(92) MACKIE, A., 1915.

(93) Even though the Department of Education has encouraged all teachers to update their professional qualifications since teacher training was instigated, particularly since 1959, primary courses of study in teachers' colleges are still shorter than secondary courses of study; e.g. see DEPARTMENT OF EDUCATION AND SCIENCE, Teacher Education in Australia, 1970.


(95) TURNER, I.S., 1943, P. 15.


(97) BELL REPORT, Report of the Committee of Inquiry Into Teacher Education (N.S.W.), 1971.

(98) In the 1945 Report of the Minister for Public Instruction (P. 4) it was reported that a Leaving Certificate was necessary to gain a teacher education scholarship, which was necessary for admittance to a teachers' college; the 1938 Report specifies that there was usually a small number of paying students at teachers' colleges as well.

(99) For example, the following percentages are those teachers employed in the State teaching Service and who hold University Degrees for the specified years:
1918 - 3.5%; 1928 - 10%; 1938 - 18%; 1948 - 18%; 1955 - 12%; 1961 - 18%; 1975 - Not specified. Figures are calculated from Tables presented in Reports of the Minister for Education for respective years.


(102) See (91).

(103) The appropriate institution for the training of teachers has been a matter of some debate. Some hold the view that teachers' colleges are the only places in which effective teacher training can be accomplished (e.g. Barcan). Others hold the view that in order to affect the proper professionalisation of teacher preparation, universities should be responsible for all teacher training (e.g. Turner).


(105) (N.S.W.) REPORT OF THE MINISTER OF PUBLIC INSTRUCTION FOR THE YEAR 1913, 1914, P. 50.


(108) This was one aspect of the reorganisation of secondary schooling in the 1960's, as recommended by the WYNDHAM REPORT of 1957, and as described in the (N.S.W.) REPORT OF THE MINISTER FOR EDUCATION FOR THE YEAR 1962, 1963.


(111) The fact that universities are viewed as the 'final link in the chain' or the highest level in the educational hierarchy is evidence enough. However, the large body of research into matriculation and wastage of 'high ability' students supports this contention, as do the recommendations provided in upper secondary syllabuses for the choosing of appropriate subjects for study.

(112) "For administrative purposes, the State is now divided into 10 Directorates", (N.S.W.) REPORT OF THE MINISTER FOR EDUCATION FOR 1966, 1968, P. 5.
These characteristics have been described as: "Although there are many ways of being a good teacher, there are some criteria by which the good teacher can be identified. He is a vital, balanced, wholesome person to whom parents are happy to entrust their children; his horizons are wider than the classroom walls; he has a sympathy with, and an understanding of, his pupils; he is a master of sound teaching techniques; above all, he believes in education and in what it can do to promote the welfare of children", (N.S.W.) DEPARTMENT OF EDUCATION, Curriculum for Primary Schools, 1963, P. xi.

C.f. Calendars, Wollongong Institute of Education, which provide descriptions of courses available each year.

MACKIE, A., 1915, P. 12.


A description of the administrative structure of teacher education immediately prior to the 1960's is available in TURNER, I.S., 1961.

MARTIN REPORT, 1964, Vol. I.


Most teachers' colleges in Australia had been granted autonomy by 1971, (N.S.W.) REPORT OF THE MINISTER FOR EDUCATION FOR 1971, 1972; the Wollongong Institute of Education became part of the C.A.E. structure in 1971, but was not granted complete autonomy until 1975, Calendar, Wollongong Teachers' College/Wollongong Institute of Education, 1972 and 1975.


Reports of the Minister for Education are not available for the War years, however, a description of the introduction of this scheme is given in a later Report; (N.S.W.) REPORT OF THE MINISTER OF PUBLIC INSTRUCTION FOR THE YEAR 1946, 1948.

The advent of Commonwealth funding to Universities is progressively described in Reports of the Minister of Public Instruction for 1950 to 1960.

A detailed and substantiated account of the gradual intercession of the Commonwealth Government, and the specific responsibilities it assumed, is given in WILLIAMS, B., Systems of Higher Education: Australia,

(127) For a description of this scheme, see (N.S.W.) REPORT OF THE MINISTER OF PUBLIC INSTRUCTION FOR THE YEAR 1952, 1954.


(130) Statistics are: For all Australian universities, females comprised 23% of the student population in 1961, while they comprised 31% of the student population in 1971, and 42% in 1980. At the University of Wollongong statistics are: in 1975, females comprised 25% of the student population, whereas in 1981 this was 34%; Australian Bureau of Statistics, University Statistics (Part One: Students), A.G.P.S., Canberra, 1961 to 1981; University of Wollongong, Statistics, University of Wollongong, 1975 to 1981.

(131) However, it is difficult to define the effect of the abolition of fees on enrolments at the University of Wollongong, because prior to 1975 it was affiliated with the University of N.S.W. and separate statistics were not published by gender.


(135) Reports of the Minister for Education for the years 1912 to 1965 all indicate an increase in enrolments (except for 1932, due to the Depression). However, Reports of 1954, 1963 and 1965 state that the increases are exceptionally large, due to the birth-rates of the post-war period. The 1963 Report (P.22) expected 'this trend to continue'. Figures for primary and secondary students are as follows: 1915 - 273,482; 1925 - 332,960; 1935 - 356,569; 1945 - 354,601; 1955 - 496,550. These figures are Gross enrolments, and are calculated from relevant Tables in Reports of the Minister.

(136) Child Welfare Act of 1939, in force as from 1940; (N.S.W.) REPORT OF THE MINISTER OF PUBLIC INSTRUCTION FOR THE YEAR 1939, 1940.

(137) Youth Welfare Act of 1940, in force as from 1943; (N.S.W.) REPORT OF THE MINISTER OF PUBLIC INSTRUCTION FOR THE YEAR 1940, 1941.

(138) Radford, W.C., Staying Longer at School, Information Bulletin No. 2, Series No. 47, A.C.E.R., Victoria, March 1966; Data from 1954 to 1959 was analysed, and it was stated that "a 50 per cent. increase in the percentage continuing into Form 5 is remarkable in the short space of four years", P. 3.

(140) (N.S.W.) REPORT OF THE MINISTER OF PUBLIC INSTRUCTION FOR THE YEAR 1914, 1915.


(142) Ibid.

(143) For a description of the bonding system, see DEPARTMENT OF EDUCATION AND SCIENCE, The Training of Teachers For Government Schools, 1968, Pp. 102 - 104.

(144) (N.S.W.) REPORT OF THE MINISTER OF PUBLIC INSTRUCTION FOR THE YEAR 1950, 1951.

(145) (N.S.W.) REPORTS OF THE MINISTER OF PUBLIC INSTRUCTION FOR THE YEARS 1919, 1921 and 1952 state that salary increases are specifically designed to make the teaching profession 'more attractive'.


(150) DEPARTMENT OF EDUCATION AND SCIENCE, 1970.

(151) Ibid.

(152) The most recent publication on demographic changes in Australia states: "The decline in the proportion of persons aged 0-14 years occurred in all States and the Australian Capital Territory from 1971 to 1979... A consequence of the declining numbers of young people has been the increasing proportions of the population at working and older ages..." This trend is expected to continue at least to the year 2001; AUSTRALIA, DEPARTMENT OF IMMIGRATION AND ETHNIC AFFAIRS, Review of Australia's Demographic Trends, Pirie, Canberra, February 1981, P.11.

(153) First reported in 1950 as a policy; (N.S.W.) REPORT OF THE MINISTER OF PUBLIC INSTRUCTION FOR THE YEAR 1950, 1951.


(155) Ibid.

(156) The following statements published by the Ministers of Education in 1926 and 1970, indicate the nature of this changing concern with teacher
education:
"The position with regard to teaching strength is more satisfactory than it has been for some time, but it can scarcely yet be said that the supply is fully adequate", (N.S.W.) REPORT OF THE MINISTER OF PUBLIC INSTRUCTION FOR THE YEAR 1926, 1927, P. 1;
"Improvement in the selection and education of teachers is fundamental to an improvement in education", (N.S.W.) REPORT OF THE MINISTER FOR EDUCATION FOR 1970, 1971, P. 30.


(158) Reports of the Minister of Public Instruction for the years 1912 to 1916 all show that females were outnumbered by about 500 males only.


(160) Op. Cit., P. 247; The Married Women (Lecturers and Teachers) Act was passed on the 30th November, 1932, and the Department of Education was able to "terminate the services of a number of married women whose husbands were in the position to support them", (N.S.W.) REPORT OF THE MINISTER OF PUBLIC INSTRUCTION FOR THE YEAR 1932, 1933, P. 1.


(165) Relevant statistics are as follows, and show the percentage of women teachers in primary and secondary teaching respectively for the given years:
1915 - Not available by gender; 1925 - primary 55%, secondary 45%; 1935 - primary 52%, secondary 42%; 1945 - primary 60%, secondary 47%; 1955 - primary 53%, secondary 47%; 1965 - primary 60%, secondary 43%.
Percentages have been calculated from Tables within the Reports of Ministers of Public Instruction/Education.


(168) C.f. Reports of the Ministers of Public Instruction for the years prior to World War II, where females constituted approximately 40% of the final secondary population; COMMONWEALTH OFFICE OF EDUCATION & A.C.E.R., Matriculation - And After. A Survey of Pupils in Australia Who,
in the 1957 Examinations, Qualified to Matriculate to Australian Universities, A.C.E.R., Victoria, May 1961. An analysis of matriculants revealed that "of the 11,144 students who matriculated in 1957, about 62 per cent. were male students", P. 5; (N.S.W.) DEPARTMENT OF EDUCATION, Computer Printout of 1981 H.S.C. Candidates and Matriculants, available from the Vice-Chancellor's Unit, University of Wollongong, in which it is revealed that females now outnumber males at the final examination in secondary schools in N.S.W., and that more females than males (as a proportion of their own sex) gain matriculation status.


(170) Ibid.


(174) ACKERMANN, J., Australia From a Woman's Point of View, Cassell, London/Melbourne, 1913, P. 275.

(175) (N.S.W.) REPORT OF THE MINISTER OF PUBLIC INSTRUCTION FOR THE YEAR 1914, 1915, P. 33.


(178) (N.S.W.) DEPARTMENT OF EDUCATION, Curriculum for Primary Schools, 1963, P. xv.

(179) TURNER, I.S., 1943, P. 220.


(182) Ibid.
Although not strictly comparable because of slightly different methods of classification, the following figures give a good indication of the proportions of Principals who were female:

1915 - Principal Teachers (First Class), 0 were female; Mistresses of Departments, 100% were female;
1935 - Principal Teachers (First Class) 8 (1.9%) were female; Mistresses of Departments, 100% were female;
1955 - Permanent Heads (Primary) 68 (6.5%) were female; Permanent Masters/ Mistresses of Primary and Infants Departments, combined or Infants only, 539 (67%) were female; Permanent High School and Secondary School Heads, 30 (24.5%) were female; Mistresses of Girls' Secondary Departments, 100% were female;
1975 - Permanent Principals (Primary), 103 (7.3%) were female; Permanent Principals (Infants), 100% were female; Permanent Principals (Secondary), 52 (15.7%) were female.

Figures and percentages were calculated from Tables within REPORTS OF THE MINISTERS OF PUBLIC INSTRUCTION/EDUCATION. See (165) for percentages of male teachers in secondary schools.

As a proportion of full-time academic staff at universities, females constituted:
16% of the staff at all Australian universities in 1975;
10% of the staff at the University of Wollongong in 1975;
18% of the staff at all Australian universities in 1980;
13% of the staff at the University of Wollongong in 1980;

Results of a survey conducted by the author in 1980, where sexism in the New South Wales Public School System between 1912 and 1939 was investigated. The unpublished survey was based on responses to a questionnaire completed by individuals who had attended public schools in N.S.W. between 1912 and 1938. A copy of this is with the author.

The traditional position of women in society in N.S.W. is illustrated by the early part of this century, wherein:
Both males and females were enfranchised, yet females were highly unlikely to be involved in the actual governing of N.S.W. at either a local or State level (N.S.W. GOVERNMENT STATISTICIAN, The Official Yearbook of New South Wales. 1929 - 1930, Pp. 467 - 466; 1938 - 1939, Pp. 213 - 214.).
The basic wage and employment structure revealed that both males and females were expected to marry (New South Wales Parliamentary Papers, 1921, Third Session, Vol. 4, P. 1. Reprinted in KINGSTON, B. (Ed.), 1977, P. 40.). When this occurred, the male was "held liable for all necessary expenses of his wife and children" (N.S.W. GOVERNMENT STATISTICIAN, 1929-1930, Pp. 467 - 488; 1938 - 1939, Pp. 213 - 214). In return for this, the husband was "the lawful guardian and controller of children, whose education, religion and profession he can also determine (International Council of Women, 'Women's Position in the Laws of Nations', Karlsruhe, Reprinted in KINGSTON, B. (Ed.), 1977, Pp. 75 - 91. Conversely, it was expected that women would marry, raise a family and maintain a household (Maternity Bonus, Introduced on 19th October, 1912, Referred to by E. Barrett, Health, Vol. 1, No. 5, May 1923, Pp. 121 - 126; Commonwealth Parliamentary Papers, 1929 -30 -31, Pp. 4 - 5, 9 - 10, 'Maternal and Child Welfare in Australia'. Reprinted in KINGSTON, B. (Ed.), 1977, Pp. 142 - 147). In return for this, the wife had "no legal share
of her husband's income, nor in any property acquired by their joint efforts after marriage", nor had any legal rights involving the children she was expected to raise (N.S.W. GOVERNMENT STATISTICIAN, ...1929 - 1930, P. 467; 1938 - 1939, P. 213).

A recent publication which explores this in the context of power relationships is CONNELL, R.W. et al., Making the Difference. Schools, Family and Social Division, Allen & Unwin, Sydney, 1982.

(186) WOLLONGONG TEACHERS' COLLEGE, Calendar, 1967 and 1968.

(187) WILLIAM'S REPORT, 1979, P. 57.

(188) In 1913 there was no specific proportion for female teachers' salaries, but they ranged from 66% to 83% of male wages, depending on the position held (Juniors received the highest proportion). In 1932 women teachers received "four-fifths of the rates for male teachers holding the same qualifications and occupying similar positions". In 1954 salary rates for women teachers were raised to 90% of male wages. In 1959 it was decided that female wages would be progressively raised until 1963, when male and female wages would theoretically be equal. REPORTS OF THE MINISTERS OF PUBLIC INSTRUCTION/EDUCATION FOR THE YEARS 1913, 1932 (P. 4), 1954, 1959.

(189) MOSS, J.D., 1982.


CHAPTER THREE.

(1) LAND, F.W., 1960.

(2) DETTRICK, G.W., Available 1982.

(3) The explanation was: "there appeared to be four separate levels of training and groups were arranged as follows...". SOUTHWELL, E.G., 1965, P. 179.


(5) Statistical Tables presented as Appendices in the (N.S.W.) Reports of the Minister for Education reveal this trend.


(9) WOLLONGONG INSTITUTE OF EDUCATION, Calendar, 1975.

(10) This was arrived at following a perusal of the examination sheets for the years 1977 -1981 for those completing the Diploma in Education courses at the University of Wollongong, in which methods courses were specified.
(11) Information obtained from the Student Enquiries Offices at the University of Wollongong and the Wollongong Institute of Education, April 1982.

(12) C.f. Mathematics syllabuses 1953 to 1973. For example, the 1965 Third Level Syllabus contained the following subject matter: products and factors; quadratic equations; logarithms and slide rule; elementary solid and special geometry; locus, graph and envelope; function; elementary trigonometry; number, number systems and numeral systems; series; sets; probability and random variables; and applications of trigonometry to geography and navigation. The 1953 Syllabus for General Mathematics merely specified the three broad areas of algebra, geometry and trigonometry.

(13) See Statistical Tables presented as Appendices in Reports of the Minister for Education. For example, the following percentages apply to the numbers of teachers holding any sort of Degree:
1925 - 76%; 1935 - 70%; 1945 - 68%.


(20) SIEGEL, S., 1956, P. 201.

CHAPTER FOUR.

(1) DETTRICK, G.W., Available 1982.

(2) MYERS' REPORT, 1980, P. 90.


(4) (N.S.W.) BOARD OF SENIOR SCHOOL STUDIES, 4 Unit Course, Mathematics Syllabus, 1973, P. 1.

CHAPTER FIVE.

(1) MYERS' REPORT, 1980, P. 90.

(2) Interview with mathematicians from the University of Wollongong, See Appendix B of this thesis.


(4) WOLLONGONG TEACHERS' COLLEGE, Calendar, 1968, P. 89.


(6) See Appendix B.


(8) A 1978 survey of all Australian institutions thought to be engaged in pre-service teacher education concluded that 70% of respondents were clearly "of the opinion that inadequate time was being given to the study of mathematics and mathematics education". A Report from the Mathematical Association of Western Australia to the Australian Association of Mathematics Teachers on Pre-Service Mathematics Education for Primary School Teachers, Unpublished, Available 1979.


(11) COMMONWEALTH OFFICE OF EDUCATION & A.C.E.R., 1961. Data analyses suggested that female matriculants were not as effectively used as male matriculants, because they pursued less academically demanding courses of study or did not pursue tertiary studies at all.

(12) WILLIAMS' REPORT, 1979, P. 57.

(13) MOSS, J.D., 1982, Table 6.3., P. 30.

(14) The University of Wollongong was originally dominated by technological subjects such as Engineering. As the University expanded, its available subject areas widened to include Arts and the Social Sciences. For technological subjects, ratios of males to females have been higher than those for all universities within Australia: Engineering - in 1975, male : female at the U. of W. was 76 : 1, whereas at all Australian universities it was 49 : 1; in 1980/1, male : female at U. of W. was 33 : 1, whereas at all Australian universities it was 20 : 1.
Economics/Accountancy - in 1975, male : female at the U. of W. was 9 : 1, whereas at all Australian universities it was 4 : 1; in 1980/1, male : female at the U. of W. and all Australian universities was approximately 3 : 1, although Wollongong was slightly higher.

Natural Sciences - in 1975, male : female at the U. of W. was 5 : 1, whereas at all Australian universities it was 2 : 1; in 1980/1, male : female at the U. of W. and all Australian universities was approximately 2 : 1, although Wollongong was slightly higher.


(17) (N.S.W.) REPORT OF THE MINISTER OF PUBLIC INSTRUCTION FOR THE YEAR 1918, 1919.

(18) The ratios of males to females given in (14) exemplify the preponderance of males in 'masculine' areas at Australian universities.
ANNOTATED BIBLIOGRAPHY
(1) RESEARCH


This provides a reliable survey of the state of education, with reference to: examinations, matriculation, selection to schools, teacher recruitment and teacher training. This is an excellent source for cross-referencing and verifying Department of Education sources.


Provides a brief summary of the results of ability tests which were administered to all teachers' college students in Australian colleges. In this Report (which is the only one available, due to individual Colleges retaining all complete records), there is no description of the tests used. However, as the A.C.E.R. is a widely accepted reliable source, results were considered useful. Results are in the form of ranks for States and gender, with some means and standard deviations provided for I.Q. and other tests. Five areas (English, Speed of Reading, Social Studies, General Science and Mathematics) were examined. N.S.W. was found to usually occupy "4th or 5th positions" for all rank orders on all tests. As this is the first national research of its kind on student teachers, the information therein (although scanty) is invaluable.


Using systematic observation of classroom behaviour and concentrating on teachers' verbal behaviour, 18 kindergarten teachers in Melbourne were studied over a period of 6 months. The relationship between the teachers' classroom behaviour and the children's number
development (measured through various appropriate tests) was examined through a well-controlled design and analysis. This research also examines attitudes towards and ability in mathematics by gender, and discusses implications for the teaching of arithmetic to young children. The study is interesting from this aspect, because students in kindergarten are not usually the subject of research into mathematical ability.


This study was used as a means of gauging some potential intruding factors upon the types of students entering tertiary institutions (and therefore also teacher education programmes). The study concentrates upon Australian universities' and Colleges' of Advanced Education internal students - and includes an examination of socio-economic-status and sex differences. Although there were few 'before' measures, it was concluded that the "presence or absence of fees makes only a relatively small difference to the s.e.s. composition of the university student population", and that the "social composition of students in higher education appears to have changed little over time". This conclusion was rather surprising, considering some of the data presented for groups such as women.


Using a 1967 survey as a comparative basis, a 1972 survey on the 'number of mathematical experts available in Australia' is documented. Provides interesting data and thoughts on the state of knowledge being partly reliant upon the number of experts available at
any given time. This study was useful as a potential influencing factor upon the changing status of mathematics.


Based on the 1978 (Keeves at al.) design, this offers comparative 1980 data on 10- and 14-year old Australian students. The numeration tests reported a mastery by 78% of 10-year olds and 86% of 14-year olds. Sex differences were similar to the 1978 results. There was an overall improvement on the basic items common to both studies for both age groups. This series of studies is exceptionally well-designed, meticulously analysed, and more than adequately presented to the reader.


This study examines the characteristics of those who matriculated and were entitled to enrol at universities, compared to those who actually did enrol at a university. Sex differences were one of the major findings of this study. As this is one of the first studies of this kind in Australia, it provides useful data and insights into the 'new' concern with matriculants.


This study follows the introduction of a new Mathematics syllabus in Queensland in 1964, which was followed by the publication of two new textbooks. Based on the major concern of a preponderance of learning theory, but a lack of teaching theory, this experimental research seeks to examine the two new texts in the context of 'Ausubelian' and 'Traditional' teaching theories.
With a sample of 1964 - 1965 Grade 8 Queensland classes, drawn by structured random sampling from the entire State, three tests were administered (I.Q., mathematics attainment and mathematics attitude) at the beginning and end of the school year. Although the results were inconclusive, the researcher thought there was 'some support for the principles advocated by Ausubel'. The most useful feature of this study is the attempt to investigate teaching within a theoretical framework, which is not examined very often.


This 1973 survey of social science students examined secondary mathematical background and mathematical training attained during a first Degree - with a view towards establishing current practices in order to plan future strategies for change. Data was obtained from University statistical sources.

Due to the varied educational systems throughout Australian States, mathematics syllabuses and examinations, and marks gained in specific questions on various examination papers, were compared in order to establish some basis for generalisation. This procedure was described in some detail and was adapted for use in this thesis. A State by State comparison of matriculation mathematics courses provides a source devised by a professional mathematician for cross-checking levels devised for this thesis.

An invaluable and excellent source for this thesis, namely in devising level of mathematics passed.

Reviews research into the teaching of secondary mathematics, mainly in the U.S.A., under the following broad headings: ability (in terms of curriculum changes and changes in teaching methods); ability (in terms of organisational patterns of the classroom); ability/achievement (in terms of the use of time); achievement (in terms of teaching and atypical students); achievement (in terms of media influences); longitudinal studies of ability; and abilities in terms of psychological studies (e.g. problem-solving, perception patterns and attitudes). The main impact of this review is to make the reader aware that teachers are almost always the subject of research in the context of their relationship with students.


This pilot study tested the primary mathematics curriculum competencies and attitudes to mathematics of 338 Independent and State school teachers, in Victoria in 1981. The average scores of all teachers was 68%, and an 80% mastery level analysis indicated that 59% of the total number of items were not mastered. While concentrating on the development of test instruments as a basis for decision-making about inservice mathematics programmes, it highlights relationships and results relevant to this thesis. In particular, two of the "three most useful predictors of performance" were relevant - namely, the sex of the primary teacher and the years of secondary school mathematics studied. Although only an Interim Report, this study appears to thoroughly and competently investigate teachers' abilities in a relatively new area of research. As such, it is an excellent source.

Elliott's book provides a useful summary of the progression of secondary education from its major inception with State involvement in its expansion. Periods are examined in three main categories - prior to 1912, 1912 to 1931, and from 1931 (as the present date). It is mainly concerned with descriptive statements of changes in certification, based on relevant Education Acts.


Since adolescence is regarded as a crucial period in the emergence of sex-typed interests, this was examined as a possible cause of differences in mathematical achievement. Data was collected from a U.S.A. national sample, in two-year cohorts from 1961 to 1967. It was found that individual differences increased with age; the arithmetic mean increased with age; and although there were exceptions, generally that sex differences increased with age in favour of males. This is a well-designed study, which provides a different type of data (longitudinal) to that usually found in research into mathematical ability.


This is a 1957 English survey of 2254 first-year trainee teachers, with a major view towards establishing attitudes towards and performance in all subjects, with particular attention to mathematics and science. Performance was gauged by a standardised mathematics test, through assessment of secondary subjects studied and levels gained in examinations, and through subjects selected for study in training colleges.
This is the only research discovered in the literature search for this thesis which focuses on student background. While interesting trends appeared in the 'background' section, analysis was limited due to the restrictive use of percentage comparisons only. It is also the first study which examined, albeit briefly, contact time as an influencing factor. However, this was analysed in the context of sex-segregation schools, rather than as an influence on ability — although sex differences in ability due to different contact hours was suggested.

Other factors which were examined included: sex differences in attitudes towards mathematics, in performance and in background; home influences on the choice of subjects; the qualifications of the teaching staff at the training colleges; and, the levels of qualifications of those entering universities as compared to those entering training colleges. While many aspects were superfluous to the main area of this thesis, its value lies in the comparatively extensive analysis of student background and the treatment of background as an influencing factor.


In this study, teacher behaviour and student behaviour were examined using classroom observation of Australian secondary schools at Form I level. A host of variables were analysed in the context of identifying characteristics important to teacher effectiveness in mathematics and science.
This Australia-wide study examined - (1) levels of attainment in basic skills of literacy and numeracy, and (2) relationships between specific educational and environmental factors and competence in these skills. Basic skills were those which were regarded as essential for continuing education "beyond the most elementary level and for living in Australian society". Of special interest is the examination of 10- and 14-year olds' mastery levels in the context of sex, and of the implications for the identification of learning difficulties in teacher education institutions. While reporting a high proportion of competence, the report focuses on the minority who are thought to require remedial work.

The major focus of this 1975 Australia-wide study is on the 14-year old student about to leave school. It is concerned with the identification of competencies, the development of appropriate tests, isolation of those failing to attain basic skills, and the relationships of these and other factors. However, it is also a pilot study design, developed to enable future replication and comparison at a more stringent level than is usually found in research reports. Therefore sampling procedures, etc., are extremely detailed. Conclusions are similar to the 1977 publication. The ultimate value of this research lies in the production of comparative data and the monitoring of students' abilities and attainments over time to ensure that basic levels (at least) are maintained.
"This report uses evidence from the First and Second IEA Mathematics Studies in Australia in 1964 and 1978 to investigate changing patterns associated with sex differences in participation, achievement and attitudes towards the learning of mathematics in Australian schools" (P. 2). Two populations—13-year old and final year mathematics students in secondary schools—were used from all Australian States in both studies, with Government schools participating in the 1964 study and both Government and non-government schools in the 1978 study. The three major findings were: (1) between 1964 and 1978 female participation in the study of Year 12 mathematics increased in all States, (2) sex differences in achievement favoured males—although when "allowance was made for age, father's occupation, and hours spent studying mathematics, the observed sex differences largely disappeared" (P. 47), and (3) although differences were not large, males from all States regarded mathematics as more important to them than did females, for both the 1964 and 1978 studies. The value of this research to the thesis is that it is the most recent publication on sex differences in mathematical ability in Australia, and as such, indicates that 'traditional' abilities and/or expectations of performance are changing on a national level.


Radford's publication provides national and State statistics for secondary school retention rates from 1954 to 1964, by age and sex. It established that there was a trend for Australian adolescents to indeed 'stay longer at school' than previously. The implications of this trend are not discussed to any great extent, and the study is therefore useful mainly as an additional statistical source.
This article reviews the major areas of research, concentrating on research in the U.S.A. Major areas are identified as: attitudes (in terms of sex differences, age differences and ability); individual differences (in terms of methods/programmes and achievement); the teacher (teaching strategies, use of time, etc.); and content (in terms of skills and understandings). As with the review of research into the teaching of secondary mathematics, this review emphasises the fact that teachers are rarely the subjects of research in terms of their own abilities and knowledge.

A Report From the Mathematical Association of Western Australia to the Australian Association of Mathematics Teachers on Pre-Service Mathematics Education for Primary School Teachers, Unpublished, Available 1979.

In 1978 questionnaires were sent to all Australian tertiary institutions thought to be involved in pre-service primary teacher education (N = 85). The focus of the survey was on the nature and content of the mathematics and mathematics education units in these institutions. Contains valuable information on 'current' opinions and practices, although this information in only in the form of 'all colleges', 'all universities' and type of course (Dip. Teach. etc.). The survey was basically an information-seeking exercise, although there is a Chapter of the Report devoted to many recommendations for pre-service programmes.


This study is primarily concerned with the adequacy of previously-used unidimensional attitude-measuring instruments, and therefore uses this concern to develop a multidimensional attitude-
towards-mathematics measuring instrument. 317 primary trainee teachers in Victorian Colleges in 1974 were subjected to a large test battery in order to ascertain the adequacy of various tests, inventories and techniques. Positive correlations (exceeding .5) were yielded by both types of multidimensional instruments. There were also significant correlations between achievement and attitudes towards mathematics teaching. Generally this is a commendably cautious and well-presented study.


This study began with the question of whether arithmetical ability was 'innate or the result of the effectiveness of training'. The sample consisted of 100 primary trainee teachers from Wollongong Teachers' College in 1962 (the first year of its operation), and examined factors such as anxiety, I.Q., sex differences and environmental differences in the context of arithmetical ability. However, due to methodological problems, the data was sometimes questionable. (For example, it was reported that some scores on the arithmetic test were altered by the researcher because of personal acquaintance with the students, i.e. the researcher 'knew' that student X was under-achieving on this test, and therefore altered the score.) However, the value of this study lies in the fact that it does supply some Regional data which was useful as background for this thesis.


A diagnostic test of primary school mathematics was developed and administered to first year students at two N.S.W.'s Teachers' Colleges (N = 292), in order to ascertain areas of mastery and deficiency. Results indicated that a quarter of the students tested
understood only 65% of the mathematical concepts in primary school arithmetic, and were unable to effectively carry out 76% of the mechanical processes. This study also examined mathematical background as an 'interesting note', while establishing some relationship between mathematical background and test scores. (Although this relationship is not as indicative as it could have been, due to the illogical method of categorising mathematical background.) It also examined the relationship between attitudes towards and achievement in mathematics. Remedial work and a post-test revealed improvement in most students' scores. Despite some problems (such as the categorisation of mathematical background), this thesis is generally cautious in its interpretations and is well-presented.


This is the first survey in Australia which examined teacher education on a national scale. From information obtained by questionnaires and interviews, it provided comparative data for 1940 - 1941 for the numbers of students and courses in teacher education programmes throughout Australia. It was also useful to this thesis in tracing the development of teacher training in general, and for indicating the primary-secondary teacher training dichotomy.


Male and female students from two universities in N.S.W. (Macquarie and N.S.W.) were sampled from Engineering, General Studies and Education Departments. After completing semantic differential scales, it was concluded that males and females agreed closely in their conceptions of an 'excellent student', where 'excellent student' approximated the masculine stereotype. It was also proposed that females
would confront sex-role conflicts because of this finding. However, findings did not generally support this expectation. Although a limited sample was used, the methods of analysis and conclusion were relevant and useful contributions to research into sexism in education.

(2) OFFICIAL DOCUMENTS

A. Reports


Various sections of this Report dealt with Victorian and national academic entry standards of those entering pre-service teacher training; national entry scores to universities and colleges of advanced education; and a generally descriptive view of Australian teacher education institutions. 'End-on' courses were viewed as less effective for teacher education than concurrent Degree/Diploma courses, or a B. Ed. (which was recommended as the minimum requirement for future teachers).


The major concern of this Report was with retention and loss rates of Teachers' College scholarship holders. It contained some recommendations which were reiterated in the 1980 Report on Teacher Education, and provided further evidence for trends in tertiary education in N.S.W. It also provided details of selection procedures for teacher education scholarships, which were not usually published. Further, it provided details of approved courses of study for scholarship holders at each university in N.S.W.
While focusing on current and projected future teacher preparation needs, there was also an examination of the current and future needs of pre-tertiary education in this Report. Data was also provided regarding trainee teacher opinion and teacher educator opinion. As with the Martin Report, it may later be found that this Report has anticipated a future change in teacher education - largely in its recommendation of a new teacher qualification of a four-year training course (B. Ed.).

Besides examining post-secondary education at a national level, there was a large section of this Report which dealt with teacher education. It was particularly concerned with the quality of teacher education, and recommended that because teacher training influences all levels of education, teacher preparation should become a national task rather than a State task. This Report is of particular relevance to the reorganisation of tertiary education in the 1960's and 1970's, and the resulting influences on teacher preparation - such as the introduction of the three-year training course. Volume III examined, amongst many other things, secondary teacher training in a similar context, as well as providing a section on mathematicians.
to the increasing technological nature of Australian society and the Australian labour market, there was a section on the implications for education. There was also a brief examination of sex-typed subjects, and the Report recommended that more females be encouraged to study technological subjects in order to meet labour market demands in the future.


This Report serves as a source for national statistics on recruits to teaching. Of particular relevance were the recommendations for teacher education based on various A.C.E.R. surveys on literacy and numeracy. Effective training was the focus of the teacher education recommendations, and there was thus a concentration on remedial education and techniques for learning. The Committee also briefly examined sex-typed subjects.


The survey of secondary education was conducted in 1957. Pre-1960 material in this Report was in survey form, although there was also some historical background on the development of secondary education in N.S.W. Many of the post-1960 recommendations were later implemented, and this Report therefore proves an invaluable source for the redirection and reorganisation of post-primary education. It also thus serves as a single-source bridge from 5 to 6 year secondary schooling in N.S.W., with attendant implications.

This Report provided a 'current' source of opinions and ideas on teacher education. It devoted a large proportion of its content to descriptions of teacher training (such as the structure and financing of teacher education), which was useful as a description of the 'new' C.A.E. system.


Recommendations provided in this document were aimed at giving teacher training institutions 'levels' for comparative evaluation of their current practices. With an orientation towards mathematics as a necessary aspect of full participation in an increasingly technological society, various concerns were expressed. Amongst these were: that fewer pupils are studying mathematics at Year 12 level; that the mathematics currently taught in schools is not as useful as it should be; that the time allocated for mathematics study is decreasing in schools; and with the entrance and graduation standards of those preparing to be teachers. In this context, and on the basis of 'evidence' with no specified source, this document provided recommended levels and times for the study of mathematics in different institutions.


This publication provided an overview of the Conference, a summary of Working Groups' Reports, and views of professional mathematicians, towards primary school mathematics. Views ranged from the general to the specific, from the teaching of mathematics to the preparation of teachers in training institutions, and from content area as
it is to how it should be. Conflicting opinions were therefore apparent throughout this document. However, the Report generally specified that a minimum exposure time to mathematics for teachers in training should be two hours per week for two years - although no indication was given as to whether this should be in primary content and methods areas, or as an extension of the trainee teachers' personal knowledge of mathematics.


Published annually, these provide an excellent source for examining the overall development of education in N.S.W. this century. Until 1920, each Report gave comprehensive details of education and educational institutions in N.S.W, including Reports of various inspectors. The Reports from 1920 to 1940 were not as detailed, although they still contained much information and statistical data. From 1941 to 1944 no Reports were published, although a copy for each year is held at the Research Branch of the N.S.W. Department of Education. From 1945, but particularly from the 1960's on, there was a decreasing amount of statistical and other useful information in these Reports. However, these Reports were indispensible to this thesis.


This provided the first national in-depth examination of sexism in Australian schools, and thus documents the extent and nature prevalent, particularly at the primary and secondary levels of education. While this Report addressed a whole range of topics related to sexism in education, the idea of sex-typed subjects was of special relevance to the relationship between gender and mathematical background examined in this thesis.

This Report provided matriculation requirements of 1964, as well as statistics for the educational levels of trainee teachers entering schools in N.S.W. in 1960 - 1961. This provided useful data for establishing the adequacy of the research design, in addition to comparative data.


Those at this conference provided an interpretation of the 1963 primary syllabus, as well as opinions regarding the inadequacy of the aims and processes underlying the 'current' syllabus. This Report marks another place of importance, for after the conference 'arithmetic' in primary schools would henceforth be known as 'mathematics'.


While considering many facets of learning difficulties in different types of people of different ages, there was a section of this Report on the implications for teacher education. Recommendations for teacher training programmes focused on remedial work, and through this vantage point pre-service courses and research needs were discussed.

B. Department of Education Publications


First published in 1964 as a 'statement on the nature of
mathematics, as it was likely to be taught in primary schools, and which would introduce primary school teachers to some of the more recent concepts, terms, processes and approaches' (P.7). The 1972 edition is a metric version of the first. Both editions are intended as a nationally-relevant source for primary teachers. This text contains comprehensible descriptions and explanations of content areas and evaluation techniques. It also addresses the problem of the nature of mathematics and the (developmental) nature of the child in a learning context. It is useful as an aid to a non-mathematician attempting to come to some sort of terms with the content area of primary mathematics.


(Information is correct as at May 1970.) Published spasmodically, this publication provides descriptions of: School Certificate courses and awards; Higher School Certificate courses and awards; matriculation requirements; University entrance requirements; School Certificate and Higher School Certificate statistics for 1969; and selection for, and scholarships available for, N.S.W. Teachers' Colleges.


(Information correct as at December 1970). This revises the 1968 details. The booklet includes extra details as well - i.e. non-government teacher training institutions and teacher training in universities are described here. Other than this, the type of information supplied is identical to the 1968 publication, and it therefore gives a guide to dis/continuity.

(Information correct as at May 1968.) This booklet provides details of scholarships, Certification, courses available at different institutions throughout the States, descriptions of these courses and qualifications awarded.


Although given different labels over time, these syllabuses all specify the content which is to be learned for the Leaving/Higher School Certificates in N.S.W. They therefore provide valuable information on the aims, timetables and course content of secondary mathematics education in N.S.W. secondary schools. These formed part of the basis for the development of the measuring scale for levels of mathematics passed by trainee teachers.


These were always published after curriculum revision. Prior to c. 1970 they were prescriptive documents for teachers in primary schools. However, recently they provide more of a guideline for use within school-based curriculum construction. They provide valuable information on the aims of primary schooling, timetables and course content. Major changes in philosophical views towards education can be identified merely by scrutinising these documents. Recent issues (1941, 1952, 1957, 1961, 1963, 1967) were used to establish content and contact for primary mathematics courses which trainee teachers usually would have undertaken. The 1952, 1963 and 1967 editions are particularly useful indicators of more dramatic changes - the remainder being minor revisions of earlier editions.
These two documents for the 1955 and 1961 examinations provided accounts of examiners' reactions and assessments of performance to the answers in the papers for each subject. Details were very specific, and an analysis of the general performance of each item in each examination paper was given. Comments also included comparisons with past performance on specific items.

This publication discussed the nature and scope of primary school mathematics, concentrating on concrete examples of changes in mathematics courses in primary schools. It illustrated the conceptual bases of mathematics, together with explanations and evaluations of 'current' modes of thinking about mathematics.

This booklet contained information for all types of people working in and administering to secondary schools in N.S.W. It was especially useful for information on School Certificate and Higher School Certificate courses and awards.

These were copies of examinations set for teacher certification. Besides helping to indicate that mathematics was continuously available for certification awards, the 1966 version was particularly relevant to the Wollongong Institute of Education - for from 1966 to 1973, prospective primary teachers could sit for this examination if the Institute's compulsory course in mathematics was failed.
C. Miscellaneous


This book provided a collection of source material as well as some commentary. Documents illustrate the 'diversity of women's experience in Australian history,' and the major themes were: varieties of women; women in society; and women and morality. The period covered by these documents extends from 1827 to 1972, although there were a large number of documents from the period 1880 to 1930. This is the first source-book published on the history of Australian women, and such provides an extensive (although by no means complete) portrayal of women's contribution to Australian history.

Mackie, A. The Training of Teachers in New South Wales. A Paper Read to Section L of the British Association for the Advancement of Science at the Meeting in Sydney, August 1914, Government Printer, Sydney, 1915.

As Professor of Education at the University of Sydney, Mackie provided an informed and informative description of the 'new professional' methods of teacher preparation in N.S.W. While commending the 'present' system as more useful than the previous pupil-teacher system, Mackie also expressed reservations about the 'present' system. It was considered to be inadequate from two perspectives - that education is conservative, and the type of teacher required for education for a democracy would not usually be produced under the 'present' scheme; and that the principles embodied in the 'new' form of training would take time to be effectively incorporated into the education system.
Documents illustrate the continuities and changes in Australian education, although the States of Victoria and Queensland were more heavily documented than the other States. Themes of the documents were: the founding of colonial education; the organisation and administration of education; infant education; primary education; secondary education; and tertiary education. Each section of primary source material is prefaced by a brief summary and commentary.


Published annually for the graduation ceremony in May of each year, these provided lists of those graduating by the qualification awarded. They were used in this thesis for sampling purposes only.

The Wollongong Institute of Education. 'Graduation Book', 1973 - Current, Unpublished, Document held in the Student Enquiries section of the Wollongong Institute of Education.

This document provided lists of those who successfully completed the requirements for an award each year. It was used in this thesis for sampling purposes only.


Published annually, these provided information on: the development of admission requirements for the Institute from the late 1970's on; the composition of the Certificate, Diploma in Teaching, Diploma in Education and other courses; courses available; basic course content; and contact times.

Published annually, these provided information on:
admission requirements; the composition of Degrees and Diplomas; courses available; basic course content; and contact times.

(3) SECONDARY SOURCES


Anderson gives a critical estimate of syllabus changes and progress made in mathematics in schools to 1954. (Although Anderson would be inclined to call this regression rather than progression.) With a review of the examination system in the context of demands from universities, he also provided interesting views on changing levels of abilities of secondary school students in Australia. Unfortunately an A.C.E.R. investigation regarding the correlation between performance in a subject and the number of contact hours spent studying the subject, is not referenced and therefore was unable to be located and examined in further detail.


In this article, Barcan discussed the teachers' college/university dichotomy in teacher training, with an historical perspective touching on nineteenth century conditions, but concentrating on the 1970's. Utilising a supply and demand model, Barcan presented a rather biased view of teacher training courses. In a nutshell, Barcan concluded that the "academization of teacher training is an unhealthy outcome of the university entry into this field" of teacher training. His final suggestion was that
teachers would be more fruitfully trained practically and vocationally (as opposed to academically).


Clements presented an historical study of British developments compared to Colonial Victorian developments in mathematics training. It was contended that the sex-typing of this subject was traditionally gained from British views, although the colonial education had its own peculiarities.


The thesis focused on the period c.1880 - 1919, largely within an economic and political context. It proved interesting as one view of circumstances which surrounded the change from the pupil-teacher training system to the establishment of State-controlled teacher training, particularly as there was some primary source evidence of teachers' attitudes towards the two systems.


While examining various influences on secondary education developments, there was a concentration on 'traditional' factors of historical research, such as people of note, the effects of Parliamentary Acts, examination changes and general organisational changes. However, it was useful as a general overview of developments in secondary education prior to the period examined in this thesis.

This book provided an invaluable overview of the establishment of a teacher training system in Australia, to the period prior to the sudden expansion and change in the 1950's. Hyams identified alterations in trends due to crises, and compared primary and secondary teacher training systems (which was deemed to be the development of the binary system of training). Hyams also isolated several continuous features throughout the period - namely, the slowness of change; the conservatism of teachers' colleges; pragmatic official policies; and the British influence on Australian teacher education. Three main characteristics of teacher education in Australia emerged in his conclusion - "expedience, governmental parsimony, and centralized control" (P. 140). While concentrating on a synthesis of similarities between Australian States, this was an extremely useful and readable book which also highlighted differences between States.


Volume I dealt with the establishment of the New Education; Volume II with syllabus changes within the period examined; and Volume III was a summary which developed and refined the ideas presented in the first two volumes. While giving an exhaustive study of primary education from 1919 to 1939, there was also extensive reference to socio-economic-political influencing factors. This thesis was an excellent source for providing a basis of continuity and change for the period prior to that examined in this thesis.

This thesis gave an interesting basis for establishing some background in the nature of curriculum change in primary schools. Well-defined and sound discussions aided in establishing continuity with more recent philosophical bases of the syllabuses for primary schools.


In this article, Power discussed traditionally feminine and masculine labour roles, using economic and social factors to explain interdependencies between these roles. Evidence was given for areas of 'feminine' occupations in Australia from 1911 to 1971. Despite "great changes in the economy", it was stated that polarisation of occupations is still evident, although it was also suggested that polarities may change. This brief summary forms the basis of the theoretical proposition expounded within this article. It concluded with policy implications, stressing that legislative corrections alone would not solve the problem of polarisation - and in fact, may compound the problem.


After a brief introduction on the development of teacher training in Australia, Turner presented the results of a survey of the characteristics of various teacher training institutions currently (1958) available in Australia. An argument for university involvement in the preparation of all teachers (which would lead to the professionalisation of all teachers) was also given. Recommendations for the future training of teachers were given on this basis. This article provides an
interesting comparison with Barcan's article.


This short book provided a useful outline of the general movement away from State-controlled education to Commonwealth-supported education in the tertiary sector. It outlined general growth and the development of administrative changes, sometimes placing Australia in an international context. This source was useful as an overview of the structure of tertiary education, as well as placing Australia in a situation where external and internal factors claimed influence on educational change.
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