Science and Mathematics Education Centre

Student, teacher and parent perceptions of classroom environments in streamed and unstreamed mathematics classrooms.

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Declaration

To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgment has been made.

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

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ABSTRACT

The purpose of this study is to analyse the differences between upper-stream, lower-stream and mixed-ability mathematics classes in terms of student perceptions of their classroom learning environment. Both quantitative and qualitative data has been collected from students while qualitative data only was collected from pre-service teachers, practising teachers and parents. The sample for the quantitative data collection was comprised of 581 Year 9 and 10 students in 36 different classes taught by 28 different teachers in 7 schools covering 4 states of Australia. All of the schools are private schools and part of the Seventh-day Adventist school system. The questionnaire used an *actual* and *preferred* form of the 56 item version of the *What is Happening in the Classroom? (WIHIC)* survey along with 10 questions from the *Test of Science Related Attitudes (TOSRA)* modified for mathematics classrooms. For the qualitative data collection 40 interviews and 8 focus groups were conducted. Apart from comparing upper and lower-streams, other variables examined were: actual and preferred perceptions of the classroom learning environment, Year 9 with Year 10, males with females, English speakers with second language students, and attitudes with perceptions of learning environments. The most significant finding of the study was not only that lower-stream students have a more negative perception of their classroom learning environment, but that they seek less change. This negative perception is seen to be worse in Year 10 than Year 9, particularly in the areas of *teacher support* and *task orientation*. This study found a positive correlation between attitude and perceptions of classroom learning environment. This study also found a tacit acceptance of streaming as a practice by most participants in the study.

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CHAPTER 1

INTRODUCTION

1.1 Background to the Study

In 27 years of work for schools in the area of mathematics education I have always had the same questions in my mind about streaming for ability in the mathematics classroom. I have taught high school mathematics in four different countries (Cook Islands, New Zealand, Solomon Islands and Australia – New South Wales, Queensland and Victoria). I have been a deputy principal and a principal in boarding schools where I have virtually lived with the students to help them through their schooling years. This allowed me a particularly close relationship with the students on a daily basis and allowed me to get to know them as people as well as students. In helping them in evening study sessions, mathematics often featured as a source of discouragement when I wanted it to be a source of motivation. I now administer 12 schools as a director of the Seventh-day Adventist school system in New South Wales. Over this time, no matter what position I have held I have wondered about streaming in mathematics and about streaming in general. I have had students, parents and teachers at various times from primary school level up to senior secondary asking questions like: ‘Why don’t we stream the classes?’ or ‘Why do you stream the classes?’ Sometimes they would make comments like: ‘You are favouring students by streaming,’ or ‘You are favouring students by not streaming.’

A large majority of the literature I have read (eg. George, 1996; DiMartino & Miles, 2004; Marsh & Raywid, 1994; Boaler, Wiliam & Brown, 2000; Ascher, 1992) has cast a sociological shadow on streaming as a practice. It is a fact that most mathematics teachers that I have worked with or know as colleagues like streaming for a variety of reasons that they are happy to speak about. I am one of those teachers who has always enjoyed streamed classes – both upper and lower. I can extend the upper-stream and have the academic challenge for myself as well as for the students. I can have fun with the lower-stream and do activities that will hopefully help them to enjoy mathematics as a subject. Still there are questions that need to be asked: ‘Do I like streaming mostly because it is easier for me as a practitioner?’ and ‘Have I really got the best good of the students in mind when I stream as early as Year 9?’

Perhaps the most drastic form of streaming I have encountered was while teaching in the Solomon Islands. Because the country's financial situation did not allow more than about a third of students to progress past Year 9, students were tested in the areas of mathematics and English and permitted to proceed through the rest of secondary school based on those results. (http://www.unesco.org/iau/online databases/systems_data/sb.rtf). We could say that the 'top' stream was permitted to continue with their education while the rest had to return to their village or, if they were fortunate, get a very low paying job in town.

Such was my interest in the topic of streaming that at a school in New Zealand where I was principal, school management decided to experiment on the Year 9 cohort and divided their classes in different ways for their different core subjects. In mathematics we streamed for ability. In science we purposely divided the students into three mixed-ability classes with the full range of perceived science abilities in each class and then rotated them through the three teachers over the course of the year so that the teachers only had to prepare a third of a years work and teach it to three classes. In English we created a 'boys' class with a male teacher and more male oriented literature to study while giving the girl's class a female teacher and more 'girl type' literature to study.

The teachers were not only happy that the trial seemed to have many positive effects, but were also happy that we as a school were prepared to innovate. We had positive comments from the students and parents and the teachers seemed very happy with their situations. The classroom management was seen to be improved and the academic results overall improved. A teacher involved with the process reported that the streaming for them centred on four key areas: engagement of the student (relevance, motivation and interest); skill development (ensuring that they knew the basics and developed a curiosity for exploration of ideas), language expression and literature; and acknowledging that a differentiated approach is required for different groups. They found the latter was a frustration as the scale of the streaming did not permit enough differentiation to really and specifically challenge the gifted and able students. The English teacher said:

For the kids it appeared in most cases to work. It definitely reduced the energies and time spent on classroom management, discipline and organisation in the classroom. Clear expectations and content of some relevance enabled work to be produced beyond the experience of many of the boys without being too painful an experience for them.

The comments by this one teacher evoked more curiosity and questions within me to pursue the idea of streaming further. There are obviously very good aspects to some types of streaming, but the whole concept was ripe for exploration. This experiment planted the seed in my mind which became the basis for this thesis. The pilot study reported on in Section 3.8 was conducted at this same school and provided enough interesting outcomes to encourage me to pursue the topic.

Based on the experiment at this school I had questions that needed to be answered: How significant was a single one of the anecdotal comments I received? What evidence was there in scientific form that there was any difference at all? Did the teachers praise streaming because it made life easier for them or did they really perceive differences in classroom climate and academic results? Perhaps the most significant question I had came back to the mathematics classes. I had to ask myself what we were doing to the lower-stream mathematics class by streaming them so young. Did the students like their lower-stream mathematics class because the work was easier or because they got to do more activities and go on more excursions than the upper-stream? Did they even stop to think about what effect being in a lower-stream may have on their career in a few years time? Did their parents realise how young they were to be determining their future direction in Year 9?

All of these experiences have led to a desire to study streaming further. Given my interest in the topic of streaming from a theoretical and practical point of view, I needed to make the study rigorous and come to some conclusions that are supported by data, based on previous research and which answered some of the questions I had on the topic. One can easily see from the previous paragraph that there are an enormous number of possible research questions that could have emerged across a number of subjects, but my determination was to study mathematics classroom learning environments in streamed and mixed-ability mathematics classrooms. I determined to collect information from Year 9 and 10 students, from teachers and from parents. I also wanted to study the relationship between the students' attitudes to mathematics, their perceived classroom learning environment and their preferred classroom learning environment.

Given ongoing historical debate (Brewer, Rees, & Argys, 1995; Jaeger & Hattie, 1995; Gillborn, 2005) on streaming of academic classes in general, this study is designed to focus specifically on the mathematics classroom. It will contrast the *actual* and *preferred* classroom learning environments of upper-stream and lower-stream mathematics classes. There are specific groups within streams that can be included in the study. These groups may be specific genders or cultural groups for example. This study will seek to investigate how students perceive their classroom learning environment. How do students in either stream cooperate with each other? Do they carry out investigations in the classroom and are they involved? Do they get on well as a group and can they stick to their tasks? Do they feel that the teacher is supporting them and that all students are treated equally?

Apart from the quantitative data obtained from questionnaires, a sample of students, trainee teachers, teachers and parents were interviewed about their perceptions of learning environments in streamed classrooms. This provided qualitative data to complement the quantitative data. The results of this study will make a strong contribution to the literature in the area of streaming but also to the debate in educational circles about streaming. It has no preconceived hypothesis favouring streaming or non-streaming.

Stated concisely the primary area of research is this: The differences in classroom learning environments between upper and lower-stream and mixed-ability secondary mathematics classes as perceived by the students.

Of course there are secondary questions to be asked such as:

(a) What are the differences in classroom learning environments between upper and lower-stream secondary mathematics classes as perceived by teachers and parents?

(b) What is the connection between a student's attitude to maths and their perceived classroom learning environment?
(c) Is there a difference between the perceptions of males and females with regard to their classroom climate in mathematics classrooms?
(d) Does cultural background have any impact on student perceptions of their classroom learning environment?

It seems that there has been a significant amount of research undertaken on streaming in the past. Some of the research has been aimed at trying to establish the academic advantage or otherwise of ability grouping. (George, 1996; Brewer, Rees & Argys, 1995; Boaler, Wiliam & Brown, 2000; Slavin, 1995). The other aspect has been looking at the social/self-esteem aspects of ability grouping (DiMartino & Miles, 2004; Marsh & Raywid, 1994; Kemp & Watkins, 1996; McIntyre & Ireson, 2002; Ascher, 1992; Zevenbergen, 2005).

A problem with the majority of research described above is that there were many variables that would have an influence on the outcomes for and from grouping. Ireson and Hallam (1999) also identify several issues that have arisen from this research. For example: What type of grouping is practised at the school? How rigid/flexible is it? How is the blur between the measurement of academic outcomes and social outcomes as a result of streaming dealt with? They also identified issues such as the effects of streaming which may be different in different schools, communities, and cultures. There is no guarantee that results in one school will be consistent across time, across subjects or between teachers. Ireson and Hallam (1999) summarise the issues by saying that:

> The research findings regarding the relationship between pupil self-esteem and ability grouping practices are complex and difficult to interpret, particularly as a variety of measures have been used, both in questionnaire form and in interviews. (p. 348)

1.2 Purpose of the Study

The objective of this research is to address the fundamental question: What are the perceptions students have of their classroom learning environments in streamed and unstreamed mathematics classrooms? Further questions to be asked revolve around whether there is a significant difference between the classroom learning environments as students currently perceive them compared with how the classroom learning environments may be if they were what the students perceive as 'ideal'. Another purpose of this research is to discover if lower-stream mathematics students are in fact feeling disadvantaged socially or educationally by being in a lower-stream compared to the perceptions of their upper steam counterparts.

Another objective in this study is to find out about the students' attitudes towards mathematics as a subject. It may be that those who consider their classroom learning environment to be inferior, are in fact those who have a poor attitude towards mathematics as a subject. This study seeks to examine the relationship between classroom, environment and student attitude.

1.3 Theoretical Basis for the Study

There is a good quantity of research completed on the various advantages and disadvantages of streaming academic classes at school by ability (eg. DiMartino & Miles, 2004; Marsh & Raywid, 1994; Brewer, Rees & Argys, 1995). There is a significant quantity of literature that concentrates on academic differences in streamed or mixed-ability classes (eg. Brewer, Rees & Argys, 1995; Jaeger & Hattie, 1995; Hoffer, 1992). There are also many papers that comment on the sociological effects of streaming (eg. Slavin, 1996, Zevenbergen, 2005; Gillborn, 2005). After searching carefully, there appears to be little or no research that examines the students' own perceptions of their classroom learning environments and then examines the data in terms of streamed and non-streamed environments beside *actual* and *preferred* environments. The research reported on in this study shows how students perceive their learning environments in both streams, but specifically in the mathematics classroom. These elements of this study make it unique. This study seeks to add to the literature in the areas of ability grouping, classroom learning environments and mathematics education.

Given the quantity of prior research on streaming (eg. George, 1996; DiMartino & Miles, 2004; Wiliam & Bartholemew, 2004; DeLany, 1998; Lockwood & Cleveland, 2002), there is a strong theoretical basis upon which to build in order to research questions in this study. Several academic areas will form part of the background to this research. Apart from the fields of mathematics education (and education generally) and learning environments, the areas of educational sociology and educational psychology will also be drawn upon.

1.4 Mathematics Education in Australia

The pressure brought about by external forces such as globalisation and rapid increases in knowledge on a worldwide basis has brought calls for states to work towards accepting a national mathematics curriculum. The present situation is that the National Mathematics Statements have been adopted by the states and incorporated into their curricula.

The Queensland curriculum guidelines, based on the National Guidelines are on the Queensland Department of Education web site (http://education.qld.gov.au/curriculum/area/maths/index.html). Here statements are made about the objectives of mathematics education for their state. These objectives can be reflected across all of the four states which were sampled for this study. They are:

We aim to:

(a) Increase the numeric of Queensland students
(b) Have more young people aspiring to careers in Mathematics
(c) Improve the quality of Mathematics education in Queensland

We believe:

(a) Mathematics is a unique and powerful way of viewing the world
(b) Mathematics assists individuals to make meaning of their world
(c) Thinking, reasoning and working mathematically are essential elements of learning mathematics.

Mathematics helps us to:

(a) Identify and analyse information
(b) Create mathematical models
(c) Pose and solve mathematical problems

(d) Make informed decisions

(e) Reflect on the reasonableness of our solutions'

Though the states all have similar philosophical approaches to mathematics, their syllabi and assessments are significantly different.

Given that the sample of students used for this study came from four different states in Australia, it is worthwhile to report on the way mathematics is dealt with in Year 9 and 10 in each of these states. The four states chosen for this study were Queensland, Victoria, New South Wales and Western Australia. The first three states were chosen by the researcher because a good working knowledge of their education system was available from personal experience. In the case of Western Australia, it was chosen to have a new and unfamiliar perspective to add to the rest and was accessible due to its proximity to Curtin University of Technology.

In Queensland there is one syllabus for mathematics that covers Years 1 to 10. It is organised into six levels. There is no advanced syllabus as such and assessment is now outcomes based. Though there is no curriculum oriented reason for streaming in mathematics at Year 9 and 10 in Queensland, the two schools sampled leave Year 9 as mixed-ability but the students are streamed going into Year 10. The schools see this as a pathway into either Maths A or Maths B in Year 11.

In Victoria they also have just one syllabus for Preparatory to Year 10. They also have levels 1-6 as does Queensland where level 6 is to be completed by the end of Year 10. The only difference is that they have a section to their syllabus called level six extension which does not dictate a streamed situation but certainly lends itself to being streamed. The school surveyed in Victoria streams both Year 9 and Year 10 by ability by setting a certain difficulty benchmark within level 6.

In Western Australia both the syllabus and the assessments are organised in Year 10 to have two levels of difficulty. Level 10a is openly said to be for the brighter students: 'Designed for students with mid to high-ability range.' The assessments at this level carry more difficult questions. Level 10b is for students with 'low to mid ability range' and contains less difficult questions. The sub strands covered for both groups are the same except for one. They both cover Space, Measurement and

Chance and Data. Where they differ is that 10a has ‘Number and Algebra’ while 10b has ‘Number and Working Mathematically’. While it could be argued that a mixed-ability class could cope with this syllabus in that it is almost parallel, in real terms it lends itself to streaming. This is what the school surveyed does for both Year 9 and 10. The construction of this syllabus may be a concern for a late-maturing child who finds themselves in the lower-stream at Year 10 and misses out on the algebra stream which is then fundamental to mathematics in Years 11 and 12. In other words their track through secondary mathematics may have been decided at Year 9 level.

In New South Wales the Board of Studies specifically sets out different curricula for different abilities in Years 9 and 10. In fact there are three levels set out in the curriculum documents within level 5 which is the Year 9 and 10 level. They are called 5.1, 5.2 and 5.3. Schools commonly stream their classes according to these levels and call them Advanced, Intermediate and Standard. It is made clear that there are optional topics for those studying at level 5.2 but who want to do mathematics at level 6 which is Years 11 and 12. There are also extension topics for those who want to study extension mathematics at level 6. The whole program is organised to make it very difficult for schools which prefer not to stream for mathematics ability in Years 9 and 10. Indeed the Sydney schools sampled in this study reflect this and have to be very careful that they get the students in the stream of ‘best fit’ if that is possible.

1.5 Significance of the Study

After extensive examination of the literature it appears that little work has been done that combines classroom learning environment research with streaming in mathematics education as a practice. Mathematics is traditionally a subject in which students have extremes of feelings – they either enjoy it or try to avoid it (Cornell, 1999). There are few neutral feelings. Is being in a streamed class going to exacerbate those extremes of feeling or bring them closer together? Are the classroom learning environments in streamed mathematics classes going to vary much from each other?

This research may provide information to teachers and school administrations. It may provide answers to such questions as:

(a) What are students' attitudes towards mathematics in general?
(b) Does streaming produce significantly poorer classroom environments?
(c) Where should we place our better and more experienced or innovative mathematics teachers?

If it were to be found that no significant differences in perceptions of classroom learning environments were found between the different streams, then that would put to question some of the conclusions that previous researchers have put forward in terms of the practice of streaming disadvantaging the lower-stream. There would still be sufficient data to draw conclusions regarding the specific areas within a classroom that students perceive as needing improvement.

If the results of the data analysis show a significant difference in perceptions of classroom learning environments between streams, then much of the literature will be supported and there will be one more piece of research to suggest that streaming may not be a sociologically sound practice. If this is the case, then specific aspects of classroom learning environments will be highlighted as those making a contribution to the difference. This should prove useful information for schools in terms of decision-making and administration.

The emotive nature of the debate on streaming should not be underestimated. The literature contains many varied assertions regarding the damage that can be caused emotionally, socially and academically by streaming (eg. Carbonaro, 2005; Gillborn, 2005). This study does not seek to provide a final conclusion that supports either side of the argument but it may be able to provide discussion and outcomes regarding the differences in student perceptions of classroom learning environments when in upper-stream and lower-stream mathematics classes.

1.6 Overview of Methodology

This study combines the use of quantitative and qualitative data collection methods. This has been a trend over the last two decades (Fraser & Tobin, 1991) and is a useful mechanism to allow the researcher to first take quantitative data and use it for statistical analysis and then use the qualitative data to validate the quantitative findings in a non-statistical way. It can then examine more deeply factors identified in the quantitative analysis.

In this study 581 students were sampled at seven different schools in four states of Australia. This represented 28 different teachers, 36 classes, and covered upper-stream, lower-stream and mixed-ability classes. Each of these students was asked to complete a survey which established their school, teacher, class, stream, gender, language spoken at home as well as a 10 item *Attitude to Mathematics* survey and a 56 item classroom learning environment inventory based on the *What is Happening in the Classroom (WIHIC)* survey. Each student was required to answer each question from the learning environment inventory twice – once for their *actual* perceptions of the learning environment and once to ascertain their ideal or *preferred* learning environment.

Following ethical clearance, students were also given the option of providing their email address so that further questions requiring qualitative answers could be asked of them at a later date. About one-third of the students provided their email address. This was more than enough to receive a response rate of at least five percent of the total sample of students to be taken.

A small sample of teachers from the target schools and a small sample of parents were also interviewed as key informants. This was carried out to add another perspective to the data collected from the students and further validate any conclusions. Data obtained from two focus groups of trainee teachers at two tertiary institutions was used to add another perspective to the study.

The use of a valid and reliable learning environment instrument was a valuable tool in assessing student perceptions of their learning environment.

Microsoft Excel and Word Professional 2003 (Microsoft Corporation, 2003) and SPSS Version 11.5 (Norusis, 2002) were the software packages of choice to work with the data. The qualitative data were analysed manually and reported upon in a narrative fashion.

1.7 Overview of the Thesis

This thesis comprises seven chapters followed by a references section and several appendices.

This first chapter contains a personal statement detailing where the research originated, along with the purpose of the study, a little background theory, a synopsis of mathematics education in Australia, an explanation of why this study is significant, what are its limitations and a summary of how the research was undertaken. Chapter 2 contains a literature review. This is a comprehensive review of literature relating to previous research in the areas of classroom learning environments, mathematics classrooms, mathematics education and streaming in education with specific reference to the research questions covered in the thesis.

Chapter 3 contains a description of the methodology used in the study and the implementation of such. It contains the research questions, validations of the instruments and how the analyses were carried out. There is a description of both the qualitative and quantitative methods employed in the study. Chapter 4 reports on the results of the quantitative data analysis. Chapter 5 reports on the results of the qualitative data analysis. Chapter 6 is a discussion of the findings

Chapter 7 contains a summary of the main findings of the study, the limitations of the study and the range of possible research topics that have come out of this study. Following Chapter 7 are the references and the appendices.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter presents the literature from several areas of research including mathematics education, streaming or ability-grouping, attitudes to mathematics and classroom learning environments. It also presents literature on the differences in males' and females' attitudes to mathematics and those from non-English speaking backgrounds. As the results unfolded, the review was supplemented. As Anderson (2004) said: "A literature review is a summary, analysis and interpretation of the theoretical, conceptual and research literature related to a theme or topic." (p. 76)

This chapter more specifically contains a literature review that covers areas such as types of mathematics classroom (2.2), an introduction to streaming (2.3), the effects of streaming on learning (2.4), the organisational implications of streaming (2.5), the sociological effects of streaming (2.6), intermediate positions on streaming (2.7), student attitudes to mathematics (2.8), classroom learning environments (2.9), differences by gender and language (2.10), and combining quantitative and qualitative research methods (2.11).

2.2 Types of Mathematics Classrooms

How a mathematics classroom operates is pivotal to student attitudes to mathematics and to their perception of their mathematics classroom. The nature of mathematics as a subject can create two diverse types of cultures. The first is a traditional 'teach and textbook' style which stifles the investigative side that is so vital to student learning.

The second type of mathematics classroom values investigation, problem solving and cooperative learning. Fagan (2005) sees the importance of classroom culture to learning:

> Quality classroom culture and discourse go a long way in fostering procedural fluency and conceptual understanding in mathematics. Opportunities to examine, extend, and generalise patterns enable students to learn algebra with

> understanding and set mathematics in a real-world context. (p. 35)

Mathematics teachers know that there is always a better way to do what they are doing but acknowledge that it takes much time, effort and motivation to change a century old skill of imparting information and being the master of the classroom into being a facilitator of learning. One such teacher, Allen Gagnon (as cited in Schifter, 1996), a Head of Department in a high school, struggled with this change process, making the following comments:

> I have come to realise that my old view of teaching (presenting the material in a clear and concise manner) was too narrow in scope and did not take into account how learning takes place. As I struggle to gain insights into how my students learn, my teaching changes. . . There are many questions that must be answered. What is learning? How does learning occur? What is the role of the teacher in the learning process? What is the role of the student in the learning process? . . . What are my obligations to all my students, including the best and the so-called 'worst'? Where does the need to follow the curriculum fit into the puzzle? (pp. 1-2)

As Gagnon continues his reflections he asks more questions of himself when he sees the enormity of the process of changing a classroom style. The questions involve such concepts as whether continual group work and exploration of mathematics concepts is really necessary and whether his understanding of the concepts is really sufficient to facilitate this. The inevitable question of all teachers then emerges. Where will I find the time to do this properly and how can I stop these thoughts from daunting me to the point of desperation?

2.3 Introduction to Streaming

In 1977, Caroline Persell wrote a book that had a full chapter on the history of tracking (streaming) in America. A definition for tracking is that it is a practice which "places children together in a class on the basis of similar aptitude, achievement or aspirations." (Persell, 1977, p. 85). She goes on to explain that while the first recorded example of tracking was in St Louis in 1867 and was pursued vigorously by industrial capitalists, up until the date of writing it followed a haphazard history of acceptance and rejection. In the 1920's and 1930's, when large numbers of blue collar workers were introduced into America, tracking was very popular in keeping a lower-stream to cater for the children of migrants. It then lost popularity until the 1950's when the 'space race' was on with Russia, and competition called for an academic elite. This time period also saw the movement of southern blacks to the northern cities along with the immigration of Puerto Ricans and Mexicans. This added more pressure to introduce the 'ethnic lower-stream'. It was reported that in the 1970's streaming was a widespread practice. Sometimes called *educational differentiation*, streaming was still economically, socially or racially driven.

There are many terms for the practice of streaming and many variations to the concept of streaming and it is called by different names in different countries. Table 2.1 is adapted from an English report called *Aspects of Secondary Education in England* in Harlen and Malcolm (1999) and illustrates the different names for ability grouping in all of its forms.

While it can be seen that there are specific terms in England for modifications of the same ideas, in Australia only three terms are used by practising teachers. *Streaming* is the practice of grouping students in the same year level by ability for one or more subjects. *Mixed-ability grouping* is keeping classes grouped randomly or by any other method apart from ability grouping. *Within-class grouping* is understood in the same way as England and America where teachers may construct smaller groups of students within their own classroom for teaching convenience. These groups may or may not be based on ability. In this study the Australian understanding is adopted, although international terms will be referred to.

Not only is ability grouping in all of its forms called different names across different cultures, but the very culture of a country dictates their attitudes and expectations towards ability grouping as a practice. As LeTendre , Hofer and Shimezu (2003) point out:

> Our analysis suggests that dominant cultural values determine what forms of tracking are perceived as legitimate and shape parent and adolescent

perceptions of choice and opportunity. . . . Basic beliefs about tracking may vary from nation to nation and cannot simply be translated from one language to another. (p. 44)

Table 2.1
Definitions of British and American Terms

English Term	Meaning	American equivalent
Streaming	Assigning students to classes based on some measure of ability.	*Tracking*
Setting	Regrouping of students for ability in specific subjects.	*Regrouping/Curriculum assignment*
Banding	A whole year group is divided into groups based on ability as with streaming. Bands may be unequal in size.	*No equivalent*
Mixed-ability grouping	Perceived ability is not considered when making class groups. An attempt is usually made to balance them for gender and cultural background.	*Heterogeneous grouping*
Within-class grouping	Groups are formed by the class teacher within the class to reduce the number of students receiving instruction at any one time. The groups may be homogeneous or heterogeneous.	*Within-class grouping.*

Adapted from "*Setting and Streaming: A Research Review*." By W. Harlen, and H. Malcolm, 1999, The Scottish Council for Research in Education.

The history of streaming contains many discrepancies in how the different tracks have been established over the years. Even where 'ability' as measured by standardised tests was used as a benchmark for placement into classes, the result was still a separation based on social class or ethnicity. (Rosenbaum, as cited in Persell, 1977). The research of this era uncovered and reported on many controversial practices in the name of streaming. These practices included: providing different content to the different streams (Keddie, as cited in Young, 1971), using different instructional styles for the different streams (Sorenson, cited in Persell, 1977), higher streams receiving more empathy and praise while lower groups receive more direction and criticism (Rosenshine, as cited in Persell, 1977), better teachers placed into upper-streams (Hargraeves, 1967 as cited in Persell, 1977). Accompanying these inequalities were more careers guidance for upper-streams and less extra-curricular participation for lower-streams. (Persell, 1977).

According to George (1996) there exists so much evidence against streaming, yet the majority of schools are still practising it in some way or another. He records that in excess of 700 studies have been completed over the last half decade on streaming as a practice. The majority of these studies clearly indicate that it is not a desirable practice. It is a fact that around 85 percent of schools today still use ability grouping in some form.

It is said that there are three main reasons for streaming (DiMartino, 2005, p. 10):

1. It is easier and more efficient for the teacher
2. It helps students learn to their level and feel better about themselves
3. It limits the amount of failure slower students may experience and feel.

DiMartino (2005) disputes each of these points. He believes that when the evidence of research is taken together, streaming does not really help anybody. He points to studies that have shown that it is not possible to place students into groups based on ability and do it equitably or accurately. The history of research in this area also shows that students do not necessarily do better when put in classes of students with like ability. He also believes that the research shows a lower self-esteem for students in lower-streams. In fact he can see no positive aspects of streaming. The logical conclusion to what he is saying is that streaming is polarising, creates elitism, sets low expectations for both lower set students and teachers, wastes time, and encourages segregation.

While the previous statements are compelling, when the research is studied carefully, they do not constitute universal conclusions. For the statements to be true one would have to make the assumption that treating different people equally is in fact equitable. As Thomas Jefferson is reported by Fielder, Lange and Winebrenner (2002) to have said: "Nothing is so unequal as the equal treatment of unequal people."

For the first half of the 20th century it was a given fact that mathematics classes would be streamed and there seemed no cause to question this practice. (Wiliam & Bartholomew, 2004). Indeed this happened for more than mathematics classes as students were often streamed into ability groups and left there for all subjects, invariably for the duration of their schooling. When the 1960's arrived and there was an interest aroused in the individual learner, the practice of streaming began to be questioned (Jackson, 1964) and the streaming between classes for both primary schools and secondary schools declined in the 1960-1980 time period. During this period research was conducted that highlighted dissatisfaction from lower-stream students (eg. Hargraeves, 1967). Other research showed that streaming really did not bring about significant gains in academic achievement. (eg. Newbold, 1977). This trend of moving away from streaming has not continued into the latter part of the last century. Despite the evidence presented in the research, streaming is still a widely held practice in most secondary schools, particularly in the area of mathematics. Wiliam and Bartholomew (2004) report that in England around 90 percent of schools still stream for mathematics and the British government has even advocated the use of streaming in all secondary schools despite being reported as saying that they are interested in developing educational practice that is informed by research evidence.

Van Houtte (2004) provides an historical summary of streaming research from a teacher's point of view from 1967 onwards:

(a) There is a history of lower-streams receiving less interesting and less challenging classes. (Hargraeves, 1967; Metz, 1978)
(b) Less is expected from lower-stream students than from higher stream students in the academic area. (Hargraeves, 1967; Metz, 1978)
(c) A higher work rate and an ability to solve problems is expected of upper-stream students. (Hargraeves, 1967; Metz, 1978)

(d) Memorisation and a constant stream of exercises is what lower-stream students came to expect over the years.' (Goodlad, 1984; Persell, 1977)

(e) In upper-streams the academic gets the focus whereas in lower-streams behaviour is the focus. (Schwartz ,1981; Murphy & Halllinger, 1989)

(f) The whole atmosphere of a higher stream as set by the teacher is generally more set for achievement than in the lower-stream. (Oakes, 1985)

(g) Lower-stream students are expected to just do their work without the benefit of higher order explanations and very little direction as to goal or expectations. (Schwartz, 1981)

(h) Because teachers in higher streams are more motivated, they generally put more effort into their lesson preparation. (Rosenbaum, as cited in Persell, 1977; Goodlad, 1984; Oakes, 1985)

(i) Teachers can tend to take on the position of their students and thus end up streaming themselves. (Finley, 1984)

There has been a significant move towards eliminating streamed classes in America with research concluding that streaming widens the gap between those who are perceived to be upper-stream and those who are perceived to be lower-stream. For example, Lockwood and Cleveland (2002, p. 3) make several statements about the effects of streaming. They believe that it is an ongoing challenge for teachers, parents and all concerned with education to get that balance between equity and excellence. Their conclusion is that removing streaming from schools is the best way to achieve both of these objectives, given that there is no data to support the theory that ability grouping adds to overall achievement. It is accepted that streaming does create inequality.

These are all generalisations but they do describe a culture that can exist in schools that practise streaming. Either the teachers who are placed with lower-stream students are not as skilled as those for upper-stream, or teachers become discouraged by an institutionalised lower-stream class, expecting poor behaviour and thereby losing their motivation to help them.

At this current point in time the British government is supporting the selection of students based on ability. It is interesting that parent groups are against selection by ability. Shaw (2004) wrote in the Times Educational Supplement: “While the British government plans to expand support for schools that choose students based on ability, a recent survey reveals that parents are overwhelmingly opposed to selection by ability.” (p. 1)

2.4 The Effects of Streaming on Learning

This section will present a number of references that discuss the position of streaming as it appears in the existing literature. This study seeks to clarify some of these issues and for a specific sample, identify the relative merits or otherwise of streaming in mathematics education in terms of their learning environments.

Depending on the country of origin for each of the studies referred to in this section, what is called ‘streaming’ in Australia is referred to as ‘tracking’ in America and as ‘setting’ in Europe. According to Alexander and Cook (1982), tracking is “setting up distinctive, internally coherent programs of study congruent with students’ scholastic interests and competencies and tailored to their anticipated educational and vocational needs.” (p. 626)

Marsh and Raywid (1994) gave eight good reasons why streaming should not continue to be practised in schools:

1. The best teachers are often assigned to the top streams
2. Differences in content
3. Differences in quality of instruction
4. Too little is demanded of lower-stream classes
5. Students encounter an atmosphere of less motivation amongst lower-stream students.
6. Minority students often end up grouped together
7. Career opportunities could suffer
8. Students may be put in the wrong stream by mistake.

Eliminating streaming adds to the confusion and conflicting evidence available on the winners and losers if a school were to take this path. Brewer, Rees, and Argys (1995) have conducted research which shows that reverting to mixed-ability would itself "create winners and losers. . . . Our estimates imply that detracking all students currently enrolled in homogeneous classes would produce a net 1.7% drop in the average mathematics score." (p. 214) This is an interesting assertion to make and one that would be very difficult to measure with any significance or report with confidence. Indeed Jaeger and Hattie (1995) say that further research shows that the difference in scores is so negligible that it can go either way and probably should not be quoted. They also make the comment that sometimes students stream themselves by choosing a certain subject over another, more academic one.

Brewer, Rees and Argys (1996) answer their critics by again stating that there will be winners and losers if tracking is abolished. The better students will have their scores brought down while the poorer students will show improvements in scores. They say that the 1.7 percent decline in student test results, referred to as insignificant by critics, represents a net result. The actual decrease in upper-stream students' mathematics results came out to 8.1 percent. The increase for lower-stream students put in a mixed-ability class would average out at 8.7 percent. (Brewer, Rees and Argys, 1996) Their question is to ask who should make the call as to which result is more desirable. It is a difficult sociological question to answer. Which group should be performing below their best due to the way the school is organized? Certainly the parents of the upper-stream students would traditionally have the stronger voice in the school community.

Hoffer (1992) had the same to say some years ago when his research showed that any gains from ability grouping are too small to be significant. Indeed placing students from a mixed-ability class into an upper-stream produces a weak positive net result while placing a student from a mixed-ability class into a lower-stream class produces a strong negative result. This is just one more paper to illustrate how streaming benefits the upper group in a minor way but disadvantages the lower group in a more pronounced way.

A study by Venkatakrishnan and Wiliam (2003) reports similar findings. While it was stated that streaming has different effects on different students, in general it was found that upper-stream students did not receive a large advantage by being streamed, mixed-ability students kept performing at their previous level and lower performing students were disadvantaged. Like other studies reported in this chapter, the difference in academic attainment after streaming was introduced, was very small.

In a review of studies on ability grouping and academic performance compiled by Slavin (1990), 29 different studies were identified and the net effects of ability grouping were found to be very close to zero. The only exception to this seemed to be in the humanities area where the heterogeneous classes tended to perform better. These results are in contrast to other research presented in this chapter which indicates a slight improvement for upper-streams and a significant decrease in achievement for lower-streams under ability grouping.

Another perception is given by Boaler, Wiliam and Brown (2000) who use research to blame poor International Mathematics Study results in the United Kingdom, directly on streaming in that country. It is suggested that there are only two factors that affect student achievement in mathematics – "opportunity to learn and the degree of curricular homogeneity." (p. 641). They go on to say that streamed classes and curricular homogeneity are mutually exclusive. The intent of their study has similarities to the current proposal for this thesis. They study student attitudes and achievement in mathematics in ability-grouped schools. Their conclusions are that ability grouping causes negative feeling towards the subject.

Boaler, Wiliam and Brown, (2000) also comment on much of the research provided in the area of streaming for ability as very clearly indicating a slight increase in academic achievement for higher stream students, but significant decreases in performance for lower-stream students. The comment is made that most of this research has been quantitative with little or no classroom observations or any other mechanisms whereby other aspects could be measured, such as: "The way that tracking and setting impact upon students' learning of mathematics, the processes by which it takes effect, or the differential impact it has upon students." (p. 631)

It stands to reason that when streaming occurs across the board and when students are condemned to a particular set indefinitely, that some negative aspects of streaming brought out in the research may have an impact on students. There seems to be evidence in the research for the existence of poorer teaching methodologies in lower-stream classes with less qualified teachers. One might also consider the impact on individual students if they are continually labelled as and mixing with students considered as inferior because of socio-economic status, ethic background or perceived lower ability.

Van Houtte (2004) comments on the academic culture in school staffs as it relates to streaming. The results are quite telling from a sociological viewpoint. One conclusion is of particular concern. He reports: “It has been shown that teachers in lower tracks are less academically oriented than those in higher tracks, because they have a lower opinion of their pupils.” (p. 354)

He goes on to quote Hallinan (1994) in saying what has been highlighted from the literature already – that there is really no advantage in streaming. Mediocre pupils will not be advantaged, good students will benefit from streaming but poor pupils will suffer the opposite effect.

Van Houtte (2004) draws the conclusion that teachers also become tracked according to the classes they teach. They subconsciously acquire the same status as their students. DeLany (1998) says: “The appreciation teachers receive from the outside world depends on the ability level of their students.” (p. 358). It stands to reason therefore that teachers not only prefer to teach the higher stream, but usually put a lot more effort into it.

This theory is taken further by Van Houtte (2006) where he says that in the lower-streams teaching methods emphasise facts and basic skills whereas in the upper-streams teachers expect more of their students and present their material in a more enthusiastic manner. In a study conducted in Belgium by Van Houtte, he found that teachers trust students in ‘general’ schools more than they do those in ‘vocational’ schools. The level of trust a teacher has for the students is associated with the level of satisfaction the teacher has with their work, which in turn leads to the amount of effort they put into their teaching. In Belgium not only are the classes streamed but the schools are also streamed. The vocational schools represent what could be known as the lower-stream.

Arbor (2004, p. 15) highlighted several reasons why streaming does not work:

(a) It is not realistic to think that a streamed class is strictly homogeneous. However classes are divided, teachers will still have a huge range of abilities to deal with.
(b) Low income, ethnic minority and disadvantaged students usually find themselves in lower-streams.
(c) Even where schools say that their streaming policy encourages mobility between the streams, the tendency is for the placements to become fixed. Where mobility does occur it is much more likely to be a downward movement than an upward movement.
(d) When a student reaches the stage in school where streaming begins to occur, it is most likely that the student has been permanently labelled in terms of achievement and future career.
(e) Students with behaviour problems usually end up in the same class which makes the behaviour management of that class difficult from the start.
(f) 'Teachers get the message, implicitly and overtly, not to have high expectations for low-track students.' (p. 15)

It should be no surprise that Carbonaro (2005) established a link between the effort of students, tracking and their achievement. This study found that students in upper-streams tend to put a lot more effort into their work than students in the lower-streams. The factors affecting lower-streams and causing this difference in effort are firstly that historically the student has not tried and has not achieved. The experiences of the students in lower-streams also reinforce the non-urgent approach to learning.

Carbonaro (2005) goes on to quote a variety of researchers who have previously established the link between ability grouping and academic outcomes: "Research has strongly suggested that students in higher tracks and ability groups tend to learn more than comparable students in lower tracks and ability groups." (p. 27)

The line of logic is such that the classroom learning environment of an upper-stream class is more conducive to student effort. Effort is measured by how much homework is completed, how attentive the student is in class and how prepared they are for tests and exams. It then follows that this type of effort leads to greater learning

Carbonaro (2005) points out four main reasons why placement in a certain track may form a positive correlation with student learning. Firstly, "The sub-culture of a lower-stream class which often promotes antischool norms actually serves to disengage students from the learning process." (p. 29) Secondly the concept of 'prior effort' could not only be the means by which a student is selected to a higher stream, it is certainly a precursor to better results because of the previously stored knowledge. The converse is also true. Thirdly the higher stream students will almost certainly have better self-belief and ambition to achieve. Finally, where a student is placed determines the 'cognitive demands' placed upon them.

In what is a complex and extensive study, Carbonaro (2005, p. 39) comes up with four main conclusions that link effort, stream and learning:

1. The higher a student's track, the more effort she or he exerts.
2. Most of the differences in effort across tracks are explained by differences in prior effort and achievement across tracks, but factors relating to students' experiences within tracks also explain track differences in effort.
3. Effort is an important predictor of achievement
4. The effect of effort on achievement gains does not vary across tracks.

Arbor (2004) has reported on case studies with schools in America which have eliminated streaming. Contrary to what other research has shown, schools used by Arbor show significant increases in test scores after creating mixed-ability classes.

> Getting rid of tracking and having students of varying ability levels in the same class can be a challenging process but is worth the effort, say officials of South Side High School . . . and Noble High School . . where detracking led to improved academic performance for students at all achievement levels and to better school climates. (p. 15)

Arbor (2004) found that in one of the schools the passing rate on the state-wide examination went from 72 percent to 95 percent over seven years. It is also significant that: "Gains were also dramatic in percentages of African American, Latino and low-socioeconomic status students taking and passing advanced maths courses." (p. 16)

It must be pointed out that the detracking was done with quite a few conditions. These conditions would be vital to success. Firstly it would be necessary to raise the numbers in the top level by making advanced level courses available to the majority and provide the lower achievers with lots of support. Secondly provision must be made initially for in-class training for teachers doing mixed-ability. Finally the parents must be kept well informed and assured that the school will revert back to the old plan if it does not work.

Boaler, Wiliam and Brown (2000) report on research that was longitudinal over four years and was carried out in six English schools. It was not designed to study ability grouping but to a certain extent that is part of what emerged. The way students perceived their mathematics classroom learning environment was very evident. Following are three of the interim observations. The first observation was that approximately one third of the students taught in the highest ability groups were disadvantaged by their placement in these groups because of high expectations, fast-paced lessons and pressure to succeed. Secondly, students from a range of groups were severely disaffected by the limits placed upon their attainment. Students reported that they gave up on mathematics when they discovered their teachers had been preparing them for examinations that gave access to only the lowest grades. Finally social class had influenced setting decisions, resulting in disproportionate numbers of working class students being allocated to low sets. (Boaler, Wiliam and Brown, 2000) Indeed, the preliminary results of this study were that out of 48 students, 40 wanted either to change the group they were in or to go back to mixed-ability classes. The students reported that the net result of streaming for them was that the way teaching was carried out under a streaming regime adversely affected "both their attitude to mathematics and their ability to learn mathematics." (p. 636)

Rousseau and Tate (2003) reflect upon what may constitute equity in school mathematics classes. They report conversations with teachers who were asked what equity means in the teaching of mathematics. It was discovered that teachers mostly have a restricted view of what equality is. They believed that equality in mathematics teaching meant that they treated all students the same. Rousseau and Tate argue that the teacher looking for equity in their profession should be aiming at equity of outcome rather than equity of process.

A comprehensive study by Wiliam and Bartholomew (2004) followed the academic results of students from seven schools in England over two stages as they worked towards the GCSE examinations. Not only did they find no significant value added to academic results from streaming the classes, but they discovered other effects of the streaming process as they worked on their research. They saw that ability grouping, either within classes or between classes, was done on assumptions about ability, achievement or even motivation. The schools were not able to give a clear idea of how the split was done or what criteria were used. This research took in survey data, interview data and observational data.

Boaler, Wiliam and Brown (2000) had previously observed that teachers tended to change their style of teaching when working with streamed classes as opposed to mixed-ability classes. Wiliam and Bartholomew (2004) observed the same thing, noticing that teachers would often overestimate the capability of students in the upper-stream, giving them work that was sometimes beyond them. At the same time the same teacher would often underestimate the ability and capabilities of the lower-stream students. They also found that in one school, though the school may have reported that the separation into streams was done on the basis of 'attainment', the lower class was often referred to as the 'behaviour class'. Even when the majority of the 'behaviour' students had been excluded from the school, the class kept the same label.

Wiliam and Bartholomew (2004) conclude: "It appears that the most pernicious effects of setting may not be necessary consequences of grouping students by ability, but appear when teachers use traditional, teacher-directed whole-class teaching." (p. 289) Research can therefore be said to have shown that the teacher effect on classroom learning environment is of paramount importance and can be responsible for changing grades, perceived environments and even attitudes.

By reviewing the literature it becomes evident that concerns that were present, researched and reported on in the 1970's and the 1990's with regard to streaming, are the same issues that are reported on in the 21st century. A comparison of comments from 1977, 1996 and 2000 can be seen in Table 2.2. A similarity can be noticed in that in all cases a slight increase in academic results for the upper-stream is reported after streaming while for the lower-stream there appears to be a slight decrease.

Table 2.2
Comparison of Comments on Academic Streaming from 1977 to 2000

1977	1990	2000
"There is a slight trend towards improving the achievement of high-ability groups, but this is offset by the substantial losses of the 'average' and 'low' groups." Persell (1977, p. 39)	"Researchers who have compared gains made by students in different tracks have generally concluded that controlling for ability level, socio-economic status, and other control variables, being in the top track accelerates achievement and being in the low track significantly reduces achievement." Slavin (1996, p. 132)	"A slight increase in academic achievement for higher stream students, but significant decreases in performance for lower' stream students." Boaler, Wiliam and Brown, (2000, p. 644)

Despite the quantity of literature presented in this section that opposes ability grouping on the basis that there is little positive effect for the upper-streams while there is a cost to pay with the lower-streams, there is a nucleus of researchers who believe that these studies are flawed for different reasons. Bode (as cited in Tiesco, 2003) believes that the disagreements in the area of ability grouping have been over equity or excellence. She believes that the studies that have commented on the equity issue have been "largely qualitative and anecdotal in nature". (p. 34)

Tiesco (2003) goes on to report that Slavin's studies have left out the gifted classes and the special needs classes when doing his analysis because they have curricular adjustments. This is ignoring the possibly large improvements to gifted student scores after streaming. Another problem with previous research on ability grouping that Tiesco points out is that most studies have chosen schools that use some form of standardised test to separate the classes into ability groups whereas most schools today use demonstrated performance as a means of separating students into ability groups. This is one of the problems in referring to studies that are quite old. Tiesco (2004) believes that it only with curricular adjustment that the real benefits of ability grouping for teachers and students begin to emerge.

2.5 The Organisational Implications of Streaming

Linchevski and Kutscher (1998) cite several pieces of research which indicate that given an innovative setting it is possible to succeed with a mixed-ability group. Teachers can teach mixed-ability classes successfully and be satisfied with what they are doing provided they are supported in all ways – with resources, in-service courses and discipline. (p. 535)

Mallery and Mallery (1999) refer to research that points out that perhaps streaming would work if lower-streams were given the same amount of funding and some very good teachers. Of course it will not work if lower-streams are given second rate teachers and are rejected financially.

Gamoran and Weinstein (1995) go along with the idea of improving lower-stream classes rather than radically eliminating streaming in schools. They said that moving towards a mixed-ability class in mathematics does not guarantee equality of achievement or of opportunity. Just because students may be exposed to the same content in mixed-ability classes does not mean there will be equal performance. According to Gamoran and Weinstein, if students are divided by ability and then given excellent lessons from motivated and well organised teachers, there is no reason why they should not succeed. The curriculum would have to be organised so that the lower-stream has a natural progression to worthwhile career options.

Wiliam and Bartholomew (2004) in a study of streaming using seven schools in England (referred to in section 2.4) discovered that from an organisational point of view, how streamed classes are staffed is very important in terms of how it effects classroom learning environments. They found that teachers in lower-stream mathematics classes were usually the least qualified in teaching mathematics, they expected little of their students, the work given was not up to standard, they ignored students' requests for more challenging work and they had a very narrow range of teaching techniques. On the other hand the upper-streams were found to have the most qualified teachers whose expectations were often too high, leaving students behind. It seemed that teachers of streamed classes saw their students as being of common ability whereas the same teachers, when working with mixed-ability classes tended to teach differently. They used a wider range of teaching methods and catered better for individual differences.

Ireson, Hallam and Hurley (2005) conducted a study of some 6000 Year 9 students and followed their progress through to GCSE examinations. They found that results were no better for those of similar ability whether they were in higher streams or not. The implication for organisation is that setting up what a school thinks is homogeneous groupings of students is found to become not homogeneous over the years as abilities and motivations of the students change and yet mobility between classes becomes restricted. The end result is classes that exhibit a wide range of attainments. It could be said that the purpose of streaming in the first place is defeated.

2.6 The Sociological Roots and Effects of Streaming

Part of the classroom learning environment data collection to be undertaken in this study includes sociological aspects of a student's perceptions of their learning environments. For example, the students will be surveyed to find out about how the members of their class cooperate with each other or how cohesive they are or whether the students consider they are being treated equally in the classroom. Indeed, many of the arguments one will read against streaming as a practice are arguments of social justice. This section contains sources that refer to the social aspects of streaming.

Apart from the obvious arguments against streaming based on the fact that there is no apparent academic advantage to the students by doing so, the overwhelming discussion over the last four decades has revolved around the sociological implications of streaming. In fact Slavin (1996) quotes many researchers of that era who believe that tracking is a principal source of social inequality and that it causes or greatly magnifies differences along lines of class and ethnicity (eg., Braddock, as cited in Slavin 1996; Jones, as cited in Slavin, 1996; Schafer & Olexa, as cited in Slavin, 1996; Vanfossen, Jones & Spade, as cited in Slavin, 1996).

Gillborn (2001), works in the field of educational policy research in England and has a specific interest in educational inequality. He wrote:

> It is always possible to find a plausible reason why a Black child should be excluded; why an individual should be placed in a lower ranked teaching group; or why a bilingual pupil cannot receive the attention they are due because of the pragmatic necessity in a situation where there are simply insufficient resources for all. (p. 105)

In his study, Gillborn (2001) found that in mathematics education in England, as students are prepared for the GCSE, they are placed into one of three tiers where only the top tier can achieve an 'A' grade and where the highest a bottom tier student can achieve is a 'D' grade. The Black pupils and the lower socio-economic White students were found by Gillborn to be over-represented in the bottom tier. He comments that neither side of the 'educational equality' debate in England has a grasp of the issues that marginalise students in schools. Selection according to behaviour or perceived ability will continue to be practised despite the disadvantage caused to children of working class or minority ethnic backgrounds.

In a later paper, Gillborn (2005) confirms the fact that while separation by 'setting' within schools continues to be supported by the British government, there are an increasing number of separate schools being established on the basis of 'aptitude' or 'ability'. (Edwards and Tomlinson as cited in Gillborn, 2005) As expected, Blacks and minority groups are under-represented in these schools. In fact, White teachers have consistently been found in studies to place a disproportionate number of Black students in lower-streams when asked to judge their potential, their attitude or their motivation. (Sukhnandan & Lee, cited in Gillborn, 2005). As Gillborn (2005) points out, a combination of these circumstances has the following results:

> These decisions frequently have a cumulative effect whereby the initial decision compounds inequity upon inequity until success can become literally impossible. For example where students are placed in low ranked teaching groups they frequently cover a restricted curriculum; their teachers have systematically lower expectations of them; and in many high-stakes tests in England they are entered for low 'tiered' examinations where only a limited number of grades are available. (p. 496)

Given that there appears to be an over-representation of ethnic or coloured students in lower-streams and also given that there is a question surrounding the accuracy and finality of any test instrument that may be used to allocate students into streams without compensating for second language difficulties or other social limitations, the physical splitting of students into streams has to be questioned on a sociological basis. This may not be an issue for the very advanced mathematics students or for those who are obviously struggling with the very basics, but for the vast majority of those students who are considered or measured to be 'average', the stream they end up in may have a sociological basis and will almost certainly have a sociological implication.

Oakes (1992) reports on the over-representation of students from low income, African-American and Latino families in lower-stream groups. She reinforces the fact that:

> New research investigating track-related student outcomes and reanalysis of earlier studies, supports the increasingly clear and consistent (if not yet universally accepted) conclusion that this common way of organising students for instruction is, in most instances, neither equitable nor effective. (p. 12)

It is clearly not politically or socially correct in today's climate to divide classes on the basis of race, religion or class, and therefore the sociological question that must be asked is what makes it correct to divide a class for ability. Skovsmose & Valero (as cited in Atweh, Forgasz & Nebres, 2001) said:

> It is broadly assumed that it is not possible to justify difference in 'treatment' with reference to race, gender, religion, class, or any other similar category. Where did the idea that 'ability' might be an exception emerge from? . . . We believe that if an educational system does set up examinations with the possibility of failure, and if public stratification takes the form of streaming, then the links between mathematics education and democracy are broken. (p. 51)

There is much in the literature about the sociological effects of streaming. Marsh and Raywid (1994) say: "For all but the youngsters in the highest track, the practice of tracking renders schools less interesting, less productive and less rewarding." (p. 318)

Research along these lines was carried out by Oakes and Wells (1998) who studied schools that had decided to eliminate streaming, but only to the extent that would enable all students to get access to similar curriculum levels without any one group being exposed to classrooms that were inferior in resources, teacher, expectations, curriculum or environment. From their investigations in ten different schools that tried many diverse methods to bring the learning levels of lower-streams up to an equitable level, they discovered there was very limited success. The reason for this they found to be the many obstacles that society presented for them. These challenges were sometimes cultural and sometimes political. They found deeply ingrained belief structures surrounding the ideas "about intelligence, racial differences, social stratification, and privilege." (p. 40)

One very interesting result from a study conducted by Kemp and Watkins (1996) on the effects of academic streaming on self-esteem in students from Hong Kong concluded quite the opposite to other studies. Their conclusion was that high-ability children tend to have their self-esteem damaged when put into upper-streams while lower ability children tend to have their self-esteem boosted by being in lower ability streams. Their explanation for this phenomena was that:

> In a high-ability class, pupils may compare themselves primarily with other members of that class and thus view their own academic competence less

> highly than they would if they were in a class with students of varying ability levels. The opposite effect can occur for a low-ability child in a class with other low-ability children. Although the impact is likely to be strongest for academic self-esteem, there may be residual effects on other components of the self as well as on general self-esteem. (p. 652)

In the text of a debate reported by Wilson and Davis (2005), there is direct evidence of the many diverse opinions that proliferate on streaming. The problem is that most of the arguments on both sides can be supported with logic or research. Following are some of the case studies:

(a) A gifted ex-high school student who is against streaming because it took him away from other students he wanted to get to know. (Wilson & Davis, 2005)
(b) A teacher of 14 years who believes in differentiating the curriculum for her mixed-ability class. She believes that: "Students, when they are together in a mixed-ability group, will develop more tolerance of one another and possibly a new attitude towards learning." (Wilson & Davis, 2005, p. 46)
(c) A teacher at a highly academic school who supports the right of students to work to their ability level. She supports tracking but not across the board. They may be in one set for mathematics and another one for English. "No one is locked into a level and students are constantly evaluated and moved into levels that will meet their need to excel." (Wilson & Davis, 2005, p. 46)
(d) "In non-ability grouped classes, the same students always seem to be answering the questions and getting the A's. In ability grouped classes, students have more opportunities to answer questions in discussion sessions, and questions that others won't think are weak, and find validation as class leaders." (Wilson & Davis, 2005, p. 47).

Fielder, Lange and Winebrenner (2002) are particularly concerned about the fate of the gifted in an environment that eliminates streaming in the form of gifted programs. They reported that: 'The antitracking movement of the 1990s led to the anti-ability grouping movement that locked some gifted students out of the challenging programs they needed.' (p. 108) Fielder et al. ask the question whether, in the name of equality we can allow the underachievement of the gifted: "Can it be that our school systems are actually giving tacit approval to create underachievement in one ability group so that the needs of the other ability groups can be served? This, indeed is egalitarianism at its worst." (p. 109)

Fielder et al. (2002) go on to say that it could be more elitist to put a couple of gifted children in a main stream where their intelligence is so obvious to the whole class. This could, in itself tend to create snobbery: "Unless gifted students are placed in situations where they can be challenged by intellectual peers, the possibilities that they will develop an elitist attitude might well be expected to increase." (p. 110)

Historically the British system of education, which has tended to permeate many education systems in the world, was to group students by perceived ability on the basis that "students have relatively fixed levels of ability and need to be taught accordingly." (Boaler, Wiliam & Brown, 2000, p. 632)

In the same piece of research, Boaler et al. (2000) report that in the 1960's all but 4 percent of schools streamed their classes for ability. The same study "revealed the overrepresentation of working class students in low streams and the tendency of schools to allocate teachers with less experience and fewer qualifications to such groups." (p. 634)

They go on to say that the 1970's and 1980's saw: "A growing support for mixed-ability teaching." (p. 634) It seems that there was a short-lived general push for 'educational equality' which, by the 1990's was starting to be challenged by another push for academic success, particularly for the academically gifted. In fact today, in England many schools that had opted for mixed-ability classes in the 1980's, have returned to ability grouping.

Ascher (1992) reports a strong feeling about the social disadvantages of streaming:

> Although tracking remains controversial among both educators and parents, there has been a recent policy consensus that the negative effects of tracking on lower track students are so severe that schools should move towards detracking. Successful detracking rests on an 'inclusive' school culture. It

> also depends on a curriculum that is interactive and problem-solving, as well as on assessment processes that support such a curriculum. Schools embarked on detracking must draw in parents, students, and teachers, not only to ensure that these groups buy into the change, but to teach them new egalitarian ways of thinking, and to use them to help reconsider existing school routines. (p. 5)

Why would schools, or education systems continue with streaming when its negative effects are clearly demonstrated in research (Gamoran, 1992; Boaler, Wiliam & Brown, 2000)? Zevenbergen (2005) asks this question and then goes on to say that in some cases (eg. UK) streaming is mandated. It is interesting that while the British government claims to want to make policy based on research evidence, they are still promoting streaming or setting as the preferred protocol. Gillborn (2005) condemns streaming as a method of separating students and even calls the practice ‘racist’. His research and writing is prolific and directed, yet the British government choose not to be informed by his research.

Zevenbergen (2005) goes on to say that the practice of streaming can be self-perpetuating:

> The practice of ability grouping helps to reproduce the status quo, and can be detrimental to the goals of social justice. I propose that when the practice is enacted in mathematics classrooms it can create a learning environment that becomes internalised as a mathematical *habitus.* Where experiences are positive, there is greater potential for students to identify with the subject. (p. 608)

On the other side Zevenbergen (2005) suggests that a negative experience with mathematics classes could lead to a *habitus* that prevents the students from wanting to continue with mathematics as a subject.

Slavin (1995) agrees that because most research has indicated a zero net gain in scores for students in streamed classes, there is therefore no reason to stream given the social inequities that streaming infers.

Also from a sociological point of view, Ansalone (2002) is opposed to streaming. He says:

> As an educational delivery system, tracking does not promote cognitive achievement, helps to stimulate a negative self-concept in some students, and fosters resentment and misconduct. In so doing, it may be an important contributing factor in the problem of attrition. (p. 83)

He sees as an additional disadvantage the fact that teachers may create imagined positive or negative self-concept among students according to which stream they are in. He believes that "assignment to a lower track may contribute to a feeling of resentment and hostility, which can eventually lead to student withdrawal." (p. 85)

It is also a social reality that friendships formed at school and in classes have a large impact on a student's school performance and success after completion of school. Heck, Price and Thomas (2004), when commenting on courses students take, say that: "The teaching that goes on within them, and the peer friendships formed are factors that affect students' educational experiences and post-high school aspirations." (p. 321)

What impact does society have on student perspectives? Metz (1990) believes that a student's perspective on life will be shaped by the community and its subgroups, the school community itself and the teaching staff of the school.

Van Houtte (2004) compares the social impact on groups of students as well as on individual students. He says that achievement of students at school is affected by how they are treated as individuals within a classroom, as well as how they are treated within a group that they identify with, such as a particular stream within a subject.

Herb (1997) points out that tracking and ability-grouping are quite different. Tracking puts the student into a category permanently whereas ability-grouping can be done within classes and tends to be more flexible. Unfortunately it is very difficult to prevent one from leading on to the other. "Society still carries the baggage of classism and racism and that baggage will flow into the school system." (p. 12)

Given that the student sample for this study is taken from Seventh-day Adventist schools it is interesting to note that the 'Christian' philosophy adds another aspect to the sociological debate on streaming. Simpson (1985) said: "To condemn all forms of ability grouping and tracking would be naïve. Yet to abuse the practice is immoral. Finding the middle ground for Seventh-day Adventist education is not unlike walking through the minefield of public school curriculum decisions." (p. 41) The abuse of tracking she is referring to is a reflection of the fact that when students are placed in a track purely on the basis of test results, it may not be ability causing those results but rather discipline, maturation, support or motivation.

The issue of streaming has even been discussed at the Southern Christian Leadership Conference where part of their campaign was to help parents and communities recognise when children were being tracked and also to promulgate the philosophy "that says all children can learn at high levels." (Herb, 1997, p. 12)

In the same paper Rose Sanders of the Coalition of Alabamians Reforming Education in Selma, stated: "How you implement this philosophy is through a unified required core curriculum that is enriched in mathematics and science. Unified is important because it means students can't be taught separately but together." (p. 12)

Again in the same paper Emma Owens of Clemson University is quoted as saying that teachers must be trained in differentiated curriculum specialising in mathematics and science and become comfortable with students of differing ability. She says: "The workplace is tough enough for teachers, who are being asked to teach kids of all levels at the same time. It takes a special teacher to teach both groups." (p. 12)
A common question that arises from proponents of streaming is the comparison to the sporting arena. From a sociological perspective, why is it that the community is quite ready to accept the achievements and thus the separation of the 'sporting elite', but not so ready to accept the 'academic elite'? Even the naming of a sports team

such as the 'First Eleven' in cricket could be seen as pure elitism but is accepted by society.

Tammi (as cited in Fiedler et al, 2002) answered this question by saying that academic success is a general expectation for all members of society whereas sporting success may not be the desire or the need of all:

> Not all students have the ability or desire to participate on a varsity sports team, yet I have never heard any school official argue that singling out talented athletes for team membership to the exclusion of others is elitist. In fact, school districts and local community agencies go to great lengths applauding these athletes' efforts and supporting them in development. (p. 44)

According to Arbor (2004), eliminating streaming led to an improved school climate, greatly improved test results and better race relations within the school.

Ansalone and Biafora (2004) point out that when a school uses streaming and has done for many years, it forms part of the culture of the school and where there becomes a desire to revert to mixed-ability classes it needs to be done to a plan. This plan should involve a slower evolving process given that streaming is so embedded in the culture of the school. A timeline should be produced that has target dates for different levels of achievement in the undoing of streaming within the school.

2.7 Intermediate Positions on Streaming

As mentioned earlier, there are many positions that are not extreme in either direction. Following are some examples.

Ireson and Hallam (1999) comment on the large amount of research and the widely differing results that largely fail to come to any conclusion – or rather tend to come to many different conclusions. They do give some alternatives to streaming. Streaming could be maintained but actively work to reduce its negative effects. Another possibility would be to place less emphasis on ability and more on effort.

Methods could also be improved for teaching mixed-ability classes.

In a study conducted by Ireson, Hallam and Plewis (2001) which looked at the relationship between streaming and students' self-concepts, it was found that: "Moderate levels of regrouping may be beneficial for pupils' self-esteem, whereas higher levels of setting may be less advantageous." (p. 322). It was also reported in this study that while previous research had reported a negative impact of ability grouping on the lower groups, structured ability grouping may also have a negative effect on the upper-streams.

Loveless (1999) provides a very balanced look at streaming by ability. He recommends not moving too quickly with eliminating streaming because research has not far enough developed time-wise to verify any claims of benefits from eliminating streaming. He admits that moving towards mixed-ability classes seems to be showing that the gap between student performances is narrowing, but it seems to be at the expense of the higher achievers.

Kettler and Curliss (2003) suggest that while gifted and talented mathematics students are known to benefit from acceleration or advanced curricula, they can also excel in mixed-ability classes if the method of tiered objectives is used in that classroom. This means that "teachers can teach one concept to the whole class, while students develop knowledge and skills related to that concept at different levels of complexity." (p. 55)

MacIntyre and Ireson (2002) also give a middle perspective on the issue of ability grouping by suggesting that in-class grouping may have the effect of: "Raising attainment that avoids the social and emotional disadvantages of streaming." (p. 249)

Given that research has shown consistently over a long period of time that streaming does not really have a net effect upon achievement in mathematics and it seems to have an adverse sociological effect, it seems logical that alternatives need to be studied. This has been done by researchers over the years who have come to the conclusion that streaming cannot be eliminated without considerable planning and an implementation phase. (eg. Slavin, 1996; Wheelock, 1992; Arbor, 2004). Indeed some have suggested that there are alternatives for improvement within the existing structures of streaming (eg. Gammoran & Weinstein, 1995; Ireson & Hallam, 1999).

Most would agree that if alternative plans are not put into place while re-creating heterogeneous classes, those disadvantaged by streaming may well be more disadvantaged in a mixed-ability class. Wheelock (1992) suggested several frameworks that could help the process. All students could be exposed to 'thinking' activities and group work instead of just giving them to the advanced students. Advanced teaching techniques and cooperative learning that caters for individuals could be used more for all groups of students. She also suggests that school-based resources could be distributed more to those who are struggling.

2.8 The Study of Student Attitudes to Mathematics

The purpose of the attitude dimension in this study is to use it as a means of comparative analysis to the core variables of the study which are the classroom environment scales. For this reason a short literature review on previous work done on student attitude to mathematics classes is given.

Tourangeau and Rasinski (1988) come to the conclusion that attitudes are structures that are resident in long-term memory and are dependent on this memory when they are expressed in surveys or in any other way. Respondents to attitude surveys first read the question and decide what attitude it is about. They then go to their long term memory to retrieve beliefs and feelings that may be relevant to that attitude. The next step is to apply those feelings and beliefs to the question at hand and make an appropriate judgement and then finally make their response. These steps are important to remember while reading this study because while the classroom learning environment inventory is collecting data on how students see the present climate of their classroom and how they would prefer it to be, the responses to the attitude survey are affected by the files the student has stored in their long term memory and may not be a property of the present classroom situation. Responses students make to specific questions on attitude surveys can also be dependent on previous questions. Previous questions can initiate some beliefs in the respondent making later questions either easier to answer or even redundant.

Student attitudes in mathematics may be dependent on a whole range of factors. Some attitudes stem from a 'love/hate' relationship with mathematics in the community in general. What their peers, parents and family say about mathematics may have an influence on their attitude. What has happened in their previous classrooms may also have had an impact on their attitude. The current mathematics classroom a student is a member of will also be having an effect on their attitude to the subject. Much of the research in learning environments has shown that attitude to the academic subject and learning environments are connected. For example in a thesis by Rickards (1998), a positive relationship between student attitudes and student-teacher interpersonal behaviour as a measure of perceived learning environment is reported.

Boaler, Wiliam and Zevenbergen (2000) discuss the idea of success in mathematics classes as more an issue of the student having a feeling of 'belonging' rather than an issue of 'ability'. Students may want to succeed at mathematics as a means to an end but they may have no desire to become 'successful mathematicians'. Boaler et al. (2000) also cast light on the importance of a nurturing learning environment in the mathematics classroom and how this learning environment can affect student attitude. The comment is made that the mathematics classroom becomes a "community of practice" where "learning is a social activity which encompasses the relations between people and knowing." (p. 4).

A group of trainee primary school teachers was interviewed on their feeling about mathematics. Cornell (1999) reports on the findings by saying that: "The students were nearly evenly divided between those who liked and those who disliked math. In nearly all the cases, a correlation existed between attitude and success." (p. 225)
This study by Cornell (1999) supports the theory that there are few neutral feelings about mathematics at school level. The study goes on to discuss some of the reasons for the negative attitudes towards mathematics. Teachers were said to be uncaring about students' lack of ability to do what was to them simple problems. Sometimes students believed they did not get the full explanation for doing a problem, leaving them frustrated. Students felt frustration at not being able to keep up with the rest of the class. They felt they were expected to rote learn but not taught for understanding. Most of the students interviewed by Cornell were very negative about tests and

examinations and how they contributed to increasing stress, decreasing self-esteem and generally disliking the subject.

Carter & Norwood (1997) studied the relationship between teachers' attitudes to mathematics and their students' attitudes to mathematics. They found that there was an obvious link between the two facilitated by the teaching and learning that went on in the classrooms. Given this link it seems that student attitudes to mathematics can improve if teacher attitudes improve. If teachers were able to move from a traditional approach to teaching mathematics which is better suited to the more able students, to a new and more constructivist approach to teaching, then students' attitudes across the ability range may improve. This philosophical move is an extremely difficult one for a teacher who has been teaching the same material in the same way for a long period of time.

According to Burns (1998), parents can also have a significant impact on a student's attitude to mathematics. He says that seemingly innocent words parents use sometimes at home such as 'I hate maths' or 'I was never any good at maths' can contribute to the students negative feelings about maths. They may only hear complaints about bank accounts not adding up or shop-keepers giving the wrong change. Rather they need to hear positive things or have their parent pick out everyday things that may have a mathematical application and talk to the child about it.

Utsumi & Mendes (2000) make the point that negative feelings towards mathematics tend to increase as the student progresses through school. They suggest that these feelings are probably due to the fact that their understanding of the concepts and content taught is decreasing as they progress in school. Turner et al (1998) add to this point by reporting that students commonly feel negatively towards mathematics classes when they become confused with how complicated the subject can be and the accuracy required.

Another factor said to affect the attitude of students towards mathematics is their own fear of the subject. Gilroy (2002) says that: "One of the problems is the fear associated with maths. Society puts such an emphasis on mathematics as an indicator of intelligence that if students are not good at it, they feel a bigger sense of failure. They believe that they are not smart." (p. 40)

This study will seek to establish what the link is between student attitude to mathematics classes and the classroom learning environments in streamed mathematics classes. Sukhnandan and Lee (as cited by Venkatakrishnan & Wiliam, 2003) report a connection between streaming and student attitude, particularly in lower-stream students:

> Research suggests that streaming and setting, compared with mixed-ability teaching, have a detrimental effect on the attitudes and self-esteem of average and low-ability students. Research suggests that poor attitudes and low self-esteem can lead to a decrease in achievement which can create a vicious circle from which it is difficult for low-ability students to escape. (p. 195)

The instrument used in this study to survey students' attitudes to mathematics class is based on the Test of Science Related Attitudes (TOSRA) but modified to suit mathematics and highly condensed. Of the seven scales of 10 items each proposed by Fraser (1978), only the scale for 'Enjoyment of Science (mathematics) Lessons' was used.

2.9 Classroom Learning Environment Research

The concept of 'learning environment' has an array of meanings, but if applied to the classroom can be broken down into two elements. The first is the physical learning environment in terms of classroom furniture, displays, lighting, air quality and technology. The second is the psycho-social or human element to the learning environment which includes the behaviours and interactions of the students and the teacher within that classroom or school. The concept of a 'learning environment' will be the combination of these two aspects. A positive learning environment will be one that combines the positive psychosocial interactions within the classroom with a pleasingly aesthetic physical environment to provide a place where students can maximise their opportunity to learn. There have been studies that illustrate the connection between a positive learning environment and meaningful learning. (eg. Brophy & Putmnam as cited in Duke, 1979) There are also studies that examine the association between physical learning environments and psycho-social learning environments. For example, Zandvliet (1999) made this connection when he studied networked computerised classrooms in terms of their physical or ergonomic learning environment along with the psycho-social learning environment.

Studies conducted over the last three decades have shown the association between student learning and the way students perceive their classroom learning environment (Fraser, 1994). This fact is what makes the study of learning environments vital and is a reason why learning environment research has become a specialised area which has contributed to improvements in classroom learning environments. (Anderson, 1982; Fraser, 1991; Fraser, 1998a; Fraser & Walberg, 1981).

Educational learning environment research has grown out of studies by Rudolf Moos (Moos, 1974) and Herbert Walberg (Anderson & Walberg, 1974). Before this Leary (as cited in Alden, Wiggins & Pincus, 1990) developed the concept of interpersonal theory (O'Connor & Dyce, 1997) and introduced the idea of measuring personality and group interactions using a circumplex scale. Leary in 1957, developed dimensions of interaction, or reflexes of interaction as a precursor to the Q*uestionnaire on Teacher Interaction (QTI)* which is based on the circumplex model. It seeks to measure student and teacher interaction. (eg. Wubbels & Levy, 1993; Fisher & Rickards, 1998; Rickards, 1998).

A landmark study by Welch and Walberg (1972) studied the impact of a new program for teaching Physics. This program was called the *Project Harvard Physics* and was undertaken to address the decreasing numbers of 'middle intelligence' students selecting Physics as a subject in senior school. Among the several tests and inventories that made up this study, learning environments were measured using the *Classroom Learning Environment Inventory (CLEI).* Welch and Walberg (1972) reported that the results were significant to the extent that the learning environments under the new program were perceived by the students to be more diverse and less difficult than the traditional program.

The majority of the early research into classroom learning environments was for the purpose of establishing relationships between the nature of the classroom environment and the student outcomes measured, mostly in terms of achievement (Wong, Young & Fraser, 1997). It seems that in the past: "This research has revealed that students' classroom environment perceptions account for appreciable amounts of the variance in student learning outcomes, often beyond that attributable to student background characteristics." (p. 450)

Some of the implications highlighted by Wong, Young and Fraser (1997) that have been discovered historically with classroom environment measurement are:

(a) The size of the class can have an impact on the nature of the classroom environment. (Anderson & Walberg, 1972)
(b) There are differences between teachers and students in how they see their classroom environment. (Fraser, 1984)
(c) Classroom environments have been found to differ between Catholic and Government schools. (Dorman, Fraser & McRobbie, 1994)
(d) The achievements of a class can be improved by altering a classroom environment to be more in keeping with student preferences. (Wong, Young & Fraser, 1997)

Some useful outcomes of classroom learning environment research have been:

(a) Teachers have shown an interest in classroom learning environment research to the extent that they have used it to try and improve their own professional practice. They base it on five steps: assessment of *actual* and *preferred* environment; feedback; reflection and discussion, intervention; and reassessment. (Fraser & Fisher, 1986)
(b) Ideas gleaned from classroom learning environment research have been incorporated into teacher assessment. (Heroman, Loup, Chauvin, & Evans, 1991)
(c) Ideas gleaned from classroom learning environment research have been incorporated into teacher education. (Fisher & Fraser, 1991)
(d) The combination of qualitative with quantitative methods in learning environment research has been adopted. (Fraser & Tobin, 1991)

(e) Ideas gleaned from classroom learning environment research have been incorporated into school psychology. (Burden & Fraser, 1993)

Given the importance of the classroom learning environment to student learning, it is vital to consider what makes a 'good' learning environment. The challenge for teachers is that a good learning environment is not easy to develop and takes time and skill. Sometimes it may be perceived as easier to just keep doing what has been done for years.

Rover (2005) supports this: "Creating an environment in which all students can reach their full potential is one of those goals that is easier said than done. Sometimes even the best of intentions miss the mark." (p. 349)

Saunders and Kardia (as cited in Rover, 2005) attempt to define a positive classroom learning environment which they call an 'inclusive classroom'.

> Inclusive classrooms are classrooms in which instructors and students work together to create and sustain an environment in which everyone feels safe, supported, and encouraged to express her or his views and concerns. In these classrooms, the content is explicitly viewed from the multiple perspectives and varied experiences of a range of groups. (p. 1)

As the importance of learning environment research has been realised, different types of questionnaires to measure classroom environments have been developed. Chua, Wong & Chen (as cited in Fisher & Yang, 2000) report that learning environment measurement over the last couple of decades has been for four main purposes. Firstly it has been to establish a connection between the classroom climate and the outcomes of the students. Secondly classroom environment dimensions have been used as criterion variables to evaluate curriculum, courses and programmes. Thirdly it has been used to discover whether students achieve better in their *preferred* classroom environment. Finally it has been useful to implement different techniques highlighted in research to improve classroom learning environments.

Any history of classroom environment inventory research will give reference to two early instruments: the *Learning Environment Inventory (LEI)* (Walberg & Anderson, 1968) and the *Classroom Environment Scale (CES)* (Trickett & Moos, 1973). Later instruments were based on these two surveys. *For example My Class Inventory (MCI)* (Fisher & Fraser, 1981) was derived from the *LEI*. Some instruments were developed that were specific to certain subjects such as Science. *The Science Laboratory Environment Inventory (SLEI)* (Fraser, Giddings & McRobbie, 1995)

The instrument used for this research is the *What is Happening in this Class? (WIHIC)* (Fraser, Fisher & McRobbie, 1996). This instrument: "Was developed for use in any classroom environment context. It combined the best features of the existing instruments and included new dimensions of contemporary relevance." (Chua, Wong & Chen, 2000, p. 367). This instrument was originally a 90 item survey with 9 scales but the version used in this study saw the original edition reduced to 56 items with 7 scales. Another reason for using the *WIHIC* in this study was that it has available an *actual* form and a *preferred* form. This method of allowing the students to give accurate perceptions of their current learning environment but also their ideal learning environment, allows the researcher to measure the discrepancy between the two. Fraser and Walberg (1991) reported that students perform better and are more likely to achieve their academic goals when learning in an environment that is more closely aligned to their preferred classroom learning environment. This information makes it worthwhile and practical to have students complete both forms of the survey.

A summary of the nine major instruments used in the assessment of the classroom environment is given by Fraser (1998) and is best illustrated in a table (Table 2.3) similar to the one produced by Fraser (1998a) which categorised inventories by target group to be surveyed and by the scales first identified by Moos (1974).

Studies have been undertaken that use a combination of one or more of these instruments. For example, Henderson, Fisher and Fraser (2000) report on a study that used both the *Questionnaire on Teacher Interaction (QTI)* and the *SLEI (Science Laboratory Environment Inventory)* in one survey to: "Investigate associations between students' perceptions of their biology teachers' interpersonal behaviour and their laboratory learning environments and their attitudinal, achievement and performance outcomes." (p. 26) The outcomes of this study showed that desired classroom learning environments were more positive than the students' current perceptions of their learning environments and that these discrepancies were largely due to the same scales that other studies had found were most significant.

As research into learning environments develops further, new learning environment instruments are being developed and trialled and existing instruments are being modified to cater for new areas of research. A recent example is a comparative student version of the *Constructivist Learning Environment Survey* (CLES-CS) which has been developed by Nix, Fraser and Ledbetter (2005) to: "Evaluate the impact of an innovative teacher development in school classrooms." (p. 109).

A new scale for measuring students' attitudes to learning mathematics with technology (*MTAS*) has been developed by Barkatsas (2005) and was presented at the 28th Annual Conference of the Mathematics Education Research Group of Australasia in 2005. This survey is designed to measure the attitudes of middle secondary students using five variables relevant to the learning of mathematics with technology.

As well as new instruments being developed to monitor current situations, current instruments are used to monitor new situations. A recent example of this is reported by Nijhuis, Segers and Gijselaers (2005) who used a combination of the *Random Course Experiences Questionnaire* (Wilson, Lizzio & Ramsden, 1997) and the *Biggs Study Processes Questionaire* (Biggs, 1997) to evaluate the depth of learning being experienced by a changed learning environment.

Given that one school of thought indicates that streaming can, from an early age, condemn a student to a non-academic future (Arbor, 2004), it may be helpful to look at research that zeros in on teachers of elementary schools and their attitudes to streaming. What sort of learning environments are they trying to foster? Elementary teachers are equivalent to Primary teachers in Australia and teach ages 5-12 years approximately.

Table 2.3
A Summary of Learning Environment Inventories

Instrument	Level	Scales Classified According to Moos' Scheme		
		Relationship Dimensions	**Personal Development Dimensions**	**System Dimensions**
Learning Environment Inventory (LEI)	Secondary	Cohesiveness Friction Favouritism Cliqueness Satisfaction Apathy	Speed Difficulty Competitiveness	Diversity Formality Material Goal Direction Disorganisation
Classroom Environment Scale (CES)	Secondary	Involvement Affiliation Teacher Support	Task Orientation Competition	Order Rule Clarity Teacher Control Innovation
Individualised Classroom Environment Questionaire (ICEQ)	Secondary	Personalisation Participation	Independence Investigation	Differentiation
My Class Inventory (MCI)	Primary	Cohesiveness Friction Satisfaction	Difficulty Competitiveness	
College and University Classroom Environment Inventory (CUCEI)	Higher Education	Personalisation Involvement Student Cohesion Satisfaction	Task Orientation	Innovation Individualisation
Questionaire on Teacher Interaction (QTI)	Secondary	Leadership Understanding Helping/Friendly Freedom/ Responsibility Uncertain Dissatisfied Admonishing Strict		
Science Laboratory Environment Inventory (SLEI)	Upper Secondary Higher Education	Student Cohesiveness	Open-endedness Integration	Rule Clarity Material Environment
Constructivist Learning Environment Survey (CLES)	Secondary	Personal Relevance Uncertainty	Critical Voice Shared Control	Student Negotiation
What is Happening in this Classroom? (WIHIC)	Secondary	Student Cohesion Teacher Support Involvement	Investigation Cooperation	Equity Task Orientation

Adapted from Fraser (as cited by Gabel, 1994)

A study by Ansalone and Boafora (2004) asked teachers several questions about streaming and came to the conclusion that in the majority of cases the teachers were still committed to the idea of grouping by ability. They point out that teacher expectations in the classroom have been found to be central to student achievement: "There is ample evidence to support the conclusion that the structure of the classroom could very well limit the academic achievement, and career trajectories of students." (p. 250) (Ansalone, as cited in Ansalone & Boafora, 2004; Hallinan, 1994, as cited in Ansalone & Boafora, 2004). Historically we find that: "Educational psychologists have identified the role of teacher expectations and instructional prejudices to help explain documented educational gaps." (Rosenthal & Jacobson, 1968, p. 18)

In the study reported by Ansalone and Boafora (2004), teachers were asked questions about their own experiences with streaming, about the advantages and disadvantages of streaming, about their attitudes to streaming the gifted, about equal opportunities to learn, and the effect on student self-concept. The results indicated that despite the teachers' own experiences with streaming and despite the amount of research available, teachers were not sufficiently concerned about classroom environments in streamed schools to 'vote' against them. They were most likely influenced by the ease of teaching for themselves in homogeneous groups and the likely risk to student learning if they, as the teacher, had little or no experience with teaching "large classes of diverse learners." (p. 254)

In a thesis by Rawnsley (1997) where he specifically looked at the classroom learning environment of mathematics classrooms, he discovered that: "The association between students' perceptions of their mathematics learning environment and attitudinal outcomes was stronger than the association with cognitive outcomes." (p. 154) He also reported that: "The greatest cognitive gains were found to be associated with teachers who displayed minimal dissatisfied behaviour and who gave their classes minimal responsibility and freedom." (p. 154) This research illustrates the fact that the classroom learning environment in mathematics classes is linked to learning outcomes. Understanding the impact of classroom learning environments on academic performance highlights the need for further study in this area.

English (1998) decided that students themselves would provide the most useful feedback on what sorts of mathematical tasks would most engage students. She says:

> Worthwhile mathematical tasks are generally considered to be those engaging students' intellect, capturing their interest and curiosity, developing their mathematical understanding and reasoning processes and allowing for different solution strategies, solutions, and representational forms. (p. 67)

Anonymous (1998) reports on David Drew of Claremont Graduate School who believes that children who are labelled as being bad at mathematics will end up performing badly. "He treated his students like winners, and they achieved higher scores in maths." (p. 17) He believes that a student's performance is directly related to the expectations placed on them. He referred to a study in which a minority group was given extra special treatment to see how they performed:

> When the African-American students participated in a workshop that introduced high expectations, long study hours, work groups, and extra homework –elements of the Chinese students' success – the study showed that they actually outscored white and Asian counterparts. (p. 17)

The study of constructivist learning environments and the use of the *Constructivist Learning Environment Survey (CLES)* has been an area of research over the last decade that studies critical theory perspectives alongside learning environments. Taylor, Fraser and Fisher (1997) give an account of the studies that proved this instrument to be robust in terms of: "Internal consistency, factorial validity and cross-cultural integrity." (p. 1). Though this study looks at classroom environments for the purpose of comparing lower-stream students' perceptions with those of upper-stream students, there is no doubt that if the objective were to study teacher transformations of a constructivist nature, the *CLES* would be the instrument to use.
Recent developments in the areas of mathematics and science education would look to new ways of helping students to develop at a conceptual level. Instead of scales relevant to the average classroom as used in the *WIHIC* (*student cohesiveness, teacher support, task orientation, involvement, investigation, cooperation and equity*), the *CLES* uses scales that measure epistemological innovation of the teacher

(personal relevance, uncertainty, student negotiation, shared control and critical voice).

Dorman, Adams and Ferguson (2002) studied the relationship between classroom environments and self-handicapping. The results of this study showed that there was a significant relationship between the classroom environment scales on the *WIHIC* and the extent of student handicapping. The scales on the WIHIC did in fact account for a greater proportion of the variance in self-handicapping than did the scales of the *Constructivist Learning Environment Scale* (*CLES*). This indicates that a good conventional classroom is more likely to lead to academic efficacy than a constructivist learning environment. (Ferguson & Dorman, 2001).

2.10 Learning Environments – Differences by Gender and Culture

2.10.1 Differences by Gender

The contrast between the way males and females learn mathematics has been the subject of research for many years (Leedy, LaLonde & Runk, 2003). The perception, supported by research, has been that mathematics is more of a male domain. Research conducted by Leedy, LaLonde and Runk (2003) of students who were particularly talented at mathematics showed that: “Traditional gender-based differences in the beliefs regarding mathematics persist even in these mathematically talented students.” (p. 285) It was a finding from this study that much of the gender differences in approach to mathematics comes from deep set opinions or beliefs held by the students’ parents and teachers. Erickan, McCreith and Lapointe (2005) investigate the same area and come to similar conclusions that the attitude of parents has the greatest impact on the attitude of girls, in particular, to mathematics. They conclude that: “Parents education level, a socioeconomic related variable, was one of the strongest predictors of participation for Canadian female students.” (p. 5)

Previous studies (Martin, 2003) have shown that boys and girls are different with regard to their attitude to classes and their approach to their school related studies. Martin showed that girls are more positive than boys with regard to: “Their belief in the value of school, learning focus, planning, study management and persistence.” (p. 44) At the same time the boys were found to be more willing to sabotage their own opportunities. The qualitative part of the study showed that boys have higher expectations of their learning environments. They want better relationships with their teachers. They want to have strong and fair teachers who value their input and they want their schoolwork to be interesting and relevant.

A study conducted by Tocci and Engelhard (1991) looked at American and Thai students' relationships between attitudes toward mathematics and mathematics achievement. The study controlled achievement and parental support and still found there were significant differences in gender attitudes. Both Thai and American females had a more positive attitude towards mathematics when all other variables were controlled. A study by Goh and Fraser (1998) of teacher interpersonal behaviour, classroom learning environment and student outcomes in primary mathematics classes in Singapore reported that boys showed better levels of achievement than girls but the girls had a more positive view of their learning environment than the boys.

2.10.2 Differences by Language

Schools in Australia are in many cases – particularly in the cities – having to come to terms with an increasingly diverse student population. Teachers have to learn to cope with the integration of students with special needs in many areas. One of the most frustrating areas for teachers and students is coping with the second language students' needs in the classroom. As Buchanan and Helman (1993) point out, in the mathematics class the second language student must: "Learn in a linguistically and culturally unfamiliar environment, constructing understanding without the background knowledge that their classmates employ to make assumptions and process new information." (p. 1) They go on to say that it is necessary for there to be a moving away from traditional teacher approaches and more into the integration of literacy teaching and mathematics teaching side by side.

The types of tasks that may benefit literacy students doing mathematics will also benefit the rest of the class. Buchanan and Helman (1993) set out the steps necessary for this to happen. First mathematical activities have to be chosen that will challenge and interest the student. Just because their language skills are very low does not mean their mathematics skills are underdeveloped. Secondly the classroom activity must then create discussion and investigation. Thirdly computers and other technologies must be used as often as possible to foster investigation. Fourth the teachers must try and find out the level each student is at and create links for that student between what they know and the new work they are doing. Fifth the teacher must also try to use a variety of instructional settings in the classroom. Small group work in particular will expose the literacy student to other students' language as well as the teacher's, which is beneficial to their literacy development.

According to Chamot, Dale, O'Malley and Spanos (1992), while learning conversational English for new students from overseas may only take around two years, learning English sufficient for the study of academic subjects takes more like five to seven years. Chamot et al. (1992) reported on a study that showed how innovative teachers (called *high implementation* teachers) brought about the more successful teaching of an assessed skill than the low implementation teachers. This adds weight to the notion that literacy students need variety and innovation to learn mathematics and value their educational experience in Australia. Chamot et al. (1992) also suggest that the teaching of academic language in ESL classes is another way to help the literacy students in their academic subjects. If this was done with the language of mathematics it may help the perception of international students of their mathematics classes.

There have been studies done to help mathematics teachers to better cope with literacy students in their classrooms. Anonymous (2001) presented some 'Classy Tips' for this purpose. One such tip was to pair literacy students with English speaking students as study partners so they can help each other with language as well as mathematics. Another idea put forward by Carroll (1996) is to ensure that literacy students get enough time to finish set tasks and examinations. Providing equal time for all students is not providing equity.

This study examined the differences in classroom learning environments experienced by different groups within a classroom. One such group is the students who come from overseas and do not have English as their first language. Planas and Gorgorio (2004) report research which shows that in our societies of today students from overseas account for the highest rates of failure at school. This rate becomes even worse when mathematics is considered alone. This is a concern because traditionally it would seem that mathematics has the least use of the English language and so students should perform better in mathematics. According to Planas and Gorgorio (2004), one of the reasons for this discrepancy is that students from any type of minority group: "Experience difficulties when trying to participate in contexts of mathematical practices where they do not feel themselves represented, when others do not recognise them, or when they have to cope with actions and behaviours that are different from those they would expect." (p. 16) Planas and Gorgorio (2004) observed in classrooms that though the teacher may have the very best of intentions and may believe that they run an inclusive classroom, immigrant students' ideas were observed to be less valued than the ideas of the local students by the students and the teacher.

As much as students in schools who do not have English as their first language may feel isolated and frustrated when trying to learn mathematics in an English speaking country, secondary teachers struggle with the practicalities of providing the best environment for these students to learn in. In a study conducted by Reeves (2006), it is reported that: "Although the findings reported here suggest that teachers want to welcome ELLs into the mainstream, the data also reveals a teaching force struggling to make sense of teaching and learning in multilingual school environments." (p. 139)

2.11 Combining Qualitative and Quantitative Research Methods

For many years positivist research methods have taken precedence over any other method of data collection. Quantitative data has been seen as objective and easily analysed. (Erickson, 1998) This has also been the case with learning environment research where perceptions of teachers or learners has been collected from surveys in numerical form ready for statistical analysis. The use of qualitative data in the form of interviews, observations and focus groups has been introduced into learning environment research (Tobin, Kahle & Fraser, 1990) and has proved to be extremely useful in adding understanding to the numerical data obtained as well as opening up new insights into the way the participants in a classroom see their environment and why this is so.

It is evident that using a combination of qualitative and quantitative research methods in educational research has become popular and serves a distinct purpose

(Fraser, 1998). The use of qualitative data can complement and also add to the data gathered by using quantitative methods. In the first case, it may be possible to ask interview type questions that may not be possible to ask in a way that can be quantified. A narrative response may highlight an aspect of the research that could not otherwise be isolated. In the second case the interview can be used to expand on or explain things that are shown as significant using the quantitative research tool. In either case there is a strong argument for using both types of data in humanities type research. (Johnson & Onwuegbuzie, 2004)

It appears to be responsible reporting of research to go beyond the: "sterile dead end of checklists for 'effective' practice and the limited approach of method or technique-led research." (Nixon as cited by Barkatsas, 2005). The researcher can then: 'See individuals as living storied lives on storied landscapes." (Clandinin & Connelly as cited in Barkatsas, 2005).

Rickards and Fisher (1999) stated: "The combination of qualitative and quantitative methods in science and mathematics education research has provided a new direction to the way we examine schools and classrooms today." (p. 2)

Their example of combining the two types of data collection was at the time when the Questionnaire on Teacher Interaction (QTI) (Wubbels & Levy, 1993; Fisher, Fraser & Rickards, 1996) revealed differences in male/female perceptions of classroom environments and also how interpersonal teacher behaviour is associated with student attitudes. Using interviews of key informants made it possible for the subjects of this research to expand on trends that were obvious in the quantitative data. The result was that: "The quantitative data thus suggested that females perceived the classroom learning environment more positively than did males. This was also supported by the interview data." (p. 16)

Using both quantitative and qualitative data makes it possible to use the best aspects of both types of data collection. Supporters of each side of the debate over which type of research method is more appropriate have compelling arguments. Supporters of quantitative methods believe they are dealing with fact and leaving any biases out of the scenario. Qualitative researchers believe that it is impossible to leave out biases and that researchers should use the value-laden aspect of qualitative data in order to ‘tell the whole story’. Johnson and Onwuegbuzie (2004) believe that using both types of research together (mixed methods) is worthwhile. The weaknesses of each method can be left out while the strengths of each method can be capitalized on. Qualitative data can complement and help answer phenomena or anomalies that may arise from quantitative data. Johnson and Onwuegbuzie (2004) also point out that: “Mixed methods research offers great promise for practicing researchers who would like to see methodologists describe and develop techniques that are closer to what researchers actually use in practice.” (p. 15)

Another advantage of mixed methods research is that it helps bridge the gap between researchers from each persuasion and will hopefully help their work to complement each others. It is also a distinct advantage that a researcher who can legitimately see the benefit of both data collection methods in their research, will be able to use both methods and have them work together.

2.12 Summary

In this chapter, the literature has been reviewed in the following areas: types of mathematics classroom (2.2), an introduction to streaming (2.3), the effects of streaming on learning (2.4), the organisational implications of streaming (2.5), the sociological effects of streaming (2.6), intermediate positions on streaming (2.7), alternatives to streaming (2.8), attitudes to mathematics (2.9), classroom learning environments (2.10), differences by gender and language (2.11), and an introduction to combining quantitative and qualitative research methods (2.12).

The following chapter will discuss the methodology used in this study.

CHAPTER 3

METHODOLOGY

3.1 Introduction

Chapter 2 outlined a review of the literature pertinent to the area of study in this research. This chapter contains an explanation of the research design and implementation.

This study is unique in that it uses relatively modern but well established classroom environment assessment techniques to gather information on perceived differences in upper and lower-stream mathematics students' perceptions of their classroom learning environments. This chapter is devoted to providing a detailed description of the research methods used to answer the questions that have been asked in this study.

The chapter is organised as follows. Firstly, the research questions (3.2) and the instruments used to collect the data in this study are introduced with a discussion of why this particular instrument was chosen (3.3). The population and sample for the study is introduced (3.4) followed by an outline of how the quantitative data were prepared, transcribed and analysed (3.5). There is a description of the methods used to collect the qualitative data (3.6) and analyse (3.7) it along with an outline of how it is used to support and triangulate the quantitative data. Finally an outline of the pilot study (3.8) for testing and refining the instrument is presented to provide sufficient preliminary results to confirm the value of a full study in the area of streaming in mathematics classes.

In examining student perceptions of their learning environment in upper and lower-stream mathematics classes, this study will utilise a primarily quantitative approach. It will then seek to verify the quantitative data with an in-depth analysis of interview data that will be used to gain a deeper understanding of participants' perceptions than a quantitative analysis alone would allow. Learning environments research is well populated with research studies that have utilised this combination of qualitative and quantitative research methodologies. The advantage of this methodology is that both qualitative and quantitative methods can be used to assess the same learning environment from two different perspectives. This triangulation will strengthen the value of any outcomes from the data. The qualitative data were collected from a sample of the population in the form of face-to-face interviews, email interviews and focus groups. As well as providing validation information, this additional data adds interest to the information collected in statistical form.

One of the intended outcomes of the study is that its findings will be utilised in some of the schools who participated in the study. This will allow the benefits of this research to contribute to the environments which made time available to participate in this study.

3.2 The Research Questions

Earlier in this thesis the research questions were introduced in the form of objectives for the study. In this next section the research questions will be clarified.

Classroom learning environment research has seen rapid development over the last 30 years. (Fraser, 1998) The purpose has been to examine relationships between classroom environments and student performance, evaluating curriculum, investigating the "differences between teachers' and students' perceptions of the same classroom" and "whether students achieve better when in their preferred environment." (Fraser, 1991, p. 12)

This study will utilise five research questions to examine differences in student and teacher perceptions of the classroom learning environments of upper and lower-stream of middle secondary mathematics classrooms.

> Research Question 1.
> What. if any, are the differences in student perceptions of classroom learning environments in upper and lower-stream secondary mathematics classes?
>
> Research Question 2.
> What, if any, are the differences in teacher and parent perceptions of classroom learning environments in upper and lower-stream secondary mathematics classes?

Research Question 3.

What, if any, are the differences in the perceived classroom learning environments in mixed-ability classes when compared to streamed classes?

Research Question 4.

What, if any, is the connection between a student's attitude to mathematics and their perception of the classroom learning environment and does this vary between streams?

Research Question 5.

What are the student perceptions of upper and lower classroom learning environments and attitudes to mathematics and do they vary by gender and cultural background?

The next section discusses the instrument used to collect the quantitative data, how it was developed originally and how specifically it was used in this study.

3.3 Development of the Instrument

As the literature review reported, there are many instruments available for assessing various aspects of classroom learning environments. As this study focuses on the measurement of student perceptions of mathematics classroom environments, an appropriate instrument to assess this type of class level environment had to be chosen.

There are several reasons why the *WIHIC* was the instrument of choice for this research. It has proven to be a reliable instrument in terms of its validity and reliability in a diverse range of classroom settings. (Fraser, 1998) Unless the purpose of the study is to develop and validate a new instrument, it makes sense to use a previously well validated and widely accepted instrument. It has seven well defined scales which are separately valid but in combined form help to construct a comprehensive picture of the classroom. (Aldridge & Fraser, 2000). It has an *actual* and a *preferred* component to the instrument which is very useful for evaluating differences between students' current perceptions of their classroom learning environment and their ideal classroom learning environment. Because this is identifiable by scale, it is useful to pinpoint possible future areas of professional development for teachers. Finally, though it is a comprehensive instrument, it was expected that students could complete the survey in around 15 minutes and so has minimal impact on the operation of the regular class during completion.

This particular instrument is well validated in a wide range of different science learning environments and has been used in many different research projects. It has been used to investigate the relationship between classroom learning environments and student outcomes or performance. (McRobbie & Fraser, 1993; Margianti & Fraser, 2002). Thorpe, Burden and Fraser (1994) used it to help teachers to make a difference in their classroom based on classroom environment research. For example there was an outcomes based learning environment developed using technology (Aldridge, Fraser, Fisher & Wood, 2002) and an innovative science program (Lightburn & Fraser, 2002) and a laptop computer based classroom (Raaflaub & Fraser, 2002). It has also been used to assess the classroom learning environments in different countries: Australia (Aldridge, Fraser, Fisher & Wood, 2002), America (Lightburn & Fraser, 2002), Singapore (Fraser & Chionh, as cited in Dorman, 2004), Korea (Kim, Fisher & Fraser, 2000), Taiwan (Aldridge & Fraser, 2000) and Indonesia (Margianti, Fraser & Aldridge, 2002)

Therefore, because of its extensive history of valid and reliable research results, the *WIHIC* survey was the instrument used for the quantitative data collection in this study. The survey in the form used in this research, was developed by Fraser, McRobbie and Fisher (1996) for the measurement of student perceptions of their science classroom learning environments. Originally there were 9 scales with 10 questions in each scale. This was later reduced from 90 items to the present 56 items in 7 scales. It is this later version which was utilised for this study. In this study students were asked to respond to each item in the *WIHIC* for each of the two versions of the instrument, namely the *actual* version which is the classroom environment as the students currently evaluate it, and the *preferred* version which collects student perceptions of their ideal classroom.

Table 3.1

Scale Descriptions and Sample Items for the Actual Version of the WIHIC Scale for Students

Scale	Description	Sample Student Item
Student Cohesiveness	How do the students support each other?	I work well with other class members.
Teacher Support	How interested in the student is the teacher?	The teacher helps me when I have trouble with the work.
Involvement	To what extent are the students involved in the learning in the class?	I explain my ideas to other students.
Task Orientation	How important is it to stay on task?	I know what I am trying to accomplish in this class.
Investigation	Do the students get involved in the problem solving part of the course?	I solve problems by using information obtained from my own investigations.
Cooperation	To what extent do the students work together for mutual benefit?	I share my books and resources with other students when doing assignments.
Equity	The students are treated equally by the teacher in the class.	I get the same opportunity to contribute to class discussions as other students.

Note: This table was prepared from the *WIHIC* survey form.

The instrument used in this study was finalised after a pilot study (Section 3.8) using the *WIHIC* was conducted using a very small sample. The results of this pilot study were reassuring not only because the results showed some significant trends but also because the students did not find it daunting to complete. While the results of the pilot study showed that the *WIHIC* was going to be a good choice of instrument, it also showed that there were a couple of adjustments to make in order to have sufficient variables available to answer the research questions (Section 3.2). To address this, a small ten item ‘Attitude to Mathematics’ survey was included in the main instrument. This was based on the *TOSRA* (Test of Science Related Attitudes). Surveys that have included a combination of a classroom learning environment inventory and an attitude inventory have been used before. For example Henderson, Fisher and Fraser (2000) used the *Questionnaire on Teacher Interaction* (*QTI*) and the *Science Laboratory Environment Inventory* (*SLEI*) together with the seven item *Attitude to This Class* scale and the *Attitude to Science Laboratory Work* all in the one instrument.

For this study the students' sex, recorded as male or female, and the language the student primarily uses at home were requested also in the main survey to ascertain gender and cultural differences in student responses.

A sample of questions from the *WIHIC* according to scales is shown in Table 3.1 and the full survey can be found in the Appendix D at the end of this thesis.

3.4 Quantitative Data Collection

This section discusses the sample chosen for the quantitative data collection and how this data were collected.

The sample of 581 students for the quantitative part of the data collection is the entire Year 9 and 10 classes from seven different secondary schools from four different states of Australia. This included 28 classes and 36 teachers. A description of the sample can be found in Table 3.2. The schools sampled are all Seventh-day Adventist schools to which the researcher has easy access. These schools are classified as Christian independent. It made sense to eliminate the variable *type of school*. While the schools sampled all operate on the same philosophy, they vary greatly in terms of student demographic, geographical area, size of school and experience of mathematics staff. A sample of the educational objectives of Seventh-day Adventist schools in Australia are (http://adventist.org.au/services/education/about_adventist_education#one):

(a) Acknowledges the significant role of teachers as models of Christian grace, demonstrating professional competence in teaching, pastoral care and ministry.

(b) Encourages excellence in all areas with diverse opportunities being provided.

(c) Employs methods that are sensitive to the various abilities and needs of all, with students being engaged in tasks individually and collaboratively.

Table 3.2
Description of the student sample

	Sample															
	Upper-stream				Lower-stream				Mixed-ability				Total			
	English Speaking		Non-English Speaking		English Speaking		Non-English Speaking		English Speaking		Non-English Speaking		English Speaking		Non-English Speaking	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Year 9	52	50	10	6	42	35	13	7	45	39	8	9	139	124	31	22
Year 10	54	65	17	11	43	49	15	11	_	_	_	_	97	114	32	22
	106	115	27	17	85	84	28	18	45	39	8	9	236	238	63	44
Totals	221		44		169		46		84		17		474		107	
	265				215				101				581			

n = 581

Of the students who do not speak English at home, many cultures are represented in the sample. These include Japanese, Tongan, Spanish, Fijian, Turkish, Chinese, Korean, German, Hungarian, Papua New Guinean, Croatian, Bosnian, Samoan, Burmese, Italian, Indonesian, French, Thai, Maltese, Hindi/Punjabi, Arabic, Polish, Greek, and Portuguese.

The size of the sample for this study is not as large as other studies that have been undertaken to measure classroom learning environment perceptions. For example Aldridge and Fraser (2000) used a sample of 1081 students for a cross national study of learning environments in Taiwan and Australia. Margianti and Fraser (2002) used a sample of 1056 when researching perception of classroom environments in Indonesia. Dorman, Adams and Ferguson (2002) used a sample of 3602 in the study of classroom environments but that was across three countries. There are examples of small sample sizes in the literature. For example Henderson, Fisher and Fraser (1998) used just 489 students in their sample to study the associations between students' perceptions of their biology teachers' interpersonal behaviour and their laboratory learning environments along with other factors. Dorman (2000) also used a sample of 489 students when validating a university level classroom environment survey. Fraser and Treagust (1986) surveyed 372 tertiary students with a learning environment inventory.

The 581 students taken as a sample in this study represents 40 percent of the population of Year 9 and 10 students in Seventh-day Adventist schools in Australia. It can be seen that this is a large sample when looking at the source of the sample and it does spread across four states of Australia. Tasmania, South Australia, Northern Territory and Australian Capital Territory were the only states or territories not sampled.

The means of collecting the data were to first approach the principal of each school in the sample and get permission to work through the Secondary Coordinator and Head of Mathematics Department. An information sheet (as required for ethics approval) was given to each principal explaining the process and can be found in Appendix A. This document explained to the principals the aims of the study, what the participants would be asked to do, the fact that all data would be kept confidential, that there is no risk to student or teacher in the process and who they should contact if there is a problem according to National Health and Medical Research Guidelines. The survey was then administered personally with the students in their mathematics classes according to a set procedure which is also included as Appendix B.

3.5 Preparation and Analysis of Quantitative Data

Each form completed by a student had to be checked to make sure it was going to provide valid information for the study. Invalid attempts were considered to be ones where large sections of the data were left out or it was obvious that students had given the same answer for all questions. These surveys were discarded. Surveys where less than five items had not been entered were repaired using the SPSS function which replaces missing data. The remaining surveys were then coded according to school, class and stream and each survey was given a distinctive code. The schools were coded as 1-7, the classes as 1-36 and the teachers as 1-28. Year 9 and 10 were coded as 1 and 2. Upper-stream, lower-stream and mixed-ability classes were coded as 1, 2 and 3 in that order. Males and females were coded as 1and 2 and

English speakers and non-English speakers were coded as 1and 2. To determine if a student was an English speaker or non-English speaker students were asked which language they commonly spoke at home with their families.

The data for both the attitude survey and the *WIHIC* was coded so as to make a response of '1' the most positive response and '5' the least positive response. This data, once collected was placed into an EXCEL spreadsheet. Variables were added along the horizontal axis as headings for each column. Each respondent was allocated one row of the spreadsheet. The string type variables (gender, teacher and language) were entered as their coded numeric values. The complete master data set was then transferred into an SPSS file after the variables had already been defined.

The SPSS data file was then used to perform such operations as factor analyses, alpha reliability, correlations, analyses of variance and to collect descriptive statistics such as means and standard deviations. Of particular interest in these analyses was the relationship between the perceptions of their classroom environments of students in different streams and the relationship between attitude to mathematics and the scales of the *WIHIC*. Other data analyses covered gender differences and cultural differences in perceptions of classroom environments and attitude to mathematics.

3.6 Qualitative Data Collection

It became obvious during the data collection phase of the student quantitative data that some students were feeling uncomfortable confining their answers to circling a number. They had a story to tell and some wanted to tell it, asking the researcher if they could add notes to the survey form. The teachers looking after these classes often wished to make comments about the issues coming out of the survey when it was explained to them what was happening in their class with the survey.

Despite the fact that a large amount of data were collected from the survey and it was converted into many different statistics that tell stories in themselves, it was clear that the students needed the opportunity to express themselves as to why they gave a particular response to a particular question. Of course it would be a major and unnecessary undertaking to collect narrative answers from students for all items on the survey. It was possible to take a sample of the items and scales that were most revealing in the quantitative data analysis and ask the students for further explanation on these responses.

The questions asked of the students to obtain the qualitative data were framed in a methodical manner. They needed to be able to validate the quantitative data. The method was to first look for significant trends in answers given by students on the surveys and frame questions that would add meaning to those responses. The questions needed to focus more on a particular scale within the survey rather than on a particular item. This scale focus was initiated after the first pair of general questions was put forward. Secondly, the objective was to keep the research questions in mind constantly, making sure the interview questions were designed to provide answers to the research questions. Finally, for the sake of validity and consistency, it was determined to ask all students the same questions initially, but to expand interviews for specific students based on their responses and whether more clarification of their responses was required.

Though each school in the sample was similar in philosophy, each had students from different demographics and cultural backgrounds. Flexibility needed to be exercised during the course of collecting the qualitative data.

According to Erickson (1998):

> Because settings are locally distinct, one cannot anticipate fully in advance the circumstances that will be encountered when the study has begun. Research questions, data collection operations, and research role relationships necessarily will change during the course of a qualitative study. In spite of this it is useful to frame questions in advance and to think of the kinds of evidence that we want to have accumulated in order to answer those questions, as well as anticipating issues of ethics. (p. 1159)

These principles also applied to the qualitative data collected from teachers, trainee teachers and parents. While the questions they were asked could not be linked to a quantitative survey as completed by the students, the questions were still framed to derive answers to the research questions. The same basic set of questions were asked of each person or group. Because of the differing directions the interviews went however, allowance was made for variations.

While there was already in place a plan to collect qualitative data through interviews, as the research unfolded it became apparent that in order to make a complete report, different means of collecting that qualitative data would be necessary. These different methods included: one-on-one interviews with teachers, parents and students; interviews with small groups of respondents – both students and teachers; the use of focus group interviews with teachers and trainee teachers; the interviewing of students and teachers by email.

The collection of qualitative data fell into four categories. Questions were asked of students, teachers, trainee teachers and parents that required extended responses. These questions were aimed to add valuable information to the already obtained quantitative data and to help in answering the research questions. For each group of people a different method of data collection was used. The students were asked questions by email. Their email addresses were an optional entry on their survey forms and were only used after ethics clearance and after the students were told how the addresses would be used. The first two questions to the students were the same for each student but after that the questions became more personalized as they would in a face to face interview. It was found that the students were very open and honest using the email method of interview which is one of their standard means of communication today. Where the English level of the student prevented them from communicating confidently in writing and when significant trends in the quantitative answers of non-English speaking students emerged, small group interviews were organized.

Qualitative data collection was organised with convenience for the school or people concerned in mind. As the data collection phase progressed, it became apparent that each mode of collection has its strengths. For example as Table 3.3 shows, email interviews overcome many of the traditional issues with face to face interviews. Students were not threatened and therefore appeared to be happy to give honest answers. Multiple sessions became simple to conduct and there was a pleasant but focused informality that engendered probing answers to questions without any threat to student anonymity. Teachers who were interviewed by email also found it convenient to be able to answer at their leisure and also gave detailed answers that could be followed up with further questions at any point and as observations surfaced in the quantitative data analysis.

For each of the interviews, whether face to face or by email, each interviewee was a key informant, selected for their specific ability to provide information that would add meaning to the data already collected. The sample did not therefore need to be large as the purpose was for depth rather than breadth. It was more important for the interview sample to be "an inch wide and a mile deep" rather than "a mile wide and an inch deep" (Peckman, 1998, p. 33) since each person interviewed was a key informant. Every student interviewed had already completed the survey and each teacher interviewed was a teacher of one of the classes that were surveyed.

Focus groups were used to collect data from trainee teachers and one whole group of teachers in a staff meeting. Not only was the use of focus groups convenient for the teacher training institution, in both cases the tutor joined in as part of the group and the session became interactive. Discussion was generated that would not have arisen in a one to one interview. As Anderson (2004) states, focus groups provide: "Group synergy to maximise recall and highlight the diversity of perspectives." (p. 168)

Though not a particular focus of this study, it was considered that interviewing trainee teachers could add meaning to aspects of student answers in the survey. They are the future teaching workforce and their beliefs about streaming may have a major impact on many classrooms in the future. They were interviewed as two focus groups at two tertiary institutions. Mathematics teachers have most likely come from upper-stream mathematics classes at secondary school. It is possible that streaming could become self-perpetuating without too much thought to the inherent pedagogy involved or to suitable alternatives. Interviewing these pre-service teachers may have the effect of helping them think about the issues of streaming as well as providing data for this study.

Practicing teachers were interviewed as a focus group, as small groups and sometimes individually. Selection of interview techniques was based on the convenience for the school and teacher as well as the best anticipated way to collect the information. Individual interviews were by email because this was the most convenient way to communicate with single teachers without using their very limited spare time at school. Small group interviews were organized often by default when they were found to be in one venue together and were happy to discuss the issues. The same questions were asked of the teachers in general as were asked of the trainee teachers in order to establish whether the same philosophies were adhered to by both groups and whether the teachers had fixed ideas about streaming.

Parents were interviewed individually, and were asked questions that related to what they thought might be the differences between the classroom environments in upper-stream and lower-stream classes. In some cases parents answered interview questions by email by adding their opinion to their children's opinion on the same email and using their children's email addresses.

3.6.1 Collecting Student Data

For the students it was decided that the best way to communicate with them would be to use email. It was vital to get ethics clearance for this part of the study because of the growing awareness of child protection with regard to the use of the internet. Students were given the option of providing their email address on the survey form and were also told at the time of data collection how the email would be used. The first email the students were sent was to give them the option of having their email address deleted so that they would receive no further communication. The whole address book is to be deleted when the study is complete. Communicating by email is a very popular way for young people to 'talk' currently and it was believed that more accurate, complete and revealing answers may be obtained in this way. Email also made it possible to overcome issues that Simons (as cited in McCormick, 1982, 239-246) and McCormick and James (1988) see as potential problems when interviewing children. Email communication has many aspects that make a student feel safer than in a one-to-one interview. Table 3.3 illustrates how email can be used to answer each difficulty put forward.

Table 3.3

Solving Interview Problems by Using Emails

Potential Problem	***Ways email response compensates***
"Establishing trust"	Interviewer can be affirming and interested by email
"Overcoming reticence"	Students are keen to communicate using their common genre
"Maintaining informality"	Email, by its very nature is informal
"Avoiding assuming that children 'know the answer"	Questions can be framed asking for opinions rather than factual answers. They can take as much time to think about their answers as they wish without feeling embarrassed while the interviewer waits.
'Overcoming the problems of inarticulate children'	Verbally inarticulate children can be articulate using email. They are not being 'watched' and can take their time to respond. Standard grammar rules are regularly broken on email so they are not left exposed if they make mistakes.
"itching the question at the right level"	The interviewer can determine the appropriate level of response each time they read an answer.
"Choice of vocabulary"	The interviewer can come up with appropriate vocabulary based on each student response.
"Non-verbal cues"	Non-verbal cues do not become an issue with email interviews.
"Avoiding children giving answers they think the interviewer wants to hear"	Children are far less likely to do this if the interviewer is not present in person.
"Avoiding the interviewer being seen as an authority spy or plant"	It is difficult to see someone at the other end of an email as being a spy, particularly when the student is anonymous.
"Keeping to the point"	The interviewer can think carefully about each question asked by email to ensure it is in line with the research questions.
"Having students be open and honest despite peer-group pressure"	Email answers should be devoid of peer group pressure.
"Having students feel equal in importance to adults"	One can arrange questions to make the student feel that their contribution is important.

Note: Potential problems taken from McCormick and James (1988).

Out of the 581 students sampled, 207 students volunteered to provide their email address. The first email sent to them was to give them the opportunity to have me remove their email address from my address book if they had changed their minds and decided they would rather not answer questions. In this first run 40 emails were returned as undeliverable, meaning that students had given a misleading address or the writing of their address on their survey was not legible enough to be accurate. This left 167 students with whom to communicate. Of these only one student asked for his/her name to be deleted from the address book. In general 5 percent or 25 students would have been an acceptable number of students to respond by providing qualitative data. In fact 37 students were finally interviewed by email. Of this number 11 students were from Brisbane, 8 were from Sydney, 7 were from Newcastle, 7 were from Melbourne and 4 were from Perth. Of these 14 were males and 23 were females, 16 were upper-stream, 13 were lower-stream and 8 were mixed-ability.

The initial questions asked of the three groups were as follows:

Upper-stream:

1. You are in a more academic maths class doing a higher level of maths than some of the other kids in your year level. Do you think it is a good idea to have those of similar ability in one class or do you think it would be better to have the classes all mixed? Can you explain the reasons for your answers.
2. What do you think would be the main differences between how your class works and how the class doing easier maths works? Would it just be that you get harder work or would there be other differences?

Lower-stream:

1 You are in a less academic maths class doing a different level of maths than some of the other kids in your year level. Do you think it is a good idea to have those of similar ability in one class or do you think it would be better to have the classes all mixed? Can you explain the reasons for your answer.

2 What do you think would be the main differences between how your class works and how the class doing more difficult maths works?

Would it just be that you get different work or would there be other differences?

Mixed-ability:

1. You are in a class where all the students are mixed up for their maths classes. Those who are very good at maths and those who are not so good are in the one class. Do you think this is a good idea or would you rather be in a class for maths with kids who are about the same as you in maths ability?
2. If the class were to be divided up into a higher level maths and a lower level maths, what do you think would be the main differences between the classes apart from the level of difficulty?

As the students answered these questions they were sent reply emails that sometimes just thanked them for their responses but in some cases had clarifying questions for them to respond to. The second common round of questions focused on attitude to mathematics classes and were designed to establish whether or not the students could make a connection between their attitude to mathematics classes and their classroom environment. They were as follows:

Upper-stream:

1. Do you think your attitude to life in general affects your attitude to maths and maths classes or is there no connection? Do you think your attitude to maths could be changed one way or the other by the quality of teaching and the way things happen in your maths class?
2. Do you think that your class (advanced) has a better learning environment than the lower-stream classes?

Lower-stream:

1. Do you think your attitude to life in general affects your attitude to maths and maths classes or is there no connection? Do you think your attitude to maths could be changed one way or the other by the quality of teaching and the way things happen in your maths class?

2. Do you think the advanced class has a better learning environment than your class?
3. The results of the survey shows that your class gets on pretty well. Are they united in doing their maths or are they united for other reasons?

Mixed-ability:

1. Do you think your attitude to life in general affects your attitude to maths and maths classes or is there no connection? Do you think your attitude to maths could be changed one way or the other by the quality of teaching and the way things happen in your maths class?

2. You will probably go into a streamed class next year. Do you think the advanced class has a better learning environment than the lower-stream class?

During the course of the quantitative data analysis a significant discrepancy occurred between the attitude to mathematics of non-English speaking students and their perceptions of their classroom learning environments. At this point it was decided to interview four groups of these students face to face. Each group had three students so that they would talk without feeling intimidated. There were two groups of Asian students, one of Pacific Islanders and one of South Americans. The groups were chosen as such so that the students would feel comfortable talking and would be able to support each other. Having the same cultures together was for the purpose of establishing common issues in different ethnic groups. It is well documented (Peng, Nisbett & Wong, 1997; Berry, 1969) that there are dangers in making comparisons across cultures using the same instrument because each culture may relate to the inherent values of the survey in a different way. For this reason it was important in this study to use multiple types of data for validation purposes.

3.6.2 Collecting Teacher Data

Because of the geographical constraints of the schools surveyed and because of the time constraints that are placed on teachers, three methods of data collection were used. At one school a focus group was used by engaging teachers of all subjects in a staff meeting. There were some interviews with individual teachers at schools and there were some interviews conducted by email. In each case the same questions were put to the teachers. These revolved around firstly their opinion of streaming as a practice and then the differences in classroom environments they had experienced in different classes.

No matter what form of data collection was employed, the teachers were cooperative and glad to be able to contribute. This made for interesting and vibrant interview periods. The teachers did not feel inhibited in speaking about their opinions and practices. A sample of 10 teachers at 5 different schools was interviewed and the questions were designed to help answer the research questions and add weight to the student interviews and quantitative data.

To start the data collection process with teachers an interview was conducted with two teachers together at one school. One was the Head of the Mathematics Department and another was a senior mathematics teacher. They were asked questions that explored the concept of classroom environments in streamed classes more deeply. For example they were asked:

1. How is streaming organised in your school?
2. How young is too young to stream?
3. Are there behaviour differences between the streams?
4. Is the curriculum different between the two streams?
5. Can the students move between the streams?
6. Do you think streaming causes any self-esteem issues for lower-stream students?

The results of this survey are reported on in detail in Chapter 5 and discussed in Chapter 6.

The next step in the collection of qualitative data from teachers was taken after the quantitative data from the students was analysed. The teachers were sent a brief summary of some of the findings of the study and asked just one question by email (see Appendix C). The purpose in sending a few findings was to make them feel part of the research and that their considered comments would be valued and added to the current findings.

The question asked of the teachers were based on the seven scales of the *WIHIC* and were as follows:

> Can you comment on the differences you have experienced between a lower-stream and an upper-stream in terms of *classroom learning environment? A possible definition of 'classroom learning environment' is below.
>
> *Classroom environment can be interpreted under the following categories:
> (a) Do the students get on well together?
> (b) Are the students making full use of your skills?
> (c) Do the students get involved in their learning?
> (d) Do the students generally get on with their work?
> (e) Do the students work together on problem solving?
> (f) Is there a general feeling of cooperation in the class?
> (g) Do all students feel like they are treated equally?

As the teachers answered this first standard question by email, they were followed up with other questions, the results of which are reported in Chapter 5 and discussed in Chapter 6.

3.6.3 Collecting Trainee Teacher Data

The method used to obtain the data for pre-service teachers' opinions was group interviews or focus groups.

The trainee teachers were interviewed in order to gain a perspective from those who had been through the school system as such but had received training in modern pedagogy and learning theories. These were all fourth year trainees in their final year of university at two different tertiary institutions. The form of these interviews was that the researcher as the facilitator was given the whole class for one session where theories of streaming were talked about and then students were invited to participate by asking and answering questions, the answers to which were recorded.

The format was that of a focus group. There was significant interaction between participants and feedback was comprehensive.

The same core questions were asked of both groups during the course of the classes, but the varying responses from the trainees dictated the direction of the session. The core questions revolved around: the trainees' general opinions of streaming for ability in mathematics, differences in learning environments in upper and lower-stream classes, any social equity issues with streaming, which stream they would want to teach when they graduate and where they think the 'best' teacher should be placed in a streamed situation.

3.6.4 Collecting Parent Data

Parents were interviewed on an individual basis. 10 parents were interviewed with the intent of finding out how they perceive the classroom learning environments in upper and lower-stream mathematics classes. These interviews were collegial with parents very happy to talk about their opinions of streaming and the differences between what might be happening in the upper and lower-streams of their childrens' mathematics classes. The difficulty faced in these interviews was keeping the parents focused on the question at hand. Parents in some cases felt so comfortable in the interview that they felt the need to report the history of their child's education. The results of these interviews can be found in Chapter 5.

3.7 Preparation and Analysis of Qualitative Data

The qualitative data collected in this study was in many formats. There were transcripts from interviews and focus groups as well as email responses.

All of the data collected in verbal format for the purpose of qualitative analysis was transcribed into written form. Data collected by email was obviously already in electronic written form and did not need to be transcribed.

The result was a large quantity of written data containing a wide range of information on many and diverse issues, only some of which pertains to the research at hand. The researcher determined which responses were pertinent to the research questions.

As Erickson (1998) advised: “Analysis consists of recursive review of information sources with a question or assertion in mind, deciding progressively which information bits to attend to further and, perhaps even more importantly, which not to attend to.” (p. 1162). Erickson (1998) goes on to say that all of the data must be searched carefully for: “Evidence that might confirm or disconfirm assertions about student conceptions.” (p. 1163) and further that persistence is necessary in that the researcher must: “Continue reviewing evidence until all relevant data have been identified and compared.” (p. 1164)

As a key to the types of information to retrieve from the raw data, it is necessary to search for “orientational meaning” (Lemke, 1998) rather than “presentational meaning.” This means going beyond the descriptive data which has already been collected with the *WIHIC*, and moving into the: “Interpersonal or attitudinal constructs of our social, evaluative and affective stance.” (p. 1179). This is to say that while quantitative data has its limitations with regard to interpretation of the data, there is no such limitation with qualitative data.

The results section in Chapter 5 which reports on the qualitative data therefore has several objectives:

(a) To have the objective of answering the research questions
(b) To support or validate the results obtained from the quantitative data
(c) To report clearly and persuasively the results of the qualitative research
(d) To deal more with the social dynamics of the classroom environment than the quantitative data is useful for.

The software program *NUD*IST* was considered for the purpose of sorting the qualitative data and formatting it but was ultimately discarded as a tool for this study. Because the researcher, the interviewer and the author of this study is the same person, it was felt that because they had built a relationship with the people used in the sample and had an understanding of the context of the data gathered, it would be more meaningful and accurate if a software program were not used in this case. The qualitative responses were therefore analysed according to the scales of the *WIHIC*.

After having already done the quantitative analysis and having the scales firmly fixed in mind, it was not difficult to categorise responses according to these scales.

3.8 The Pilot Study

This pilot study was for the purpose of sampling the questionnaire that is to be applied. As Anderson (2004) indicates: "A pilot study is a small scale study conducted prior to the actual research. . . pilot studies are used to test questionnaires and other instruments and to see whether there is a possibility that worthwhile results will be found." (p. 12)

Anderson (2004) also advises that doing a pilot study helps find ambiguities in the questions as well as errors of typing and omissions. He suggests finding a group of volunteers to trial the questionnaire.

A pilot study of two streamed Year 10 mathematics classes was carried out and the following question was asked: How do students in upper and lower-streams perceive their learning environment?

Using the *WIHIC* survey, students in upper and lower-streams were given the survey once to allow them to describe their *actual* learning environment and once to describe how the environment would be in their ideal *(preferred)* classroom. These two versions of the *WIHIC* were administered in consecutive weeks. The responses of both streams were then compared against each other and against themselves in terms of the actual and the ideal. It became apparent from the finding of this pilot study that the following were valid questions to ask:

(a) How does *student cohesiveness* compare across streams?
(b) How is *teacher support* perceived in each stream?
(c) How does *student involvement* compare in each stream?
(d) How does the amount of *investigation* differ in each stream?
(e) Is one stream more on task than the other stream (*task orientation*)?
(f) Is *cooperation* more prevalent in one stream than the other?
(g) Is *equity* more evident in one stream than the other?

Having a thorough knowledge of this particular school and the teachers, the researcher chose Year 10 for the pilot study because the two teachers involved were equally keen for the surveys to be done in order for them to receive feedback that would help adjust their teaching with a view to improvement.

The classes had 33 students altogether, the upper class contained 22 students and the lower class 11 students. Clearly the sample is insufficient for the purposes of reporting generalisations, or for expecting all seven scales of the *WIHIC* to emerge in a factor analysis, but it was sufficient to ensure the instrument was well understood by the students. It also helped to highlight what modifications could be made to the final instrument to be used in the main study.

The students were from the many different cultures represented in New Zealand and also included some international students. Some of these were given language assistance in completing the questionnaires. Both genders were represented in the sample.

The role of the researcher was to select the appropriate classes and give copies of the survey to the two teachers to make sure they were completely satisfied with what the students were to be asked, given that the results would shed light on their own performance to a certain extent. When the two teachers agreed to have their classes participate, the researcher then went along to the classes and explained what the research was about. The students were also told that the results of the survey could be helpful to the researcher and also to their teachers in order to find areas of possible improvement.

Though the sample was small, the following information was taken from the pilot study:

(a) The Alpha Reliability was 0.93, indicating internal consistency which should improve considerably with a larger sample.
(b) Four of the seven scales emerged with a factor analysis.
(c) Upper-stream *actual* and *preferred* scores on the *WIHIC* were more positive than their lower-stream counterparts by around 9 percent.

(d) There was a high degree of agreement between all students as to what scales of classroom learning environment they would like to see improved the most.

Obviously the sample size for the pilot study is not sufficient to draw any conclusions from. With the number of items in the survey, at least 500 students need to be sampled.

After looking at the results and deciding that there were significant issues introduced that would warrant the full study to be continued, it was decided that there needed to be some modifications to the survey before the full study was to be undertaken.

It was decided that the final edition of the survey to be used in the full study should include more variables than in the survey used for the pilot study. When using a sample of 500, it was decided that more information needed to be collected from the students so as to be able, if desired, to differentiate between males and females, and between native English speakers and those who speak other languages at home. An 'attitude to mathematics' inventory was also added after searching the literature for an appropriate tool to assess student attitude.

In the pilot study the *actual* and the *preferred* forms of the survey were separate and given at separate times. It was decided that in the full study the two forms would appear on the one page so that each question would be read once but answered twice: once for the students' *actual* response and once for their *preferred* response. The reason for this was firstly that in real terms when collecting data in a school it is unreasonable to want to interrupt a class twice to collect two lots of data. Secondly it was believed to be more accurate for students to consider their 'actual' and 'preferred' responses alongside each other.

3.9 Summary

It can be seen from this chapter on methodology that this sample is unique in that only one type of school, Seventh-day Adventist schools, is being targeted. The sample represents a large proportion of the Adventist school system in Australia. Secondly this study combines the area of classroom learning environment research with the controversial area of streaming for ability. Thirdly there is a combination of quantitative and qualitative methodologies being used where the qualitative component serves not only to validate the results from the quantitative data analysis, but also to provide a greater depth of understanding of participants.

The next chapter will report on the quantitative data findings and their analysis.

CHAPTER 4

QUANTITATIVE DATA ANALYSIS AND FINDINGS

4.1 Introduction

This chapter details the results of the quantitative data collection. As reported in Chapter 3, quantitative data were collected using a survey that contained items from the *Test of Science Related Attitudes (TOSRA)* and the 56 item version of the *What is Happening in the Classroom? (WIHIC)* survey. The survey was used in this study along with interviews to help validate the quantitative data and to add a greater depth of understanding of available data. The results of these interviews will be presented in Chapter 5.

4.2 Factor Structure of the WIHIC

A principal components factor analysis with varimax rotation was used to establish whether the items from the seven scales of the *WIHIC* formed seven separate measures of the students' perceived learning environments in the classrooms. (*Student Cohesiveness, Teacher Support, Involvement, Task Orientation, Investigation, Cooperation, Equity*).

The seven scales of the *WIHIC* emerged when factor loadings less than 0.4 were eliminated. The results of the factor analysis are shown in Table 4.1. The factor loadings for the *actual* and the *preferred* form of the *WIHIC* are both shown on the table. The factor structure of both forms of the *WIHIC* for the student sample of 581 was supported.

Two variations of the *WIHIC* were used in this study, the *actual* version and *preferred* version. Factor loadings for the *actual* form of the survey demonstrate that the scales of *task orientation, teacher support, co-operation, and investigation* are internally consistent with no confusion existing with other scales for this sample. The scales of *equity, involvement* and *student cohesiveness* are also clearly consistent except for some minor cross-overs which may be easily explained. The scale of *student cohesiveness* was shown to be statistically linked to *cooperation* by student participants. This is understandable given that the items of confusion were about helping each other with the work in class (see Table 4.2, Item 6). While this question

Table 4.1

Factor Loadings for the Actual and Preferred Forms of the WIHIC

	Student Cohesiveness		Teacher Support		Involvement		Task Orientation		Investigation		Cooperation		Equity	
	Act	Pref	Act	Pref	Act	Pref	Act	Pref	Act	Pref	Act	Pref	Act	Pref
Q01	0.67	0.61												
Q02	0.63	0.73												
Q03	0.57	0.66												
Q04	0.75	0.75												
Q05	0.42	0.60												
Q06	-	-												
Q07	0.75	0.64												
Q08											0.55	0.47		
Q09			0.71	0.72										
Q10			0.76	0.68										
Q11			0.72	0.66										
Q12			0.68	0.41										0.42
Q13			0.77	0.66										
Q14			0.75	0.71										
Q15			0.68	0.68										
Q16			0.61	0.47										
Q17					0.74	0.68								
Q18					0.78	0.73								
Q19			0.50		0.45	0.67								
Q20					0.62	0.65								
Q21					0.41	0.50								
Q22					0.58	0.58								
Q23						0.42					0.51	0.45		
Q24					0.49	0.57								
Q25							0.60	0.61						
Q26							0.63	0.68						
Q27							0.54	0.62						
Q28							0.63	0.63						
Q29							0.52	0.62						
Q30							0.66	0.63						
Q31							0.64	0.65						
Q32							0.68	0.67						
Q33									0.69	0.70				
Q34									0.59	0.67				
Q35									0.70	0.74				
Q36									0.56	0.64				
Q37									0.73	0.74				
Q38									0.75	0.78				
Q39									0.78	0.79				
Q40									0.76	0.75				
Q41											0.64	0.60		
Q42											0.60	0.63		
Q43											0.70	0.62		
Q44											0.70	0.71		
Q45											0.73	0.69		
Q46											0.79	0.76		
Q47											0.70	0.66		
Q48											0.68	0.66		
Q49			0.53										0.59	0.64
Q50			0.42										0.62	0.62
Q51													0.71	0.70
Q52													0.71	0.70
Q53			0.42										0.69	0.75
Q54													0.76	0.76
Q55													0.66	0.59
Q56													0.73	0.69

Factor loadings smaller than 0.4 have been omitted. n=581 belonged in the *student cohesiveness* scale, it clearly also fits with *cooperation*. The scale of *involvement* ventured into the areas of *teacher support* and *cooperation*.

Table 4.2
Alpha Reliabilities if Items with Multiple Loadings are Deleted

Scale	Item		Alpha for Scale	Alpha if item Deleted
Student Cohesiveness	6	I help other class members who are having trouble with their work	0.79	0.79
Student Cohesiveness	8	In this class I get help from other students	0.79	0.79
Teacher Support	12	The teacher helps me when I have trouble with the work	0.91	0.91
Involvement	19	The teacher asks me questions	0.84	0.83
Involvement	22	I explain my ideas to other students	0.84	0.83
Involvement	23	Students discuss with me how to go about solving problems	0.84	0.83
Equity	49	The teacher gives as much attention to my questions as to other students' questions	0.93	0.92
Equity	50	I get the same amount of help from the teacher as do other students	0.93	0.92
Equity	53	I receive the same amount of encouragement from the teacher as other students do.	0.93	0.91

n=581

The item within *involvement* that was confused by participants with *teacher support* asked whether 'the teacher asks me questions' (Table 4.2, Item 19). Students may have interpreted the teacher asking them questions as a supportive action and have coded it in the *teacher support* scale rather than in the *involvement* scale. The item (Table 4.2, Item 22) in the *involvement* scale that ended up fitting into the *cooperation* scale was whether the students explained their ideas to other students. Again the confusion may be due to the students seeing that sharing ideas with each other is an act of cooperation as much as it is an act of involvement. On three items (Table 4.2, Items 49, 50 and 53) the scale of *equity* was loading with the scale of *teacher support*. It is clear to see how students relate equity in the classroom with the support they get from the teacher.

The factor structure of the *preferred* version of the *WIHIC* is very clear for all factors. As for the *actual* survey there is a question in the *student cohesiveness* scale (Table 4.2, Item 8) which loaded into the *cooperation scale*. It asks about the way students help each other. There was also a question in the *teacher support* scale (Table 4.2, Item 12) on teacher help that was duplicated in the *equity* scale. Students interpret the time a teacher spends with each student as an equity issue as well as a show of teacher support. As for the *actual* survey, Item 22 of the *preferred* survey (Table 4.2), asking about students explaining things to each other in the *involvement* scale was also loaded into the *cooperation* scale.

To help explain some of the outliers in the factor loadings an inter-scale Pearson Correlation was performed. This can be seen in Table 4.3 and shows correlations ranging between 0.23 and 0.70. This data shows that the three strongest correlations are between *teacher support* and *equity* at 0.70, between *student cohesiveness* and *cooperation* at 0.63, and between *teacher support* and *cooperation* at 0.55. The relationship that exists between these scales, as perceived by the participants, as shown by the correlation coefficients, helps to explain the outlying data in the factor loadings. For example the high correlation between the scales of *equity* and *teacher support* would help to explain why in the *preferred* survey, the item which asks whether the teacher helps the student when they have a problem (question 12), has almost the same factor loading in both of the scales. The students perceive *equity* and *teacher support* in the same way.

Though there is a duplication of the factor loadings for some of the items, Table 4.2 shows that if the specific items were to be deleted from the survey, the reliability would not improve and in some cases would decrease. This is sufficient justification to use the *WIHIC* in its standard form even though some items loaded into more than one scale.

Table 4.3
Pearson Correlation Between Scales

	Student Cohesiveness	Teacher Support	Involvement	Task Orientation	Investigation	Cooperation	Equity
Student Cohesiveness	1	0.29*	0.54*	0.32*	0.25*	0.63*	0.32*
Teacher Support		1	0.47*	0.50*	0.36*	0.23*	0.70*
Involvement			1	0.42*	0.51*	0.55*	0.47*
Task Orientation				1	0.50*	0.33*	0.40*
Investigation					1	0.33*	0.40*
Cooperation						1	0.31*
Equity							1

n = 581 in 36 classes. * $p<0.01$

It is interesting to note that in a study by Margianti and Fraser (2002) where the classroom environments of Indonesian tertiary computing students was studied, the factor analysis of that study also found the same anomalies with the *student cohesiveness* scale. Question 6 did not load a value of 0.4 or greater and Question 8 loaded into the *cooperation* scale instead of the *student cohesiveness* scale. Another example of the same observation is in the study by Aldridge and Fraser (2000) where they looked at classroom learning environments in Taiwan and Australia. The same two questions did not load exclusively into a scale.

4.3 Reliability of the Instrument

The next step was to calculate Cronbach's Alpha Reliability Coefficient for scales of the *WIHIC* and the *attitude scale* to check for internal consistency or reliability. Table 4.4 provides information for the *WIHIC* when used specifically with the present sample of mathematics classes. Statistics are reported for two units of the analysis, namely, the individual student's score and the class mean score. It can be seen in the table that, as expected, the reliabilities for the class means for each scale were higher than the reliabilities for the individual student on each scale. Table 4.4 also shows that the range of Alpha Reliability figures for each of the different *WIHIC* scales ranged from 0.79 to 0.93 when the individual student was used as the unit of analysis and from 0.89 to 0.97 when the class mean was used as the unit of analysis. These are high reliabilities for all scales of the *WIHIC* when used with the present sample.

Table 4.4
Internal Consistency (Cronbach Alpha Coefficient) and Ability to Differentiate Between Classrooms for the WIHIC

Scale	Unit of Analysis	Alpha Reliability	ANOVA Results (eta^2)
Student Cohesiveness	Individual	0.79	0.14*
	Class Mean	0.92	
Teacher Support	Individual	0.91	0.31*
	Class Mean	0.97	
Involvement	Individual	0.84	0.13*
	Class Mean	0.89	
Task Orientation	Individual	0.84	0.18*
	Class Mean	0.91	
Investigation	Individual	0.89	0.14*
	Class Mean	0.93	
Cooperation	Individual	0.89	0.11*
	Class Mean	0.93	
Equity	Individual	0.93	0.25*
	Class Mean	0.97	

n = 581 in 36 classes *p<0.001

It is also worthwhile to determine whether the *WIHIC* is able to differentiate between the perceptions of students in different classrooms. That is, while it would be expected that the mean perceptions of students in individual classes should show some similarity internally, those mean class differences should vary across classes. To establish this relationship a one-way ANOVA with class membership as the main attribute was evaluated for each scale of the *WIHIC*. It was found that each scale did differentiate significantly ($p<0.001$) between classes. The eta^2 statistic ranged from 0.112 to 0.251. This represents the proportion of variance explained by class membership and is also shown in Table 4.4.

For the current sample, the ten item Attitude to Mathematics class survey was found to have an alpha reliability of 0.90 with the individual student as the unit of analysis and 0.96 when the class means were used.

4.4 Comparing Streamed and Mixed-ability Classroom Environments

For this section it should be noted that unlike other versions of the *WIHIC*, the 1-5 scale for each item represented more positive to less positive perceptions of classroom environment. Lower scores represent the more positive responses. A comparison of student perceptions of classroom learning environments in Year 9 and Year 10 mathematics classes in upper and lower-streams was a key focus of this study. Mixed-ability classes were also included in the study to enable a comparison to the upper and lower-stream classes. Table 4.5 is a summary of the means and standard deviations for each scale of the *WIHIC* across each of the 3 sampled groups that make up the survey population.

The Statistical Basis for Differentiating Perceptions of Learning Environments Across Streams

Table 4.5 shows that for every scale of the *WIHIC* the upper-stream students report a more positive perception of their mathematics classroom learning environment in the form of a lower scale mean than do their lower-stream counterparts. It can also be seen that the standard deviation for the upper-stream is smaller than the standard deviation for the lower-stream indicating that there is a larger spread of scores and hence variance of opinion for the lower-stream students.

The results from the mixed-ability classes do not provide a consistent indication of these students' perceptions of their classroom learning environment. When each scale is taken separately it can be seen that the mixed-ability group sometimes has a more positive perception of classroom learning environment than either upper or lower-streams, sometimes a less positive perception than the streamed classes and sometimes is between the two.

Table 4.5
Summary Table Showing Statistics Which Compare Streams with Actual Scales of the WIHIC

	Upper or Lower	Mean	Std. Deviation
Student Cohesiveness	Upper-stream	1.96	0.63
	Lower-stream	2.07	0.67
	Mixed-ability	2.18	0.59
Teacher Support	Upper-stream	2.40	0.96
	Lower-stream	2.67	0.99
	Mixed-ability	2.64	0.94
Involvement	Upper-stream	2.69	0.85
	Lower-stream	2.87	0.85
	Mixed-ability	2.93	0.75
Task Orientation	Upper-stream	2.00	0.70
	Lower-stream	2.27	0.76
	Mixed-ability	2.09	0.70
Investigation	Upper-stream	2.93	0.91
	Lower-stream	3.14	0.92
	Mixed-ability	2.89	0.84
Cooperation	Upper-stream	2.10	0.83
	Lower-stream	2.28	0.87
	Mixed-ability	2.37	0.84
Equity	Upper-stream	2.00	0.98
	Lower-stream	2.21	1.03
	Mixed-ability	2.13	0.93

upper-stream n=265; lower steam=215; mixed-ability=101

For three of the scales (*student cohesiveness, cooperation* and *involvement*) the mixed-ability group rate their classroom learning environments more negatively than both the lower and upper-streams. For the scale of *investigation* the mixed-ability group rate their classroom learning environment more positively than both the streamed groups and for three of the scales (*teacher support, task orientation* and *equity*) they rate their classroom learning environment mid-way between the upper and lower-stream groups. These inconsistencies are not surprising when it is considered that mixed-ability classes are made up of students who could potentially in the following year be either upper-stream or lower-stream.

Table 4.6 shows that for all scales except for *Equity*, there is a significant relationship between perception of classroom learning environment and whether the class is upper-stream, lower-stream or mixed-ability. This result gives the statistical basis for further analysis of variables. As reported by Popham (1993), using the 'F' statistic "allows us to check for significant differences among two or more groups that have been subdivided according to a variable of interest." (p. 272) The groups in this study are the different streams and the variables of interest are the scales of the *WIHIC* taken one at a time. The scale of *equity* is one that the sample schools pride themselves in as shown by the positive scores for student perceptions of equity in the classroom. Given that students across the upper-stream, lower-stream and mixed-ability classes are all very positive on equity, it is not surprising that the scale of *equity* does not discriminate on the basis of 'stream' to a significant level.

Table 4.6
Tests of Between-Stream Effects – Showing Significance of Relationship Between Streams and Scales of the WIHIC.

Dependent Variable	Type III Sum of Squares	df	Mean Square	F
Student Cohesiveness	3.99	2.00	2.00	4.95**
Teacher Support	9.68	2.00	4.84	5.17**
Involvement	5.97	2.00	2.98	4.33**
Task Orientation	8.93	2.00	4.47	8.57***
Investigation	6.73	2.00	3.37	4.13*
Cooperation	7.27	2.00	3.64	5.07**
Equity	5.65	2.00	2.82	2.88

* p<0.05, **p<0.01, ***p<0.001

To further examine the key variables associated with the research questions, an analysis of the effect size of the difference between upper and lower-streams in terms of students' perceptions of their classroom environment as measured by the actual form of the *WIHIC* was carried out and the results are shown in Table 4.7.

Using the means and standard deviations of each scale of the *WIHIC* for upper and lower-stream, the following formula was used to calculate the effect size (Cohen, 1992):

$$d = \frac{mean_1 - mean_2}{\sqrt{(sd_1.sd_1 + sd_2.sd_2)/2}} \qquad (4.1)$$

According to Cohen (1992) coefficients of 0.2 indicate a small effect size, coefficients of 0.6 indicate a medium effect size and coefficients of 0.8 indicate a large effect size.

Table 4.7
Mean, Standard Deviation, Effect Size and t-test for Differences Between Student Perceptions of Classroom Environments in Upper and Lower-streams.

	Mean		Standard Deviation		Difference between streams	
	Upper	Lower	Upper	Lower	Effect Size	t value
Student Cohesiveness	1.98	2.04	0.22	0.42	0.17	10.156*
Teacher Support	2.39	2.55	0.50	0.64	0.28	-1.854
Involvement	2.70	2.80	0.29	0.44	0.27	7.314*
Task Orientation	2.00	2.22	0.30	0.38	0.62	1.052
Investigation	2.89	3.10	0.33	0.40	0.57	6.347*
Cooperation	2.12	2.30	0.30	0.36	0.53	5.023*
Equity	2.01	2.12	0.46	0.59	0.20	-0.894

*p<0.001

It can be seen from Table 4.7 that there is a medium effect size for the scales of *task orientation*, *investigation* and *cooperation* and a small effect size for the rest of the scales.

Comparing Student Aspirations for Learning Environments Across Streams

Table 4.8 provides figures to show the difference between the *actual* mean scores for each scale and the *preferred* mean scores for each scale across the whole sample. It can be seen that the actual mean scores ranged from 2.04 to 3.00 remembering that the *WIHIC* has a five point scale, 1 being the most positive and 5 being the least positive.

The preferred mean scores ranged from 1.58 to 2.34 and the differences between the *actual* and *preferred* scores ranged from 0.41 to 0.71. The mean difference between the two forms of the *WIHIC* was 0.51 which on a five point scale represents approximately a 10 percent difference.

Table 4.8
Scale Means and Standard Deviations for Actual and Preferred Students Scores on Seven Scales of the WIHIC

WIHIC	Scale Mean			Standard Deviation	
Scales	Actual	Preferred	Differences	Actual	Preferred
Student Cohesiveness	2.04	1.61	0.43**	0.64	0.57
Teacher Support	2.54	2.00	0.54**	0.97	0.84
Involvement	2.80	2.34	0.46*	0.83	0.86
Task Orientation	2.12	1.58	0.54**	0.73	0.68
Investigation	3.00	2.29	0.71*	0.91	0.99
Cooperation	2.21	1.80	0.41**	0.85	0.77
Equity	2.10	1.62	0.48	0.99	0.74

n = 581 * $p<0.05$ ** $p<0.01$

This difference between *actual* and *preferred* scores on the *WIHIC* could be called 'student aspirations' because it measures the difference between what they currently have in class and what their ideal classroom would be. Having established that there was a significant difference between the *actual* scores and the *preferred* scores across the whole sample, the same differences were measured after the groups were split for stream. Table 4.9 separates the data between upper-stream, lower-stream and mixed-ability classes. It can be seen from the figures that in every scale the upper-stream is seeking greater changes than the lower-stream. In the scales of *equity*, *cooperation* and *teacher support* the differences between the *actual* and *preferred* environments for the upper and lower-stream are very small. For *investigation, task orientation, student cohesiveness* and *involvement*, the upper-stream show a much greater difference between their *actual* and *preferred* classroom learning environments than do the lower-stream.

Table 4.9 also provides a comparison between the aspirations of the upper-stream compared to the mixed-ability classes. For every scale except for *investigation* the mixed-ability class is seeking a greater change to their classroom learning environment than is the upper-stream. The area where the mixed-ability class wants the greatest change compared to the upper-stream class is in *teacher support* where the difference is 0.18.

Table 4.9 also shows that the mixed-ability class wants more change than the lower-stream group in all scales. The mean differences between the mixed-ability group and the lower-stream in terms of their wish for improved classroom environments ranged from 0.06 to 0.19. Looking at all of the data from Table 4.9, it is clear that the mixed-ability classes are least satisfied with their classroom environment and have the greatest aspirations for change to occur. This will be discussed further in the discussion of Chapter 6.

Table 4.9
Comparison of the Differences Between the Actual and Preferred Forms of the WIHIC for Each of the Streams.

WIHIC Scales	Differences between actual and preferred scale mean scores for each stream (aspirations of each group)			Comparison of differences between aspirations of each group.		
	Upper	Lower	Mixed	Upper-Lower	Upper-Mixed	Mixed-Lower
Student Cohesiveness	0.45	0.36	0.49	0.09**	-0.04**	0.13**
Teacher Support	0.52	0.51	0.70	0.01**	-0.18**	0.19**
Involvement	0.49	0.40	0.50	0.09*	-0.01*	0.10*
Task Orientation	0.56	0.47	0.62	0.09**	-0.06**	0.15**
Investigation	0.78	0.63	0.72	0.15*	0.06*	0.09*
Cooperation	0.39	0.38	0.53	0.01**	-0.14**	0.15**
Equity	0.47	0.46	0.52	0.01	-0.05	0.06

*p<0.05, **p<0.01 upper-stream n=265 lower steam n=215 mixed-ability n=101

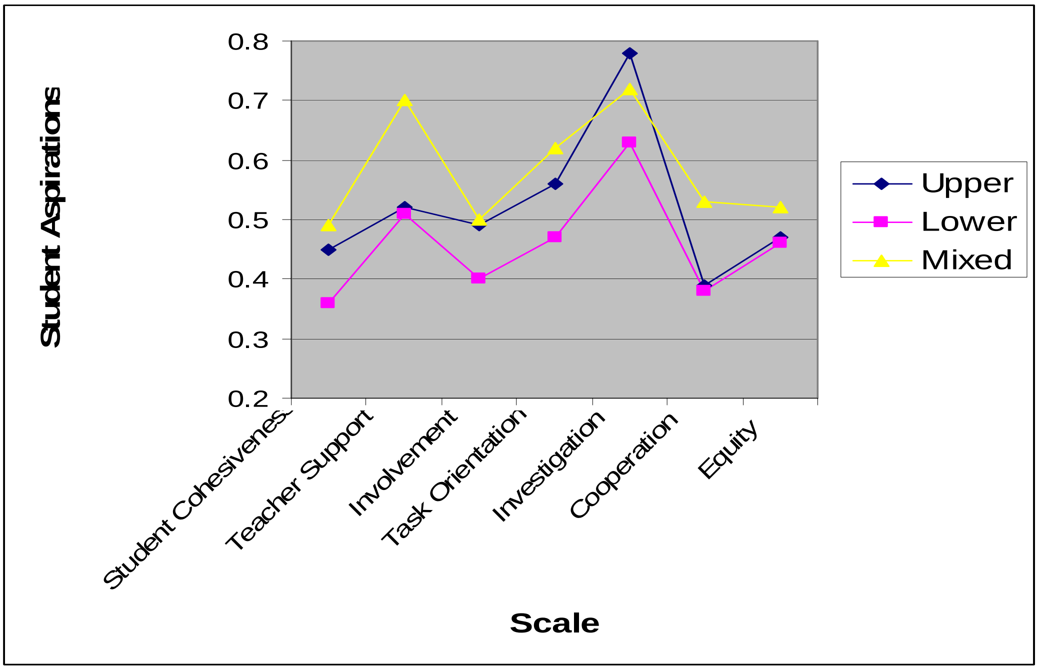

Figure 4.1. The student aspirations for their mathematics class by stream as measured by the difference between *preferred* scores and *actual* scores for each scale of the *WIHIC*

Figure 4.1 illustrates the differences between the mean scores of each stream on their *actual* and *preferred* forms of the *WIHIC*. This line graph clearly shows that the lower-stream had the least aspirations for change in their classroom environment even though their environment was rated the lowest. It also shows that the Mixed-ability group had the greatest aspirations in all but the 'investigation' scale for a positive change in their classroom learning environment.

Comparing Perceptions of Actual Learning Environments Across Streams.

Putting the *preferred* data aside now and reporting the *actual* classroom learning environment perceptions in isolation, Table 4.10 provides data to show the means, standard deviations and differences between upper-stream, lower-stream and mixed-ability mean scores for each of the seven scales of the *WIHIC*. For every scale the upper-stream perceived their classroom learning environment more positively than did the lower-stream. As can be seen in Table 4.10, the differences in mean scores ranged from 0.11 for *student cohesiveness* to 0.27 for *teacher support* and *task orientation.*

The standard deviation of the mean scores for each scale by stream showed that in all scales except one the lower-stream had a larger spread of scores than did the upper-stream indicating that the perceived classroom learning environments in the upper-stream classes are less variable than the lower-streams.

Table 4.10 also illustrates that the lower-stream perceptions of classroom environment are not so distinct from the mixed-ability classes as they are from upper-stream classes. In fact the lower-stream scored their perceptions more positively in the areas of *student cohesion, involvement* and *cooperation* than did the mixed-ability classes. Again the lower-stream class had a wider spread of scores than the mixed-ability classes as shown by the higher standard deviation. The smallest difference between the two groups is in *teacher support* (0.03) and the greatest difference is in the area of *investigation* (0.25).

Table 4.10 also compares the upper-stream and the mixed-ability classes. In this case it can be seen that the upper-stream is clearly reporting a more positive classroom learning environment on each of the scales except for *investigation* where the means are very close. The mean difference between the two groups of students is 0.16 with several scales being more than 0.2 different. Except for *cooperation* and *task orientation* the upper-stream has greater values for standard deviation. This indicates that though the mixed-ability classes are diverse in their abilities and motivations, they have a narrower spread of scores on the *WIHIC* and participants in these classes are therefore in greater agreement about their perceptions of the classroom learning environment.

Table 4.10
Comparison of the Scale Means of the Different Streams for Each Scale of the WIHIC

WIHIC Scale	Scale Means			Stream Differences in Scale Means			Scale Standard Deviations		
	Upper	Lower	Mixed	Upper – Lower	Upper - Mixed	Mixed - Lower	Upper	Lower	Mixed
Student Cohesiveness	1.96	2.07	2.18	0.11**	0.22**	-0.11**	0.63	0.67	0.59
Teacher Support	2.40	2.67	2.64	0.27**	0.24**	0.03**	0.96	0.99	0.94
Involvement	2.69	2.87	2.93	0.18*	0.24*	-0.06*	0.85	0.85	0.75
Task Orientation	2.00	2.27	2.09	0.27**	0.09**	0.18**	0.70	0.76	0.70
Investigation	2.93	3.14	2.89	0.21*	-0.04*	0.25*	0.91	0.92	0.84
Cooperation	2.10	2.28	2.37	0.18**	0.27**	-0.09**	0.83	0.87	0.84
Equity	2.00	2.21	2.13	0.21	0.13	0.08	0.97	1.03	0.93

*p<0.05, **p<0.01 upper-stream n=265 lower steam n=215 mixed-ability n=101

Table 4.11 shows a comparison of the Year 9 and Year 10 upper-stream and lower-stream perceptions of their classroom learning environment. It can be seen from the table that while the Year 10 upper-stream clearly has a more positive perception of their classroom learning environment than the Year 9 upper-stream, the opposite is true for the lower-stream where student perceptions of their classroom learning environment are more negative in Year 10 than in Year 9 for every scale of the *WIHIC*.

The significance values associated with the difference in year levels also indicate that year level is not a significant predictor of classroom learning environment perception for the upper-stream in all but two scales. In the lower-stream, year level does seem to be a better predictor of classroom learning environment perception in all but two scales. Being in a lower-stream class appears to have an impact on the students' perceptions of their classroom learning environment and will be discussed further in Chapter 6.

Table 4.11
Compares Scale Means for Upper and Lower-stream Year 9 and Year 10 Students on the Seven Scales of the WIHIC

	Scale Means					
	Upper-stream			Lower-stream		
	Year 9	Year 10	Difference	Year 9	Year 10	Difference
Student Cohesiveness	2.02	1.91	0.11	2.05	2.09	-0.04
Teacher Support	2.70	2.17	0.53**	2.33	2.95	-0.62**
Involvement	2.79	2.61	0.18	2.73	2.98	-0.25*
Task Orientation	1.99	2.01	-0.02	2.04	2.47	-0.43**
Investigation	2.92	2.93	-0.01	2.94	3.30	-0.36**
Cooperation	2.12	2.08	0.04	2.26	2.30	-0.04
Equity	2.25	1.79	0.46**	1.94	2.44	-0.5**

*$p<0.05$ **$p<0.01$ Year 9: upper n=118 Year 10 :upper n=14 7Year 9 lower: n=97 Year 10 lower: n=118

To more clearly illustrate the trend of more negative perceptions of classroom environment as the students make the transition from Year 9 to Year 10, Figure 4.2 (upper-stream) and Figure 4.3 (lower-stream) show a widening gap between the perceptions of students in Year 9 and Year 10 for several scales of the *WIHIC*.

Remembering that lower scores represent more positive outcomes on the version of the *WIHIC* used for this study, in Figure 4.2 it can be seen that the upper-stream in Year 10 is more positive about their learning environment on most scales of the *WIHIC* than the upper-stream in Year 9. There has been an improvement in the perceptions they have of their learning environment between Year 9 and Year 10

Now looking at Figure 4.3 it can be seen that the trend is in the opposite direction for the lower-stream students. The lower-stream Year 10 students have a less positive perception of their classroom learning environment on most scales of the *WIHIC* than do the lower-stream Year 9 students.

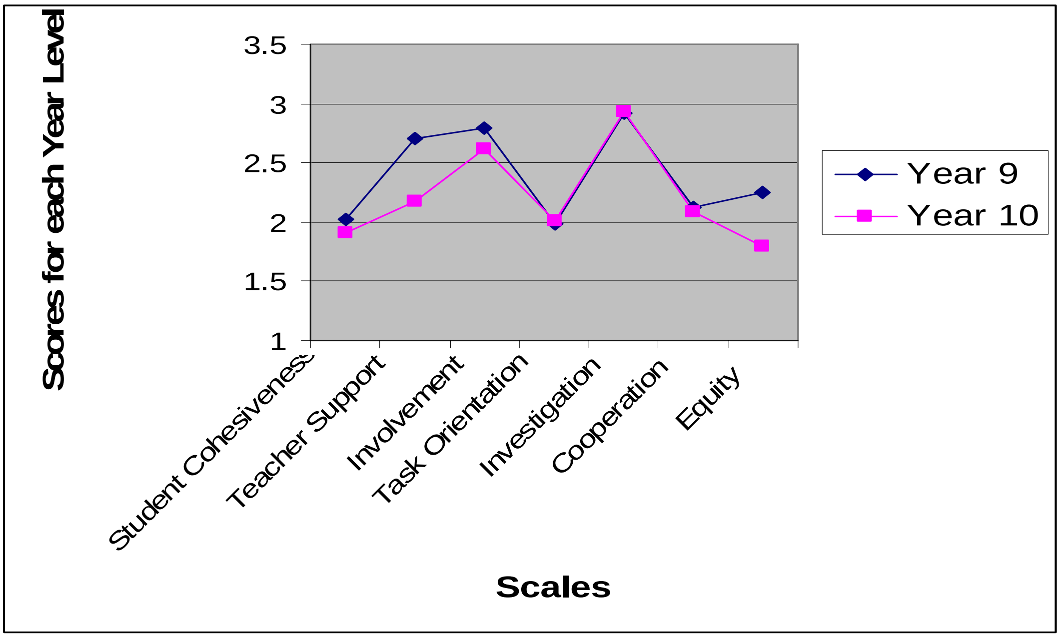

Figure 4.2. Comparing Year 9 and Year 10 upper-stream student scores on each scale of the *WIHIC*. Lower values correspond to more positive perceptions.

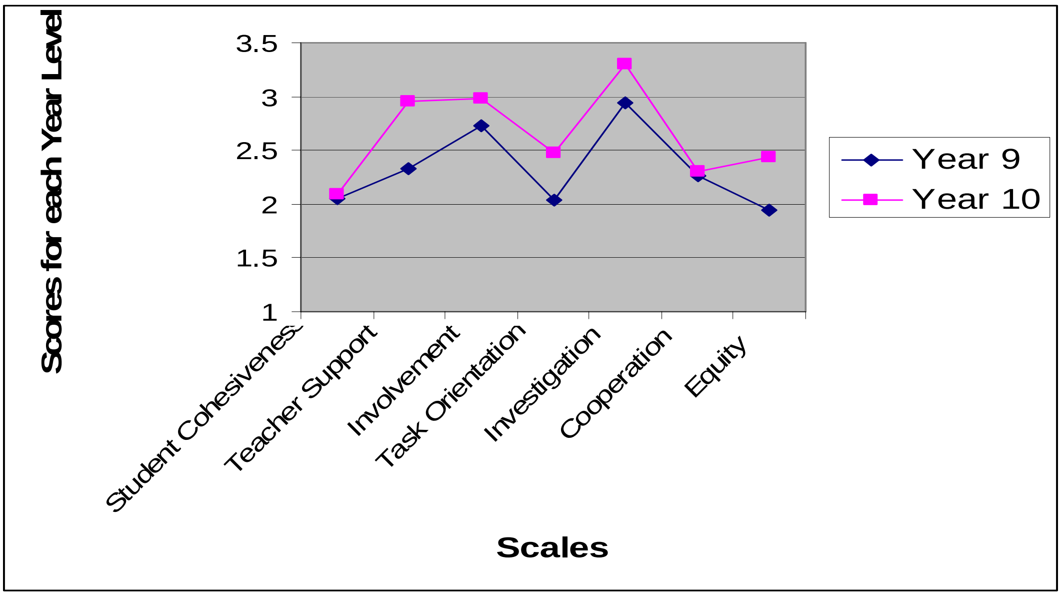

Figure 4.3. Comparing Year 9 and Year 10 lower-stream student scores on each scale of the *WIHIC*. Lower values correspond to more positive perceptions.

It needs to be considered that the Year 9 and Year 10 classes in the sample are different students. A longitudinal study over two years would be interesting to track the same group moving from Year 9 to Year 10. In this study it was found that the trend described here was evident in each school of the sample that streamed in both Year 9 and Year 10 as well as for the sample as a whole.

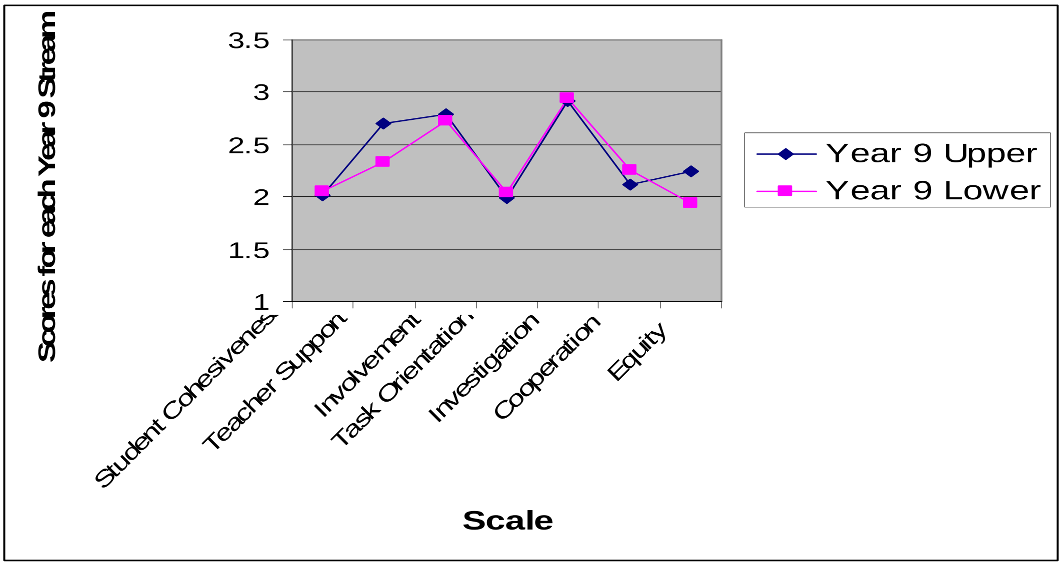

Figure 4.4. Comparing Year 9 upper-stream and lower-stream student scores on each scale of the *WIHIC*. Lower values correspond to more positive perceptions.

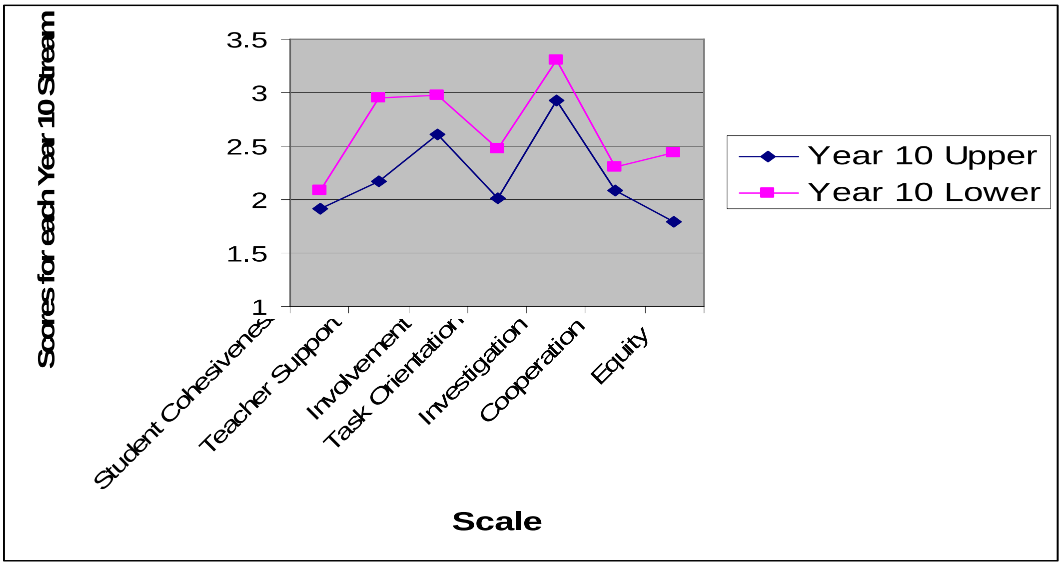

Figure 4.5. Comparing Year 10 upper-stream and lower-stream student scores on each scale of the *WIHIC*. Lower values correspond to more positive perceptions.

When Figure 4.4 and Figure 4.5 are examined together it can be seen that while there is not a clearly defined difference between Year 9 lower-stream and upper-stream students in terms of the perceptions they have of their classroom environment, in Year 10 there is a clear distinction between the perceptions each stream has of their learning environment.

4.5 Associations Between Student Attitude to Mathematics Classes and Perceptions of Classroom Environment

A comparison of student attitudes to mathematics classes is illustrated in Table 4.12. During analysis the attitude data were recoded to make the lower scores the more positive ones and thus align with the *WIHIC*. This means that 1 was recoded as a 5, 2 as a 4, 4 as a 2, and 5 as a 1. It can be seen from Table 4.12 that attitude is significantly more positive in upper-stream classes than in lower-stream classes except for Year 9 English speaking females. The only item where the two streams provided close responses was question nine. Here the students were asked if they thought there should be more mathematics classes in a week. It seems the classes were unanimous in their response to this question as the majority responded in the negative to this question. Apart from that one anomaly the differences in the mean attitude of students ranged from 0.22 to 0.49 with a mean of 0.37. Apart from two questions on the attitude survey the lower-stream had a greater spread of answers than did the upper-stream as evidenced by the standard deviations. Although the scale mean score of the attitude data were the unit of analysis, it proved meaningful to examine the mean scores for individual items on the attitude scale.

As was reported in Section 4.4, a trend that had been identified showed that lower-stream perceptions of classroom learning environments became less positive as students moved from Year 9 to Year 10 while upper-stream perceptions of classroom learning environments became more positive from Year 9 to Year 10.

Table 4.12 shows that the same is true for attitude where for every category of student in Year 9, attitude to mathematics is more positive in Year 10 if they are an upper-stream student and is more negative if they are a lower-stream student. The only exception to this is English speaking lower-stream males whose attitude remained the same in Year 10 and Year 9.

The questions in the attitude survey that showed the greatest positive difference for the upper-stream, while showing the greatest negative difference for the lower-stream, were questions which asked about the students' enjoyment and satisfaction with mathematics classes.

Table 4.12
Mean Attitude Scores for Each Category of the Sample

	Mean Attitude Score							
	Upper-stream				Lower-stream			
	Male		Female		Male		Female	
	Eng	Non-Eng	Eng	Non-Eng	Eng	Non-Eng	Eng	Non-Eng
Year 9	3.18	2.88	3.20	2.62	3.32	3.14	2.85	3.04
Year 10	2.95	2.68	2.88	2.34	3.32	3.38	3.83	3.45

n = 581

The most pronounced example of this type of difference between Year 9 and Year 10 is that of the English speaking females. The upper-stream in this category improves their attitude score by 0.32 or a positive change of 10 percent whereas the lower-stream in this category has a drop in attitude by 0.98 or 34 percent. While this trend is not as pronounced for the males in the sample, it is an interesting finding that will be discussed further in the Chapter 6.

Table 4.12 also separates the attitude data into two groups by males and females. These results show that for every grouping of students except for Year 9 English speaking girls, the upper-stream classes show a more positive attitude to mathematics classes than the lower-stream.

For both genders the survey items that illustrated the greatest differences in attitude between the streams were those asking about the students' enjoyment of mathematics classes or the activities that they do in class. The item creating the least difference between the streams was question 9 on the attitude survey which asked whether there should be more mathematics classes in the week. The female results were significant on a greater number of questions than were the male results. This may indicate that stream is a greater predictor of attitude with females than with males.

A comparison of attitude scores for the upper and lower-streams separated by language spoken at home can also be interpreted from Table 4.12. It can be seen from the data that students in the upper-stream from both language groups have a more positive attitude towards mathematics classes than those in the same categories in the lower-streams. Again the greatest difference between streams is in the area of 'enjoyment of mathematics'.

One interesting result from Table 4.12 is that while for English speaking students the standard deviation for upper-stream is less than the lower-stream, for non-English speaking students that situation is reversed. The non-English speaking students have more variable attitudes in the upper-stream than they do in the lower-stream. This is most likely the product of the diversity of overseas students surveyed and is discussed in Chapter 6. A study of the different cultures and their associated attitudes to mathematics classes is suggested in Chapter 7 of this thesis.

The attitude scores for English speaking students by stream, indicated that stream is a predictor of attitude for these students, whereas only the item on student 'enjoyment of mathematics' classes created a distinction between streams for the non-English speaking students. In Table 4.13 it can be seen that for every item, the upper-stream gave a more positive (lower value) answer than the lower-stream. The mixed-ability group also showed a more positive attitude than the lower-stream on every item. There is no such pattern between the upper-stream and the mixed-ability group.

A result that was common to all three streams was that they scored the same item the most positively, namely the item that examined if finding out about new things were important to them. The most negative response was also common to all three streams. This was the item that asked if they would like more mathematics classes in the week.

Table 4.13

Item Means and Standard Deviations for each Stream on Each Item of the Attitude Survey.

Item	Item Means			Differences			Standard Deviations		
	Upper	Lower	Mixed	Upper-Lower	Upper-Mixed	Mixed-Lower	Upper	Lower	Mixed
1.Look forward to maths classes	2.92	3.20	2.86	-0.27	0.06	-0.33	1.16	1.26	1.14
2. Maths lessons are fun	3.02	3.40	3.06	-0.38	-0.04	-0.34	1.22	1.25	1.13
3. Enjoy the activities	2.97	3.46	3.00	-0.49	-0.03	-0.46	1.18	1.23	1.10
4. Maths the most interesting of a subject	3.58	3.95	3.59	-0.37	-0.01	-0.36	1.20	1.13	1.19
5. Want to find out uses of maths	2.92	3.36	2.90	-0.43	0.02	-0.46	1.23	1.28	1.20
6. Finding out new things is important	1.91	2.13	1.88	-0.23	0.02	-0.25	1.03	1.09	0.89
7. Enjoy maths lessons	2.68	3.15	2.73	-0.47	-0.05	-0.42	1.28	1.35	1.26
8. Like talking to friends about mathematics	3.24	3.51	3.46	-0.27	-0.21	-0.05	1.29	1.25	1.20
9. Should have more maths lessons	3.97	4.02	3.88	-0.05	0.09	-0.14	1.19	1.26	1.12
10. Feel satisfied after maths lessons	2.91	3.33	2.98	-0.41	-0.07	-0.35	1.24	1.33	1.28

upper-stream n=265 lower steam n=215 mixed-ability n=101

Table 4.13 is included to show how attitudes to mathematics classes varied by stream and by specific item. This table shows that the same trends are evident whether the attitude mean score is taken or the mean scores for each item are taken separately.

Table 4.14

A Summary of Means and Standard Deviations for Upper, Lower and Mixed-ability Students Scores on Ten Questions of the Attitude to Mathematics Survey for Each Category of Students

	Mean Score			Differences			Standard Deviations		
	Upper	Lower	Mixed	Upper-Lower	Upper-Mixed	Mixed-Lower	Upper	Lower	Mixed
Year 9	3.14	3.11	3.03	-0.27	0.06	-0.33	0.83	0.96	0.76
Year 10	2.91	3.55	-	-0.38	-0.04	-0.34	0.89	0.79	-
Males	3.00	3.31	3.15	-0.49	-0.03	-0.46	0.86	0.86	0.69
Females	3.03	3.40	2.91	-0.37	-0.01	-0.36	0.89	0.94	0.81
English Speakers	3.04	3.37	3.05	-0.43	0.02	-0.46	0.85	0.92	0.77
Non-English Speakers	2.88	3.28	2.98	-0.23	0.02	-0.25	0.99	0.80	0.68

n = 581

Table 4.14 is a summary of mean attitude data which compares upper-stream, lower-stream and mixed-ability groups for each of the categories data were sorted into. It shows that upper-stream classes are considerably more positive about their attitude to mathematics classes than lower-stream classes apart from the Year 9 students as a group where there is little difference. The group with the most negative attitude score for the upper-stream students was the Year 9 group while the group with the most negative scores for the lower-stream students was the Year 10 group.

Simple correlation and multiple regression analysis were used to determine whether there were connections between students' perceptions of their classroom learning environment and their attitude to mathematics classes. The results of the correlation analysis presented in Table 4.15 show that there is a statistically significant ($p<0.01$) and positive association between the students' attitudes to mathematics classes and all seven of the classroom learning environment scales. Table 4.15 also shows the multiple regression results which indicate that three of the seven scales of the *WIHIC* uniquely account for a significant ($p<0.001$) amount of variance in student attitudes over and above what could be attributed to other environment scales. The scales of significance are *teacher support*, *task orientation* and *investigation*. These three scales also had the greatest positive correlation with student attitudes to class.

Table 4.15
Simple Correlation and Multiple Regression Analysis for Associations Between Students' Attitudes and Scores on the WIHIC.

WIHIC Scales	Student Attitude to Class	
	r	β
Student Cohesiveness	0.15*	-0.08
Teacher Support	0.54*	0.04**
Involvement	0.36*	0.05
Task Orientation	0.51*	0.26**
Investigation	0.45*	0.20**
Cooperation	0.17*	-0.04
Equity	0.43*	-0.01

*$p<0.01$, **$p<0.001$ n=581

An analysis of variance (ANOVA) was conducted for the purpose of establishing the nature of the relationship between the attitude to mathematics classroom survey responses and the seven scales of the *WIHIC*. It was discovered that there is a highly significant relationship ($p<0.001$) between attitude and five of the seven scales of student perception of the classroom learning environment. The two scales that did not report high levels of significance were *student cohesiveness* and *cooperation*. This may be explained by the fact that attitude to mathematics classes in a traditional mathematics classroom environment is more dependent on the teacher, the tasks and the subject itself rather than on the student interaction and the cooperation between students.

4.6 Gender Differences in Perception of Learning Environments

An analysis of the difference in perception of classroom learning environment by scale between males and females is shown in Table 4.16. There is evidence here that females may see their classroom learning environment in a more positive way than do their male counterparts. The greatest differences in student perceptions of learning environments are in *student cohesiveness* and *cooperation* where the differences are 0.23 and 0.31 respectively. For the scale of *investigation* there is very little difference between the two groups. The male sample has a greater spread of scores with an average standard deviation of 0.86 compared to 0.81.

The differences in perception of classroom learning environments between males and females were broken down into upper-stream, lower-stream and mixed-ability. This is shown in Table 4.17. The first observation to be made from this data is that in all scales except *investigation* upper-stream girls rate their classroom learning environment more positively than the boys. The greatest difference was in the area of *cooperation* where the girls rated that scale 0.25 of a point higher than the boys.

Table 4.16
Comparison of Male and Female scale means for Each Scale of the WIHIC

WIHIC (actual)	Scale Mean			Standard Deviation	
Scales	Male	Female	Differences	Male	Female
Student Cohesiveness	2.15	1.92	0.23**	0.66	0.59
Teacher Support	2.58	2.51	0.07	0.94	1.01
Involvement	2.83	2.76	0.07	0.83	0.84
Task Orientation	2.16	2.08	0.08	0.74	0.72
Investigation	2.93	2.92	0.01*	0.95	0.79
Cooperation	2.36	2.05	0.31**	0.91	0.76
Equity	2.15	2.04	0.11	1.01	0.97

* $p<0.05$ **$p<0.01$ males n=299 females n=282

For the lower-stream comparison of boys and girls perceptions of their classroom learning environment it can be seen that the results are not so clear. In the areas of *involvement*, *task orientation* and *investigation* the boys rated their classroom learning environment more positively than did the girls. The girls as for the upper-stream case rated the *cooperation* and *student cohesiveness* scales more positively than the boys. It was interesting to note that for the mixed-ability group the girls were more positive than the boys in every scale except for *equity* and *teacher support*.

Table 4.17
Comparison of Upper, Lower and Mixed-ability Male and Female Means for Each Scale of the WIHIC

	Scale Means								
	Upper-stream			Lower-stream			Mixed-ability		
	Males	Females	Difference	Males	Females	Difference	Males	Females	Difference
Student Cohesiveness	2.05	1.87	0.18*	2.14	2.00	0.14	2.44	1.90	0.54
Teacher Support	2.47	2.34	0.13	2.70	2.64	0.06	2.58	2.70	-0.11
Involvement	2.73	2.65	0.08	2.85	2.89	-0.04	3.05	2.80	0.25
Task Orientation	2.06	1.94	0.11	2.27	2.28	-0.01	2.17	2.01	0.15
Investigation	2.82	3.04	-0.23*	3.07	3.21	-0.14	2.89	2.88	0.01
Cooperation	2.22	1.97	0.25*	2.37	2.19	0.18	2.71	2.00	0.71
Equity	2.07	1.92	0.16	2.28	2.14	0.14	2.07	2.18	-0.11

* $p<0.05$ **$p<0.01$ males n=299 females n=282

4.7 Language Differences in Perceptions of Classroom Learning Environments.

Table 4.18 provides data to show that international students, or students who speak languages other than English at home have a more negative perception of their classroom learning environment than do the English speaking students. The figures show that in all scales except *involvement* and *investigation* the native English speakers rate their classroom learning environment more positively than the non-English speaking students. Apart from those two scales the differences in perception of each group range from 0.1 to 0.20. Of significance are the scales with the largest difference which are *teacher support* and *equity*. Non-English speaking students rate these scales very poorly in terms of their perception of the learning environment. The non-English speaking students also have a greater spread of scores in six of the seven scales indicating a wider range of experiences encountered by these students. The F ratio which predicts whether the students are native English speakers or not according to their scores on the *WIHIC* is 3.15 at a significance level of $p<0.05$. This could indicate that language does differentiate perceptions of classroom learning environments in a significant way.

Table 4.18
Comparison of English Speaking and Non-English Speaking Means for Each Scale of the WIHIC

WIHIC Scales	Scale Mean			Standard Deviation	
	English Speaking	Non-English speaking	Differences	English Speaking	Non-English speaking
Student Cohesiveness	2.02	2.12	-0.10	0.61	0.75
Teacher Support	2.51	2.68	-0.17	0.99	0.88
Involvement	2.80	2.79	0.01	0.82	0.89
Task Orientation	2.09	2.23	-0.14	0.73	0.74
Investigation	3.04	2.84	0.20*	0.90	0.91
Cooperation	2.19	2.32	-0.13	0.83	0.93
Equity	2.06	2.26	-0.20	0.99	1.02

* p<0.05 English speaking n= 474   Non-English speaking n=107

Table 4.19
Comparison of Upper, Lower and Mixed-ability English Speaking and Non-English Speaking Means for Each Scale of the WIHIC

	Scale Means								
	Upper-stream			Lower-stream			Mixed-ability		
	English speaking	Second Language	Difference	English speaking	Second Language	Difference	English speaking	Second Language	Difference
Student Cohesiveness	1.93	2.11	-0.18	2.06	2.11	-0.05	2.18	2.18	0.01
Teacher Support	2.38	2.53	-0.15	2.62	2.85	-0.23	2.65	2.60	0.04
Involvement	2.69	2.70	-0.01	2.86	2.89	-0.03	2.97	2.75	0.22
Task Orientation	1.93	2.16	-0.23	2.25	2.37	-0.12	2.10	2.05	0.05
Investigation	2.95	2.82	0.13	3.21	2.88	0.32*	2.92	2.74	0.18
Cooperation	2.05	2.31	-0.26	2.28	2.27	0.01	2.35	2.48	-0.13
Equity	1.96	2.16	-0.19	2.17	2.36	-0.19	2.10	2.24	-0.14

* p<0.05

Table 4.19 shows the comparison of perceptions of classroom learning environments when the English speaking and non-English speaking students were categorised into upper-stream and lower-stream. It can be seen from the data that for the upper-stream students, the English speaking students rated their classroom environment more positively than their non-English speaking classmates. This was true for every scale except *investigation*. For the scales of *task orientation* and *cooperation* the gap between the two groups was the greatest.

In Table 4.19 it can be seen that the non-English speaking students feel that their learning environment is more negative than the English speaking students. Again it is only *investigation* where this is not the case. It is worth noting here that the greatest gap between the two groups in the lower-stream is for *teacher support* and *equity*.

4.8 Summary

This chapter has detailed the results of the quantitative data collection. It has reported the factor structure of both the actual and preferred versions of the *WIHIC*, has discussed the reliability of the instrument used, has presented data that compares perceptions of learning environments in streamed and mixed-ability classes. There is also data presented on the association between attitudes to mathematics classes and perceptions of learning environments as well as data which describes any gender and cultural differences in both attitude and perceptions of classroom learning environments.

The next chapter will present the qualitative data.

CHAPTER 5

QUALITATIVE DATA ANALYSIS AND FINDINGS

5.1 Introduction

Chapter 4 presented the quantitative data taken from the 581 students in the sample. In this chapter qualitative data will be presented from the student perspective and also from three other significant stakeholders – trainee teachers, practising teachers and parents. The reason for not including these groups in the quantitative data collection was that the primary research question revolved around student perception. Students are equipped to give accurate quantitative assessments of their perceptions of their classroom learning environment because they are first hand participants in each class. The inclusion of trainee teachers and parents sought to add triangulation and a deeper understanding of the sample.

This chapter presents the qualitative validation data for the quantitative instrument used in this study, namely the *WIHIC.* Section 5.2 addresses each scale of the instrument systematically when presenting data from respondents. It seeks to further validate results that were presented in the quantitative data section in Chapter 4. It then goes on to present the qualitative data gathered from interviews conducted with students, trainee teachers, practising teachers and parents. Several methods of collection were employed during this study including individual interviews, small group interviews, focus groups and emails. These methods were chosen to improve validity and reliability of the data by triangulating various views from the sample. These methods were detailed in Chapter 3.

The chapter is organised in such a way that after reporting data that validates the scales of the *WIHIC*, data is then presented to systematically address the research questions. Each section has responses from the students, trainee teachers, teachers and parents.

The data were collected from students primarily by email. Trainee teacher datum was collected in focus groups. Teacher datum was collected by face-to-face interview and email and parent's data were also by personal interview and email.

5.2 Validation of the WIHIC Scales

Students when interviewed were first asked general questions about their opinion and experiences with streaming in mathematics classes and what they saw as the differences between upper and lower-streams in terms of classroom learning environment. It was expected that answers may fall into categories that would equate with scales of the *WIHIC*. These answers could then be used to further validate the *WIHIC* as an instrument, to validate the scales of the *WIHIC* and to add meaning to the quantitative data collected using the *WIHIC*. What resulted from this study was that responses given by participants in many cases did in fact confirm the quantitative results presented in Chapter 4. These data also served to introduce new perspectives that quantitative datum was not able to retrieve.

5.2.1 The *Student Cohesiveness* Scale

In the quantitative data it was found that the scale of *student cohesiveness* did demonstrate a significant difference between streams. When looking at the difference in mean scores for the scales of the *WIHIC* it was found that this scale produced the smallest differences. When interviewed, the students in all classes were more agreed on this scale than on any other scale. This notion of a small but significant difference is supported by the qualitative data where 34 out of 35 student respondents said that they were happy with the students in their class and that they do get along well together. Typical of comments that illustrate *student cohesiveness* across the streams follow: (the student names are fictional in the interests of student privacy as per ethics guidelines)

> *Cassandra: We all get on well and we all help each other out whether we are friends or not. (upper-stream)*
>
> *Alicia: We get on pretty well. We all have our little groups that we work in (lower-stream)*
>
> *David: Mostly all of the kids in our class are close friends. (mixed-ability)*

These comments are typical of the answers received for each stream. There was no discernable difference in the answers that provided support for *student cohesiveness* as a scale. These data seem to verify that for this sample the stream a student is in does not the affect in a major way the level of *student cohesiveness*.

5.2.2 The *Teacher Support* Scale

The scale of *teacher support* brought about the largest quantitative differences between the streams. It is interesting to note that in the quantitative data, questions regarding attitude showed the highest levels of correlation with the *teacher support* scale of the *WIHIC*. The differences in perceived *teacher support* between streams and its connection to attitude are illustrated in the following typical comments from students:

> *Andrew: I have become more confident towards doing maths in Year 10 because of great support from teachers and other students who enjoy maths as much as I do. (upper-stream)*

> *Hannah: I think the teachers in the dumber maths are less skilled (aren't very good at explaining things) and don't really care about the kids because they know we are just probably going to give up anyway. (lower-stream)*

> *Neva: I think the teacher support will be a lot better when we get into a streamed class because they would be able to spend more time with everyone instead of just the people that aren't so good at maths and that would make it a much easier learning environment. (mixed-ability)*

The level of *teacher support* is a key factor that has been identified by students as a determinant of their perceptions of the classroom learning environments in upper and lower-stream classes. These comments made by students also support the large numerical difference in scale mean recorded in Chapter 4 between the streams and the way in which they perceive *teacher support*.

The comments made by students also make a link between their level of perceived *teacher support* and their attitude to the class. This serves to support the strong and significant positive correlation between attitude to mathematics classes and the *teacher support* scale of the *WIHIC*.

5.2.3 The *Involvement* Scale

For this scale the students in the upper-stream mathematics class were quite definite that they were content with their level of *involvement*. More than 80 percent of upper-stream respondents indicated in the interviews that they perceived their level of involvement in their class positively. This was also indicated in the quantitative data where the scores on the *involvement* scale for the upper-stream students were higher than for the other streams. There were also positive responses to the scale of *involvement* for the lower-stream students and for the mixed-ability group but they were a lesser proportion of the total student sample. This is consistent with the quantitative data collected. Some typical responses follow:

> *Roslyn: From my experience the people in advanced participate more than those in the lower classes. (upper-stream)*

> *Tabitha: I get involved all the time. It is easy because I am quite outspoken but almost everyone is comfortable enough to share their thoughts. (lower-stream)*

> *Jessie: Yes. All of the discussions are very interesting and fun to join in. (mixed-ability)*

> *Ali: No. I don't get involved. I'd rather just listen rather than speak up and feel stupid. (lower-stream)*

It appeared from the data that the level of involvement of students had a lot to do with their own personality as well as with the environment set by the teacher. Student personality is a factor not accounted for in the quantitative data but was seen to play a part as the qualitative datum was being collected. This was evident in answers from students that indicated personality factors such as shyness or openness, or fear of embarrassment.

5.2.4 The *Task Orientation* Scale

Chapter 4 showed that along with *teacher support*, the scale of *task orientation* showed the greatest difference between the streams as measured by the *WIHIC*.

Whether the student belonged to an upper-stream class, a lower-stream class or a mixed-ability class, the interview data showed that more than 80 percent of students accepted the fact that upper-stream classes settle to their work whereas lower-stream classes are disruptive and unsettled. Other stakeholders interviewed also acknowledged this fact. This will be presented later in the chapter as the validation of the quantitative data only involves students. Examples of student answers from interviews follow:

> *Michael: The kids in the other class tell me that the other class doesn't really do much and just stuffs around all class. Everyone in my class wants to be there. (upper-stream)*
>
> *Andrew: The lower-stream usually do not enjoy maths and therefore don't want to put in the time and effort. (upper-stream)*
>
> *Nikki: The other class would have much better behaved kids there who get on with their work. (lower-stream)*
>
> *Hannah: The smarter kids in the other class would be less inclined to muck around and make a noise because they can actually do their work. In the dumber maths I think the kids muck around a lot more because they just give up on their maths when they don't know how to do it and aren't getting good attention from the teacher. (lower-stream)*
>
> *David: I think that if the classes were to stay mixed for next year (Year 10), the lower students would bring the higher students down by disrupting them and the higher students would bring the lower students up because of their*

insights and the fact of their setting a good example. (mixed-ability)

Neva: I want our classes to be separated into people who want to learn and people who don't really care if they learn or not, then it would be a lot easier to learn more things. (mixed-ability)

As with the quantitative data, *task orientation* emerged from the interviews as being one scale that had major differentiation in student perceptions of the upper and lower mathematics streams.

5.2.5 The *Investigation* Scale

The upper-stream and the mixed-ability group were found to be very keen for more investigation to be done in their classes. The quantitative data also showed that the lower-stream provided the least positive answer to the scale of *investigation* but also had the smallest difference between their *actual* and *preferred* scores for this scale. This supports the notion that while not too many investigative activities were going on in their classes, students are quite happy for their class lessons to stay that way. During the interviews, it was difficult to get students to talk about investigations in more than one or two word sentences. This may be because there is little investigation done in the traditional classrooms that made up the majority of the sample. A natural hesitancy and lack of confidence was evident. Examples of short responses were:

Nel: I don't mind the activities if I can do them in private with no public discussions (upper-stream)

David: It may be surprising but I don't mind them. (upper-stream)

Lori: I don't like problem solving because it is too much work. (mixed-ability)

Ali: I only like doing investigations in areas I understand. (lower-stream)

Gary: They are Ok as long as they don't take too long. (lower-stream)

Only a small sample of around 10% of the upper-stream student respondents gave any substantial answers as to how they would like investigations to make up a greater part of what they do. These answers provided confirmation for the quantitative data collected as they triangulated well. For example:

Luke: Maths could become more interesting if you actually used it in a practical way like doing a bridge making project where you have to use a lot of equations and maths in general to work out the size and shape of everything. (upper-stream)

Andrew: It's important that maths is taught properly from a young age so that people will understand it and enjoy it. If it's not then people will lose their concentration and will not enjoy it. It would also be good if there are some fun activities related to the topic. (upper-stream)

As for the quantitative data, the upper-stream students showed more interest in investigative tasks than did the lower-stream students. It is an interesting finding that it was the boys in the upper-stream who were keen for more investigation than the girls. This factor did not become apparent from the quantitative student data. However for the sample who were interviewed it was a factor that was presented as having some importance.

5.2.6 The *Cooperation* Scale

The factor analysis for the *WIHIC* showed that there was some confusion by the students evident in student responses between the scales of *cooperation* and *student cohesiveness*. The data did show a statistically significant difference between the upper and lower-streams on these two scales. It was also found that the difference between male and female responses was the greatest in the areas of *cooperation* and *student cohesiveness*. These findings were supported in the qualitative data. Examples of typical responses are:

Andrew: I get great support from other students who enjoy maths as much as I do. (upper-stream)

Tabitha: Yeah we cooperate OK but we don't really do much group activities. (lower-stream)

Jenny: Do we cooperate? Ha ha. Maybe too much. The guys talk a lot. (mixed-ability)

Roxanne: Sometimes there are arguments, but most of the time its OK. (mixed-ability)

Alice: If someone asks another person for help, even if they don't like that person, they will still give them help with what they need. (lower-stream)

Alex: Like all classes there's always a small tiff but 98% of the time everyone cooperates. (lower-stream)

Rose: If the teacher is busy we try to help each other. (upper-stream)

Kate: The kids in my class cooperate quite well. When someone is finished, they are quite happy to go around and help each other, especially when we have group activities. (upper-stream)

Sharon: Although at times we have issues with noise, our class is very close and love helping each other. (upper-stream)

The upper-stream students tend to express the enjoyment that comes from cooperating with each other. There is a genuine willingness to help classmates. While the other students also spoke positively of cooperation within the class, there was usually some form of reservation with their level of cooperation.

The idea of friendships within the class was also evident from the student responses. This association between the scales of *student cohesiveness* and *cooperation* that presented as being related, or at least having some common item of confusion in the factor analysis was reinforced by what students reported in the interview questions that related to both scales; namely *student cohesiveness* and *cooperation.* Conceptually, students reported some level of confusion when determining responses to these scales.

5.2.7 The *Equity* Scale

Overall the *equity* scale did not show statistically significant differences between the mathematics streams defined in this study, even though the upper-stream had a more positive mean score than the lower-stream. The relationship between equity and attitude was statistically significant in the quantitative data. The comments made by students in the interviews supported the finding that there was not a significant difference between the students' perceptions of *equity* in their classrooms in different mathematics classes. In this sample 90 percent of all respondents across the streams indicated that equity was not an issue for them in their classroom. The comments below illustrate that there were some answers that differentiated between streams:

> *Nathan: The relationship with the teacher doesn't differ if you are in advanced or intermediate. (upper-stream).*

> *Ali: The teacher pays more attention to some students more than others. (lower-stream)*

> *David: In the lower class the teacher wouldn't be able to deal with all the questions at the same time. (upper-stream)*

The schools that were sampled in this study were small schools with relatively small classes. The philosophy of these schools is very much focused on treating each student as an individual of worth. This is the Christian ethos. This would explain why the scale of *equity* does not differentiate between streams in a significant way either in the qualitative data or in the quantitative data.

5.3 Learning Environments in Streamed Classes

A major aim of this study is to examine the differences in the classroom learning environments of streamed and mixed-ability mathematics classes as perceived by several key stakeholders in the education process. This section will report on the qualitative data that reports on these questions from the point of view of each stakeholder; namely, the students, the trainee teachers, the practising teachers and the parents. The inclusion of these different and sometimes competing perspectives is a differentiating factor of this study when compared to others available in the literature. Further, this process allows multiple degrees of triangulation to test the quantitative data outcomes.

5.3.1 Upper-stream Student Data

The first two questions the students in upper-stream classes were asked were:

1. You are in a more academic maths class doing a higher level of maths than some of the other kids in your year level. Do you think it is a good idea to have those of similar ability in one class or do you think it would be better to have the classes all mixed? Can you explain the reasons for your answers.

2. What do you think would be the main differences between how your class works and how the class doing easier maths works? Would it just be that you get harder work or would there be other differences?

As the student answers are considered in this section it should be noticed that every answer refers to either the scale of *task orientation* or to the scale of *teacher support*. These are the two scales that showed the greatest difference between upper-stream and lower-stream perceptions of classroom learning environments as measured by the *WIHIC*. The following results are therefore adding emphasis to the perceived gap the students are aware of already between the two streams for these two particular scales.

The first question brought an array of positive responses and just a few negative answers. It can be noticed that students made comments about their classroom learning environments as they gave opinions on streaming. Examples of positive responses given by those in the upper-streams were:

Cassandra: I like being in a class where students are working at the same level as me. (upper-stream)

Roslyn: Streaming not only helps the teacher but the overall feeling of the class. (upper-stream)

There are also those who are concerned about the pace at which the work is being delivered to the students and how some would cope in a mixed-ability class:

David: We should have people of the same ability because then we won't be left behind and we can excel in our work. (upper-stream)

Michael: I think it is a good idea to have the classes separated because that way the people in the less academic classes get more attention and can go at the slower pace while the people in the more academic class can go at a faster pace and won't get held up. (upper-stream)

There were some students in the upper-stream who believed that streaming was not such a good idea. Examples of negative answers given by those in the upper-streams were:

Cassandra: I feel that students in my class are very arrogant towards those in lower maths classes. They constantly taunt other students about their lack of academic ability. I hate the type of behaviour these classes have created.

Nel: I think that the classes should not be streamed because sometimes students purposely don't do well because they want to be in the same class as their friends. Also, some students may excel in some areas of maths but not in others. In mixed classrooms they are able to get extension on those things they are good at and are able to get help on those things they aren't *good at. (upper-stream)*

The second question asked students what they thought would be the difference between upper and lower-streams in terms of classroom learning environment. The upper-stream students gave varied responses about their perception of lower-stream classroom learning environments as compared to their own classroom learning environment. Some examples are:

> *Cassandra: Because the lower classes may have more trouble with the work they seem to play, be rude and terrorise their teacher rather than work . . . . One student in our school was moved up a class, however it wasn't fun enough for her so she went back down. This is very sad because she could have challenged herself further but chose not to. Also I have noticed that the higher the maths level the stricter the teacher gets, however the higher classes seem to be better behaved because they are doing more work and want to work rather than play and the lower classes are misbehaved and have softer teachers. (upper-stream)*

> *Andrew: The lower level classes get less work and their work is easier. I don't think this is good because they are not challenged as much and do not get homework very often. The students in the lower classes are generally those that hate maths but that's usually because they have had trouble. (upper-stream)*

The upper-stream students also had comments to make about their own upper-stream classroom learning environments. For example:

> *Ben :Our class has no fun at all (smarter class) but after maths we hear all the stories from the other maths class about how they got chocolates and lollies and were talking all class etc. We also don't even do the same topics eg. We were doing linear equations and the other class did percentages?? I think that class is a little bit too easy but our class never stops working and it's just the same every day and our class needs to loosen up just a little.*

You also seem to get the more laid back teachers in the other class and get the strict teachers in the smarter class. (upper-stream)

Other examples of comments from upper-stream students who refer to their own classroom learning environment include:

Ben: We do get harder work but it isn't just harder, we have to revise it 50 times the amount the other class revises their work. We get homework every night and the other class is lucky to ever get homework. (upper-stream)

Andrew: At my school the advanced students do more work than the lower classes. It's important that maths is fun. Maybe teachers could make math classes more practical instead of just writing out of the textbook. (upper-stream)

The upper-stream students' responses indicate that they are mostly in favour of streaming to help students cope at a level appropriate to themselves. They seem to be aware that there is a gap between the classroom environments of upper and lower-stream classes and that behaviour and motivation are issues for the lower-stream. Very few upper-stream students believed that streaming was not a good idea and they had valid reasons for this.

5.3.2 Lower-stream Student Data

The first two questions the students in lower-stream classes were asked were:

1. You are in a less academic maths class doing a different level of maths than some of the other kids in your year level. Do you think it is a good idea to have those of similar maths ability in one class or do you think it would be better to have the classes all mixed? Can you explain the reasons for your answers.

2. What do you think would be the main differences between how your class works and how the class doing more difficult maths works? Would it just be that you get different work or would there be other differences?

The opinions and perceptions held by lower-stream students were in most cases in agreement with those that the upper-stream students reported. As with the upper-stream responses, these students focused primarily on the scales of *task orientation* and *teacher support*.

The lower-stream students were very positive about streaming. They were almost exclusively in favour of streaming giving answers such as:

> *Nikki: I personally think it is a good idea to have classes of similar ability because it is much easier for the teacher if he/she is teaching to a group of students that have mostly the same capabilities. (lower-stream)*

One lower-stream student who was opposed to streaming said:

> *Ali: I think it would be good to have all the kids doing the same level of maths in the same class so the teacher is working with them all at the same time and can help them all on a closer level. It would also be better because everyone is doing the same work and can work through it together and this way no one has to feel stupid or dumber if they're doing a less challenging maths. (lower-stream)*

When asked about the differences in classroom learning environments between the two streams some said there was no difference between the two streams except for the level of work and homework, while the others made reference to the poor behaviour affecting the classroom learning environments in their lower-stream classes. An example of the first type of response is:

> *Tabitha: Ummm, well obviously they (extension) would be doing more difficult work... but I don’t think they get as much support as normal math class students because that’s just how the extension teachers seem to teach (but when you think about it, they should be getting as much help because they have harder and more work to do). um, concerning the "attitude to maths", I don’t think extension students are any more dedicated to math*

than any other class. (lower-stream)

A typical example of a response about behaviour difference in classroom learning environments between upper and lower-streams is:

Gary: I think the differences with the classes would be in my opinion that the smarter kids in the other class would be less inclined to muck around and make a noise because they can actually do their work. In the dumber maths I think the kids would muck around a lot more because they just give up on the maths when they don't know how to do it and aren't getting good attention from the teacher. I think the teachers in the dumber maths are less skilled (aren't very good at explaining things) and don't really care about the kids because they know we're probably going to just give up anyway. (lower-stream)

5.3.3 Mixed-ability Class Student Data

The first two questions the students in mixed-ability classes received were:

1. You are in a class where all the students are mixed up for their maths classes. Those who are very good at maths and those who are not so good are in the one class. Do you think this is a good idea or would you rather be in a class for maths with kids who are about the same as you in maths ability?

2. If the class were to be divided up into a higher level maths and a lower level maths, what do you think would be the main differences between the classes apart from the level of difficulty?

Just as with the quantitative data, the interview answers from students in mixed-ability classes were divided down the middle with regard to their opinions on streaming for ability in mathematics classes. Positive comments were similar to the student who said:

Jenny: I think it's an excellent idea because it gives the chance for the *students who actually want to learn to do so. Also we would get a lot more work done because all the students in the class would be working at around the same pace. (mixed-ability)*

Students who wanted to keep their classes as mixed-ability classes made comments such as:

Neva: I like it the way it is because although sometimes it gets annoying when our teacher needs to explain things we already know, we - students good at maths - can help out our friends when the teacher is busy with someone else, helping them move through their work quicker than if they had to wait for the teacher every time they needed help.

Again, even with mixed-ability classes, the comments about the difference between the perceived classroom learning environments of upper and lower-streams were similar to all other answers and revolved around the classroom behaviour and *task orientation* of lower-stream students. Examples of this type of comment are:

Jesse: If the maths classes were divided into higher and lower classes, the lower class would be harder to manage because of their behaviour. (mixed-ability)

David: The main difference would surely be the behaviour, all the kids in the lower class would act up, 'egging' each other on, and the teacher wouldn't be able to deal with all the questions at the same time. The higher maths class would probably be all the students who pay attention. (mixed-ability)

Jenny: The classroom behaviour would definitely change because if the classes were separated into people who want to learn and people who don't really care if they learn or not then it would be a lot easier to learn more things. The teachers support would probably be a lot better because they would be able to spend more time with everyone instead of just the people *that aren't so good at maths and that would make it a much easier learning environment. (mixed-ability)*

A summary of other sentiments expressed by students but not reported on specifically here include responses about the upper-streams having better classroom learning environments because upper-stream students would be quieter in class, they would listen more than the other class, they would do more work in an allotted time, they would get more homework, harder tests and a stricter teacher. Further comments indicated that they believed the teacher would feel more relaxed and in upper-stream classes the students would help each other more and understand each other better than students in other classes. Students believe that teachers would do their best to make sure students reach their potential.

5.3.4 Trainee Teacher Data

While the information sought from the trainee teachers focused on what they perceived to be the differences in classroom learning environments between streamed and unstreamed mathematics classes, a much wider ranging discussion was held on streaming in general in these focus groups. The purpose of this was to allow preservice teacher discussion to reflect on the issues of streaming and perhaps relate this to theory and practice in their training as well as their experiences at school. Two focus groups were conducted, the first with 18 members and the second with 9 members.

The questions that generated the discussion on streaming with the teacher trainees were as follows:

(a) What is your opinion of streaming for ability in secondary mathematics?
(b) Are your answers to the previous question based somehow, negatively or positively, on the type of school you went to?
(c) When you are qualified and sent to a school that does stream, would your first preference be to teach the upper-stream or the lower-stream?
(d) If you were the Head of the Mathematics Department, where would you put your best teacher – upper-stream or lower-stream?

(e) For those of you who are opposed to streaming, is it on academic grounds or social grounds?
(f) Do you think there would be a difference in the classroom environment in a streamed class as opposed to a mixed-ability class?

As the discussions in the focus groups were conducted, many issues and ideas were brought forward. Only the data that is relevant to the research questions on classroom learning environments and streaming will be detailed in this chapter.

Though one teacher training institution was a state university and the other was a private college of higher education, the answers from the trainee teachers were very similar. In general they were in favour of streaming. The interesting part of these results is that the major themes of the following answers revolve around *task orientation* and *teacher support*. This is very similar to how the secondary students answered in both the quantitative and qualitative data. The trainee teachers however introduce a new theme and that is one of *equity*. There is also apparent in this data evidence of stereotyping of students into streams. More was mentioned of their own experiences in secondary school than of any practice or pedagogy they have experienced at university.

Comments that lined up with the scale of *task orientation* included:

Also from the point of view that your higher academic kids are more likely to give it a go while the lower-stream kids want to muck around. The teacher has to separate them so there are not so many interruptions. If we have the opportunity to extend the bright kids, we should extend them.

My best memories of maths come after we were streamed and you were working with kids who wanted to do maths like you did.

There were other comments about lower-stream students 'mucking around' and interrupting the class. There were also comments that further categorised students in this stream:

You've got the bad student that you've got to make sure they are doing their work so they are not disturbing the others from their work.

One trainee teacher made a clinical comment about the differences between the upper and lower-stream classroom learning environments from his own experience. Again it pointed to *task orientation* as being the main point of division but also referred to *teacher support* of the students and to the *cooperation* that existed between the teacher and the students in each of the different streams:

I spent most of my time with top stream Year 9 and 10 classes at an all boy's school and observed a couple of classes of the lower-streams and the difference is quite remarkable. In the top stream they had very few distractions and were on task for what seemed to be about 90% of the lesson. Also the teacher was very relaxed with them. They could have a joke together and it was all quite relaxed. In the lower-stream the behaviour wasn't quite as good and so the teacher was keeping more control over them. Also the top stream is always getting the message that the top kids are going to come from this class and there was always the expectation that they would be accelerated.

Teacher support or the way teachers are able to support their students under different classroom structure was also a comment made frequently by the trainee teachers:

I think there should definitely be streaming. It is better for the brighter kids and certainly better for the lower-stream kids. There is more support for the kids in both cases.

I think that from a teacher's perspective it makes it much harder for them in a mixed-ability class because they have to prepare work and then teach it to so many more levels. By having the kids as basically one group ability wise you are more easily able to cater for that group. So streaming allows you to focus on one group at a time which means you can more easily cater for *the student so each student can be pushed at the level they can be pushed at.*

The issue of *equity* and social justice was a popular point of discussion in the trainee teacher focus groups. This topic was used to argue for and against streaming. The main point was that whether classes are streamed or not streamed, there are issues of equity that do affect how the students feel about their classroom and thus have an impact on their learning environment. One trainee teacher commented that by not streaming we are not practising *equity* because treating all people equally does not make their educational opportunities equal. This point was expanded as reported here:

> *With reference to the issue of social justice, I was reading in the newspaper about how Australia has succeeded in sport over the past decade mostly due to the Australian Institute of Sport and the programs offered for 'elite' sports people. So it is alright to talk about an elite group of people in sport but when it comes to maths we start worrying about the social implications and the damage it could be causing the underachievers. The other side of the issue is that by not streaming for ability we are socially disadvantaging the more able mathematicians. I think we need to stream on a much more regular basis and to make our streaming much more radical*

Another student developed the idea along the same lines of thought with the following:

> *We are talking about the social justice of the lower people. What about the social justice of the higher people? What I have read tells me that there are negative effects of leaving brighter kids in with the ordinary ones. It's only Australia and New Zealand where we say that we have to worry about the social welfare of the lower people. We don't worry about that in our sporting situation. We don't say that we'll have to make special programs to help the underachievers come up to the level of elite sport. We are only interested in the top sportsmen. Why in maths do we have this incredible*

interest in the lower ends of schooling at the expense of the higher ends? There is a fundamental problem with the psyche in Australia.

One of the students who was supportive of mixed-ability classes spoke of the way lower-stream students can see themselves as a result of the culture of streaming in the school:

The strongest argument I think people would make would be the social grounds because in the school culture it is sort of telling them that they are such a class and are less expected to achieve, but in terms of maths I think you can achieve better in a mixed-ability class.

The items from the scales of *student cohesiveness* and *cooperation* were mentioned by the trainee teachers in reference to streaming. There was a belief that it is all very well in theory to have a mixed-ability class with the good mathematicians helping the others keep up with their work, but how this would work in practice was evident and caused scepticism. The following comment, though not appropriate, has been entered in unsanitised form in order to convey the level of scepticism in some cases:

My experience in being streamed was that the stereotypical dumb blond who sits up there at the front is not someone that the higher ability kids will communicate with because we are just as sure not to understand what she is talking about as she won't know what we are talking about.

With regard to educational practice and streaming, there were two opposing comments made that are worthy of note. The first is a comment of exasperation with the notion that streaming in mathematics classes is essential because it would be 'impossible' to teach all levels at the same time. The second comment says that anything is possible under the right conditions:

Even an Advanced class has such a range of abilities. To think of Ordinary and Advanced all together, the range of abilities would be so great that it *would just be impossible.*

I don't think it is just that a streamed class will push you further. Any class will push you further if the motivation and the right structure is there.

It is necessary to extract comments from this data that answer the key question: Is there a difference between the classroom learning environments in upper and lower-stream mathematics classes? These trainees are partway between being a mathematics student in secondary school and becoming a teacher of mathematics themselves. One factor to consider in addressing the question, is that each of them would be very likely to have had a positive history of being successful in mathematics at secondary level, as this is necessary to gain entry to the pre-service teacher education program. It is fair to say that in the interviews with these trainees, there was no comment made at any time that would deny there is a difference in the classroom learning environment between an upper and lower-stream and even in a mixed-ability class.

Of particular concern were the generalisations made which reflect attitudes that may be damaging to students. For example, when asked about their opinion on streaming, one trainee commented that it was absolutely necessary so that the brighter kids could be extended while the lower-stream kids can 'muck around' which is what they want to do anyway. Of equal concern was the comment that mixed-ability classes are a real problem because: "You've got the bad student that you've got to make sure they are doing their work so they are not disturbing the others from their work."

Also when discussing mixed-ability classes and the possibility of students helping each other, several trainees added the following comments:

It doesn't happen . . . . . In the junior high school years they don't care. They just start mucking around.

If they are smart they will not go and sit next to someone who will drag *them down.*

> *If kids are going to sit together, they will most likely gravitate to those of similar ability level.*

In addressing the research question investigating whether there is a perceived difference between upper and lower-stream mathematics classroom learning environments, the trainee teachers openly acknowledge that there is a difference, but their willingness to compartmentalise upper and lower-stream students so readily and so generally would indicate that these differences noted may well be self-perpetuating.

It could be expected that these new mathematics teachers may seek to continue what has worked for them in the past. Zevenbergen (2005) makes the statement:

> As a consequence of the structuring practices of their own schooling, of teacher education programs, and pre-service and post-graduation experiences teachers have been exposed to practices (of which ability grouping is one) that they internalise. This understanding frames in turn how they will interpret and act within the social world of mathematics education. (p. 610)

New mathematics teachers, in the majority of cases, report that they have come out of the 'upper-stream culture'. The answers pre-service teachers gave are quite clinical but are based on a social cycle that they see as inevitable while the innovative and more experienced educator/sociologist may want to seek ways to break or modify that cycle in order to provide the most effective education for all students.

When the issue of social responsibility became the topic of discussion in one of the focus groups, support for streaming and particularly for the upper-streams was evident. One student concluded that educators spend too much time worrying about underachievers at the expense of bright students.

A trainee teacher in the second group interviewed, focused on the social dynamics of streaming. She acknowledged that students do in fact compare themselves with each other and that their classroom learning environments reflect that sort of culture. She believed that the students' self-esteem and their image of their learning environment would improve if the movement between the two streams were more fluid. Students could then be encouraged to perform at a higher level for the purpose of moving between streams.

> *As long as it is dynamic and the students realize that they are not locked in there and they are not dummies and they can go up and down according to their ability rather than always comparing themselves to others which is what we are trying to get away from.*

Conclusions from Teacher Trainee Data

Responses from pre-service teachers fell into two categories. Firstly those who reported on social justice issues and secondly those who referred to the classroom learning environment. These pre-service teachers were divided in opinion but in general favoured streaming as a better option for improved student outcomes. From the comments made by these pre-service teachers, it appears mostly likely that these future teachers would have recently come from top level mathematics classes at their high schools and have had a good experience which has influenced their decision to become a mathematics teacher. It was also noticeable that they preferred streamed classes because they saw it is easier for them as teachers to prepare the work and to keep the students working.

With regard to classroom learning environment, those favouring streaming made comments that supported the scales of the *WIHIC*. Examples of such comments are:

> *There is more support for kids in streamed classes (teacher support)*

> *Higher stream kids want to 'give it a go' while lower-stream kids want to 'muck around' (task orientation)*

In the lower-stream you've got the 'bad' student you have to keep working so as not to disturb the rest of the class. (task orientation)

The higher ability kids will not mix with the others anyway and like working with kids they can share ideas with and who are 'like them' (student cohesiveness)

In the upper-stream it is all quite relaxed and teacher can have a joke with the class. (teacher support)

Those in favour of mixed-ability classes for students had a little to say about classroom learning environments. They favoured mixed-ability for the same reasons the other group favoured streaming. Because ability grouping allows the top stream to be more relaxed and have jokes with the teacher, the other side of the coin is that the lower-stream is often found to have poor behaviour and an atmosphere devoid of mutual trust. It became apparent that teacher expectations were perceived to make an impact on how the students perceive their classroom learning environment.

The possibility of a mixed-ability mathematics structure becoming more acceptable in junior high schools in the future may be at risk given the interview data gleaned from pre-service teachers. Our emerging teachers are generally in favour of ability grouping in schools. There was a genuine fear of teaching in a lower ability class or in a mixed-ability class. Comments such as: "it's too hard for the teacher", or "I need some experience first" were indicative of their apprehension to take on anything but top stream classes.

For lower-stream classes to become more satisfying for students or for mixed-ability classes to become more accepted, it would seem that schools need to place their best and most motivating teachers in those classes. Given that mathematics teachers of the future have concerns about teaching these groups may be an issue that needs to be addressed in the future.

Comments were made to support streaming and mixed-ability in the name of social justice. Comments like “we should be extending the bright kids” and it is their social “right” are comments that support streaming. There was also an interesting comment on how it is quite reasonable in Australia to create sports elite and even develop an Institute of Sport to foster the high achievers, but it is an inequity in the minds of some for us to create a mathematical elite. There is also the counterexample in support of streaming that says we are disadvantaging the potential upper-stream by not catering for their needs in a streamed setting. Section 5.3.4 identifies comments from pre-service teachers that support these sentiments.

On the other side of the argument were comments from pre-service teachers supporting mixed-ability classes on the grounds of social justice. This group reported that if the culture of a school supports streaming, then the lower class knows that they are expected to achieve less. This may have an impact on student outcomes and the perception of what is possible to achieve for those students.

5.3.5 Practising Teacher data

There were two modes of qualitative data collection for practising teachers. A preliminary face to face interview was held with a group of two teachers simultaneously and then teachers were interviewed by email individually thereafter.

The preliminary session was designed to establish the thoughts of teachers in general regarding the practise of streaming and the resulting differences in classroom learning environment that may come out of streaming. This helped frame the email interview questions to follow. The interview of mathematics teachers was held in a single school with the Head of the Mathematics Department and one of the senior teachers selected as the participants. At the school selected, Year 9 mathematics classes were mixed-ability groups but Year 10 was streamed for ability based on their Year 9 performance and application.
They were quite clinical about their reasons for streaming. To them it was necessary to establish subject choices in senior secondary as well as setting a path

towards a career. They do not believe that maturity is necessarily an issue because they are more concerned about the amount of information the students absorb in preparation for the senior classes. The Year 9 students need to attain 60 percent and have a good work ethic in order to go into the upper-stream at Year 10 level though they are willing to break this rule to keep a hard working student with their social support network.

With regard to classroom learning environment, they readily acknowledge that behaviour management and keeping students on task is more challenging in the lower-streams but qualify that by saying the lower-stream classes are smaller. When asked if they had noticed any social or self-esteem issues, one of the teachers said that she had noticed more self-esteem issues in the upper-stream where students become discouraged at not being able to keep up. This confirms the literature (eg. Kemp & Watkins, 1996) and the interviews with students that those in the upper-stream can feel discouraged with their classroom learning environment because of the high expectations of the teacher and the problems with keeping up.

When asked what they thought the effects on students would be of the poorer learning environment in lower-stream classes as acknowledged by them, they were philosophical and admitted having thought about that issue often:

> *Teacher 1: We have often wondered about what damage we may be doing with streaming but the parents want it and it is a way we can get the kids ready for Year 11 and 12 where they would stream themselves anyway by choice of subjects.*
>
> *Teacher 2: I just can't see any other way around it. There is content to cover and this is the most efficient way of doing it.*

The next group of results came via email from teachers when they were asked specific questions about their perceptions of the differences in the learning environments between the upper and lower-streams of a mathematics class. The teachers interviewed were those who cared for the students used for the quantitative data collection. It was a sample of these students who were interviewed and whose comments were reported on in Section 5.3.3. Out of the 28 teachers who taught classes that were part of the quantitative sample, 7 were interviewed. Many of the findings of previous researchers as discussed in Chapter 2, along with findings from the other data collection in this thesis were displayed in the answers given by the teachers. Again it was the scales of *teacher support* and *task orientation* that were significant in answers given by the teachers.

Almost every teacher interviewed commented on the difference between the two streams in terms of their behaviour and application. It was an accepted fact that if they were to teach lower-streams, they would be subject to more disruptive behaviour and would find it more difficult to settle the students into a work pattern. Reasons were given for lower-stream students being more difficult to inculcate with a work ethic. One of the reasons given was that these students find the work harder and therefore they do not see great rewards for their efforts. This can be self-perpetuating because success can lead on to success as the motivation increases. Another comment was that lower-stream students are more prone to want to socialise rather than work. Mention was also made of students finding the work boring in the lower-streams and the realisation that mathematics will probably not lead on to a career for them.

A comment made by one of the teachers summarised what most of the teachers were saying:

> *Mr H: Most of those students are harder to get to work as it does not come easily and they don't often get great rewards for their effort. The students often socialise more as a way of avoiding doing their work. When the classes are smaller (around the 15-20) it is not as bad as you have more time to monitor student progress as well as behaviour. The upper-stream classes tend to be more pleasant to teach as there is little or no discipline issues as students are normally happy to work and happy to be extended. It is probably a case of successful students being more motivated because they are successful and receive the rewards of good grades. I have taught both*

and enjoyed both groups, although you have to be more alert when teaching lower-streams as work needs to be presented in a manner that relates to them and that they can hopefully understand.

Although the teachers were not interviewed by scale, other scales of the *WIHIC* (as well as *task orientation* and *teacher support* already mentioned) were referred to by the teachers in their comments about classroom learning environments. For example mention was made that they want to make students feel they are all treated fairly (*equity*), they want to relate to the students at the level they are at and help them understand (*teacher support*), and they want to make sure the students get a variety of activities that they can enjoy (*involvement* and *investigation*).

With regard to the differences between the classroom learning environments of upper and lower-stream classes, apart from the previously noted comments on disruptive behaviour in the lower-streams, the teachers made comment that it was not a surprise that there is a behaviour difference. Upper-stream students have learnt to succeed. They have experienced success and confidence in learning maths in the past.

A comment specifically relevant to the lower-stream students and their learning environment was:

Mr H: Lower-stream students do not have that confidence and are likely to put themselves down, give up easily and some students are likely to have some sort of special needs (ADHD, dyslexic, etc.).

There were also comments made by teachers with regard to the differences in classroom learning environments between the streams that referred to other scales of the *WIHIC*. For example, there was a comment on *student cohesiveness* and *task orientation* of lower-stream students in the following:

Mrs K: I've generally found lower-stream classes to contain a greater proportion of disruptive students and therefore are a less cohesive group.

Lower-stream classes tend to have a mix of students who encourage disruption and celebrate time wastage (as it equals less work and more 'fun') and also quiet strugglers who would prefer to spend time learning but are not assertive enough to dissuade disruption or demand attention.

The same teacher also referred to the *task orientation* of the upper-stream classes she has taught:

Mrs K: Upper-stream classes tend to be more focussed on work and are less tolerant of persistent disrupters although these classes can contain their share of lazy but able students who do need to be sat on pretty tightly.

Mrs K goes on to refer to other scales of the *WIHIC* such as *investigation*, *cooperation* and *involvement* in the following statement.

Mrs K: I have observed students from upper-stream classes working together on problem solving probably more than I have seen this type of cooperation in a lower-stream class, but some of the more able students prefer to work on their own and can be quite resistant to group work. Having said that, I have found upper-stream students to be more effective at helping each other understand concepts and processes whereas lower-stream students tend to rely more heavily on the teacher and may become confused when a classmate explains something in a slightly different way. They often lack the confidence to experiment with an unfamiliar problem and will wait for help rather than trying to go on.

A teacher also spoke about the relationship between *teacher support* and *task orientation* in lower-stream classes:

Mrs C: As the teacher cannot be giving individual attention to each member of the class at the same time, lower-stream classes probably end up spending more of their time off-task than do their upper-stream counter *parts.*

While teachers were aware of the differences between upper and lower-stream mathematics classes, they were still convinced that streaming was a more sound approach to reach the majority of the students. The comment was made that it is easier to modify an activity to suit most students in a streamed class and easier to get more involvement from a streamed class where students do not feel so intimidated by the brighter members of the class.

5.3.6 Parent Data

Again with parents there were two modes of data collection. Two parents were selected for face-to-face interviews and then another 10 were interviewed by email. The two initial interviewees were mothers who represented students in each of upper-stream and lower-stream. The parents who were interviewed by email were parents of students who had themselves been interviewed by email.

Comments coming out of the interviews with the two parents at one school are particularly valuable. One was a parent of a lower-stream student and the other of an upper-stream student. In both cases the parent indicated that streaming was a good idea. The parent of the lower-stream student (Louise) agreed with streaming for the sake of those in the upper-stream "because the ones that are advanced don't get held up by the slower ones". This was said despite the fact that her perception of the classroom learning environment in the lower-stream where her son attended was less than satisfactory. She recognised that her son was "stuck with those kids who don't want to learn" and that the teacher "spends more time disciplining those kids than doing maths." Louise was not willing to put any blame on the system or the teacher, believing rather that if students in the lower-stream are recognised to have low self esteem, then they came into the school that way and streaming could not be seen as a contributing factor.

The parent (Urma) of the upper-stream child was also convinced that there is no substitute for streaming mathematics classes. She was determined that this should be done in schools right from the beginning of secondary school and even in primary school. Numerous examples were given about how her children, “bright upper-stream students” would have been disadvantaged if their classes had not been streamed. When asked about the slower maturing rates of boys and if she really thought streaming would be good as young as Year 7 she replied: “I don’t think the differing maturing rates has anything to do with mathematical ability.” Urna’s perceptions of the differences in classroom environments between the streams acknowledged that:

> *Upper-streams are quiet because they are the students who want to learn, but the lower-streams are poorly behaved but I don’t know how you get around that because there are going to be some kids who don’t want to do maths at all.*

As with Louise, there was little blame put on the teacher. Urma believes that parents have to take a lot of the responsibility for how their children perform in classes. She did believe that teachers could try things to address the issues discussed:

> *I think that given a teacher who can use different methods of teaching and keep the kids occupied in such a way that they are interested, it should overcome these problems.*

Though Louise and Urma are parents who represent children from both sides of the ability grouping, their opinions have a lot in common. They both believe that streaming is necessary for the upper-stream to achieve. Both accept that the lower-stream is poorly behaved compared to the upper-stream and both believe this situation is caused by external factors and there is not much can be done about it at a school or teacher level.

It would appear from the interview data with parents that they have thought very little about the sociological effects of streaming on students. Almost without exception parents expressed that streaming was good for all and that it is necessary to separate the able from the not so able so that all can learn. They made comments such as:

> *It allows the student to separate into their different learning abilities so that if a student has special needs they can be tended to without having to compromise other students' needs.*

Another parent believed that it was a good idea because the students could be separated into either doing harder things or easier and more practical things. One parent went so far as to say that not only was it better for the upper-stream because it allowed them to move ahead more quickly and be extended, but he also said that it is a smarter idea to have kids of the same intellect in the same classes so they can relate to each other.

With regard to the classroom learning environments of the different streams, the limited knowledge of what actually goes on in the classroom was exposed in the interviews with parents. The parents who were interviewed by email almost exclusively spoke about equity. They were very keen for their children to learn at a level that was appropriate to them and would challenge them. There was no real perception of the realities of the interactions in the classrooms except for one parent who commented on the differences in behaviour between the streams:

> *Students that are brighter can go ahead while the others stay behind. They need the open space to be able to develop at their own speed without being slowed down by other children. The slower children in maths need extra help and care which they can be given at their own speed. It's frustrating for a teacher to do both ends of the scale at once, and tiring. All round it's better for everybody, behaviour in the class would be a great deal better.*

It seemed that parents did not have sufficient knowledge to comment any further on classroom learning environments in streamed classes. This is understandable as their primary source of information would be via their children.

5.4 Attitude to Mathematics and Classroom Learning Environment

5.4.1 Student Data

The students who were being interviewed by email received a question relating to their attitude to mathematics classes. The question was as follows:

Do you think your attitude to life in general affects your attitude to maths and maths classes or is there no connection? Do you think your attitude to maths could be changed one way or the other by the quality of teaching and the way things happen in your maths class?

The answer to this question showed that in 75 percent of cases students believed that their general attitude to life did affect their attitude to mathematics classes. They were quite unanimous when questioned about how the teaching practice affects their attitude to class. A caring, motivating teacher they see as being able to alter the attitude of the students for the positive. An typical example of a student response to this question is:

> *Carrie: My attitude in general life does affect my maths. If I'm enjoying life at a particular time I will seem to be more interested when it comes to maths. I think teachers impact me the most out of anything, If I like the way my teacher explains things or the way that they go about their maths class then I will either be inspired by them or just want to do a lot better.*

One student believed there was an obvious connection between attitude and mathematics classes:

> *David: I would have to say 'yes' because someone with low self-esteem and lazy would hate maths because they would have to put work in. It is obvious.*

In some cases students related their attitude to mathematics classes directly to the teacher's performance in the classroom, even commenting on specific scales. For example the following student related 'student attitude' to *teacher support*:

Chrissy: I think that peoples' attitude to maths classes would improve if the teachers were more understanding and helpful and if the class ran better.

Another student related his attitude to mathematics classes to his level of 'task orientation':

Nate: I reckon attitude to life does affect my maths on account of some days I get up and I am really loving life, so I'm 100% focussed on task and I understand the work more clearly. Other days I don't feel anything about life and I just zone away from the task (maths in this case). I don't learn much at these times.

A comment was made which illustrated that for this particular student the learning environment can affect their attitude:

Jenny: I think if we have a poor attitude to life that it will show in whatever kind of task that you must do, This includes maths classes. If your attitude is good, bad etc then results and attitudes towards your maths class will show. If we changed our attitudes good or bad then a dramatic difference I'm sure will follow, just because we have stepped out of normal life and into a Maths class it doesn't mean that our attitudes will necessarily change. However if a maths class was a place where learning was encouraged and fun where the teachers cared about your wellbeing then I think that some people would begin to look forward to or at least appreciate the time spent in the maths classroom, which could always lead to a better attitude of life even though only one aspect has changed.

These and other comments indicated an obvious difference that could be brought about by a change in student attitude and that a similar difference could happen if the teachers made the classroom learning environment fun and motivating. The students' comments on the connection between attitude to mathematics classes and classroom learning environment validate and add meaning to the quantitative data presented in Table 4.15 which showed clearly the correlation between attitude to mathematics classes and perceptions of learning environments was at its strongest with the *WIHIC* scales of *teacher support* and *task orientation*. The comments given by the students refer to their attitude affecting the amount of work they get done in a mathematics class or to the way the teacher handles the classes.

5.4.2 Practising Teacher Data

The data collected from the teachers were not very different from that collected from the students. There was a wide acceptance that student attitudes have an effect on classroom learning environments and that the converse also applies.

Attitude towards the subject was said to be noticeably more negative in the lower-stream. This supports the findings of the quantitative data where there was a significant correlation between attitude to mathematics classes and perception of the mathematics classroom environment. Both of these factors were found to be more negative in the lower-streams.

One aspect of the results from the surveys that stood out as significant yet had not been commented on in previous research was the fact that student attitudes when in lower-streams tend to degenerate from Year 9 to Year 10 while at the same time there is an improvement in attitude of students from Year 9 to Year 10 for students in the upper-streams. There was noticed a widening gap in attitude and perception of classroom learning environments as the students progress through school by stream. With no knowledge of the quantitative data results of this study, one teacher commented on this finding. From her own experience in teaching both Year 9 and Year 10 lower-stream classes she said:

> *Mrs C: In Year 9 for intermediate (lower-stream) mathematics, students were mostly motivated and involved in the lessons towards the end of the year with no apparent changes to my lessons. However this year the Year 10 intermediate class has low motivation and are not interested in any activity or group work. They just want to cover the course in the textbook. These were basically the same students.*

A consistent result of the interviews was that all teachers were aware that teacher innovation was the key to improving the classroom learning environments of their classes whether they were streamed or not. In different contexts each teacher mentioned the teacher impact factor on student attitude. One young male teacher responded:

> *Mr L: Classroom teachers have a major influence in students' attitude towards the subject, students' engagement in the classroom and students' involvement with their peers. . . . . .An experienced teacher with strong classroom management skills, sound curriculum understanding, wide ranges of appropriate teaching techniques (eg. cooperative learning, IT in the classroom, etc) and a passion for teaching would deal with the lower or upper-stream classes equally and appropriately. The class would respond positively to the teacher regardless of the student's ability.*

5.5 Classroom Environment by Gender and Cultural Background

5.5.1 Student Data

The quantitative data showed that there was a significant difference between how males and females rated their classroom learning environments. It also showed that students from homes that spoke a language other than English rated their classroom significantly differently from English speaking Australian students. These differences were followed up when collecting qualitative data from students and teachers.

Gender Differences

The students were asked to comment on why they believed that girls rated their classroom learning environment more positively than boys. The common answer from both boys and girls was that the girls tend to be more serious about their work and that the boys tend to play more and follow each other. They agree that boys tend to succumb to peer pressure more than girls do. While girls tend to talk in class, they seem to know when to listen.

An analysis of the way males answered some of the interview questions compared to the way females answered the same questions helps to explain the gap in perceptions of classroom learning environments between sexes.

It can be noticed that the males are more dogmatic about issues, uncompromising in attitude and more demanding of the teacher. The female responses showed more understanding of others and of situations. They were willing to identify the positives in a situation. For example, when asked about the perceived distraction factor with lower-stream students, a male answered:

> *Travis: In a mixed-ability class the lower kids would bring the higher kids down. . . . . all the kids in the lower class would act up, egging each other on, and the teacher wouldn't be able to deal with all the questions at the one time.*

At the same time a female gave the following answer:

> *Cassandra: I don't think the lower levels distract more. I think it is because of the distraction they are in the lower levels if you know what I mean. (upper-stream)*

The following typical comments illustrate the difference in attitude and perception of what is going on in their classroom between males and females. Again the male comment is strong and judgemental whereas the female answer is softer and more positive. These comments represent typical responses from males and females in these classes:

> *Nate: I just think it's a bit stupid because people in my class are actually trying to fail so they can be put into the other class. (male)*

> *Lori: Anyone can be a good student as long as they put their minds to it. (female)*

David: Teachers should explain things in layman's terms so that everyone understands and then they wouldn't have to have early morning classes for a lot of the class to come in and learn the same stuff they could have learnt in class. (male)

Nikki: A mixed-ability class would be better because we could actually help our friends understand the work and get it done more quickly so they don't have to wait for the teacher. (female)

This data again validates and adds meaning to the quantitative data which shows that females have a more positive perception of their classroom learning environment. Their comments illustrate that given the same environment, female students are more willing to give leniency to their classmates and to the teachers and thereby put a positive context on situations whereas the male students are very demanding and not quite so ready to be as positive about their classroom learning environment.

Language Differences

The analysis of the quantitative data also illustrated a discrepancy between the perceptions of the classroom learning environment between overseas students studying in Australian schools and Australian students. The benchmark for the variable was whether the student speaks a language other than English in their home setting. The result from the quantitative data analysis that were most interesting was that while the overseas students have a positive attitude towards the subject of mathematics and mathematical activities in class, their perception of the learning environment is quite negative in comparison.

When the quantitative data were taken, the largest cultural group represented in the data were Asian students. Two groups of three Asian students were therefore selected to interview with questions that attempted to establish why there was this discrepancy between attitude and perception of classroom learning environment. Of necessity these students who were interviewed had a certain level of competency in spoken English and so their answers reflected how they had felt when their English was very poor and how they perceive current non-English speaking students may currently feel.

The results showed that Asian students in particular were frustrated by several things. Firstly they feel disadvantaged because they look at the work and see enough familiar material to know that they can do the work and have probably done it before in their own country but do not really understand the questions as presented in Australia.

> *Sue: Some things could be better. The teacher gets into the work too fast and we don't get it. It would be good if it was broken down more.*

> *Kim: There are some kids who just don't want to get on with their work*

Another disappointment for them with their classroom learning environment is that the class does not always settle down to work and the learning environment can be disruptive to them. In many cases they are a little older than their Australian classmates and find the lack of maturity difficult to cope with. This contributes to student stress because of the expectations Asian parents place on student achievement in school, particularly in mathematics as reported by Asian students in interviews. The comments from these students also made it apparent that new students coming to Australia from Asia sometimes feel embarrassed to ask questions and may not mix very well with other students either inside or outside class. They may not even mix with other Asian students who have been in Australia for some time.

It was evident that a possible reason for these students having positive attitudes towards mathematics classes and subject material is that it is part of their culture and it is an expectation placed on them that they will succeed in this subject. They also believe that they are more likely to achieve in mathematics than in other subjects because there is less English language in this subject for them to understand. This positive attitude towards the subject causes them disillusionment when their classroom learning environment is not as conducive to their learning as they expected it would be and that clearly they could cope with the work very easily if they had a greater understanding of the language.

Tom: There is an expectation amongst Asians that they will be very good at maths

Sample typical answers that show these students' frustrations are:

Jung: They would probably get the support if they asked more but they are embarrassed because of the level of their English and so they don't ask.

Kim: Sometimes after the class they will tell you how terrible it was or something.

Tom: I don't think the new Asians to the school socialize very much. They are more comfortable just mixing with each other.

Su: Some things could be better. The teacher gets into the work too fast and we don't get it. It would be good if it was broken down more.

Questions were asked that related to the specifics of the classroom learning environment. The way the overseas students saw *student cohesiveness* and *cooperation* was tested with the question: Do the students help each other with the work? Do you help the new students from overseas with their work? The typical answer was:

Kim: Not really. They stay to themselves a bit. That's the way the classroom is arranged.

Task orientation was another scale that was discussed with the students. A question was asked: Does it stop you working when other kids are mucking around? An answer to this was:

Tom: Yes. I can't stand it. It's OK to blame the teacher but the students *have to cooperate as well.*

5.5.2 Practising Teacher Data

There was little comment made by teachers about any perceived differences between how the males and females or English speaking and non-English speaking students related to their classroom environments. When asked about classroom learning environments in particular just one teacher spoke about gender differences in attitude to class. A lower-stream teacher commented on the difference between the attitudes of the boys and girls in her class. She noted in the interview that the boys took a lot more time and effort to settle down to work in her class than the girls did, though she tried to make sure the girls receive the attention they needed. This extra attention required by the teacher supports the quantitative data which suggests that girls perceived the class in a more positive way than the boys (see Table 4.16)

This lack of reference by practising teachers to cultural and gender differences in itself is of interest and may demonstrate that teachers do not account for differences in these groups as they would prefer. This supports the student data.

5.6 Summary

In this chapter it has been possible to report qualitative data that provides further validation for the scales of the *WIHIC* survey used in this study. The major findings were firstly, that as with the quantitative data (see Table 4.20), the levels of *teacher support* and *task orientation* were the two main factors that differentiated between the upper and lower-stream classes. It was acknowledged by both streams that there was a gap in the quality of the learning environment between the two streams and the students in the lower-stream were cognisant and accepting of their class situation. Secondly, it was the same two factors that had the closest association with student attitude towards their mathematics classes (compare to the correlation Table 4.15). Thirdly, interviews with trainee teachers, practising teachers and parents all confirmed the fact that while each group can see some of the issues with streaming, they are generally in favour of the streaming process as being the fairest means of catering for the majority of the students.

Fourthly, the teachers were able to confirm that the attitude of students in lower-streams appears to deteriorate from Year 9 to Year 10 for the same group of students. Fifthly, the interviews confirmed that females have a more positive perception of their classroom learning environment than the males (see Table 4.16). Finally, it was found that the perceptions non-English speaking students have of their classroom learning environments do not match their attitude to mathematics classes in general and that teachers did not perceive or make mention of cultural background as a factor that may differentiate students.

The next chapter contains discussion of the data. This discussion will combine the quantitative and qualitative data analysis and will provide a synthesis of the data that addresses the research questions.

CHAPTER 6

DISCUSSION

6.1 Introduction

This study has utilised a multi-method approach in which the quantitative data collection and analysis of student opinion was supplemented by qualitative data collected in numerous forms (individual interviews, group interviews, focus groups and email responses). It is hoped that by utilising data in multiple formats and from multiple perspectives, richer insights and interpretations may be available. This study seeks to add to the literature on classroom learning environment research and streaming in mathematics education that has already proved to be useful for researchers and practitioners alike. In this study a comparison of classroom learning environments in different streams of mathematics classes and at two secondary year levels was able to be engineered using these multiple methods of classroom environment research.

The use of a variety of interview methods allowed the students' perceptions of their classroom learning environments to be explored while taking into account factors that may differ according to which stream the student is in. There are key factor findings from this study that go beyond the expected result that upper-stream students would find their classroom learning environments more positive than their lower-stream counterparts. This chapter discusses some of those findings.

The variables used in this study were: school, class, teacher, stream, year level, gender and language. It is interesting to note that only the variable of *class* was able to differentiate between all scales of the *WIHIC* in a significant way ($p<0.001$). Class membership incorporates the variables of *teacher* and *stream.* This result is supported by a recent study by Zevenbergen (2005), who also found that class membership was the main determining factor when 96 students were interviewed about their experiences in school mathematics. Her study reported that:

> The surprising outcome of these interviews was the overwhelming

> emphasis on the experiences of classes – all of which had been grouped by ability (or achievement) – and the impact these experiences had on the students' relationship with school mathematics. . . While I initially hypothesised that variables such as gender, year level and school would be potential influences on students' interpretations, these variables were not as powerful as the grouped classrooms. (p. 609).

6.2 Streamed Classroom Environments as Perceived by Students

The first research question is about the differences in classroom learning environments between upper and lower-stream secondary mathematics classes as perceived by the students.

Both the quantitative and the qualitative results indicated that students perceive differences in the classroom learning environments of upper and lower-streams of mathematics classes in Years 9 and 10. Furthermore it seems that students know about this difference, what factors may cause or be associated with this difference, how this difference is played out in the classroom and what the potential outcomes of this difference are.

As illustrated in Table 4.10, the upper-stream sample for Year 9 and 10 classes scored lower mean scores across every scale of the *WIHIC*, indicating a more positive perception on every aspect of their mathematics classroom learning environment. In the scales for *teacher support* and for *task orientation* there is the greatest gap between upper-stream perceptions and lower-stream perceptions. The interviews conducted with students indicated that both upper-stream students and lower-stream students recognise and seem to accept the fact that lower-stream mathematics students will not be 'on task' as much of the time as upper-stream students, that their behaviour will be poor and rowdy and that teachers will not have enough time to care for the diverse needs of lower-stream students.

Without being prompted, students referred to the issues of *task orientation* of lower-stream students and to the amount of *teacher support* they perceived was available to lower-stream classes.

Students made comments such as: "The lower class would be harder to manage because of their behaviour", "The lower levels distract more", and "They distract because of friends or because they're just plain bored."

The mixed-ability students were asked the same question. They were asked for their opinion about the difference to their learning environment if their class were to be streamed into a higher and a lower-stream. Students in mixed-ability classes typically believe that the *task orientation* of students in lower-stream classes in their school is inferior. They hypothesise that if the classes were streamed, the students would all get more attention. While this idea about *task orientation* seems to be validated by the data, the hypothesis regarding *teacher support* is not validated by the data.

As well as *teacher support* and *task orientation*, in each of the other scales (*student cohesiveness, involvement, investigation, cooperation,* and *equity*), the upper-stream was also more positive than the lower-stream. The scale that was most favourable for the majority of students and where the difference between upper and lower-streams was least significant was the scale of *student cohesiveness*. With many of the questions asked in that particular scale of the *WIHIC*, *student cohesiveness* may mean that students could either be working together for learning, but could also be grouping together to have 'fun' as some of the respondents stated was the experience of lower-stream students. In other words, *student cohesiveness* may not always be a positive thing in terms of student learning.

It is interesting to note the standard deviations of the upper and lower-stream student scores on the seven scales of the *WIHIC*. For each scale the lower-stream students had a higher standard deviation (showed a greater spread of scores) than the upper-stream students. This indicates a greater diversity in student perceptions of their classroom learning environment in lower-stream classes. There appears to be more consistency of opinion among upper-stream students with regard to their perception of their classroom learning environments. This may mean that there are extremes of attitude existent among lower-stream students. There may be those who are content with their position in the lower-stream and are content with their classroom learning environment while others may desire more from their mathematics class and therefore are not satisfied with the learning environment lower-stream classes have on offer.

An issue uncovered in the scale of *investigation* in the mathematics classroom is one that is highlighted by the data. This scale is one that may have more meaning to a science classroom, however a progressive mathematics teacher will use investigative techniques to advantage to help students understand concepts. The *investigation* scale on the *WIHIC* was the least positive scale for both upper-stream and lower-stream classes in this study. The lower-stream student perceptions for *investigation* were less favourable than for the upper-stream. The data from this study suggest that improved use of investigative techniques for lower-stream classes would certainly help student understanding and would also improve the classroom learning environment. It would particularly improve the scales of *task orientation, cooperation* and *investigation.*

The whole sample of 581 students responded to a survey about their *actual* and *preferred* perceptions for classroom learning environments and these were compared. The results can be seen in Table 4.8. For every scale the group indicated that their *preferred* environment was more positive than their present environment. The differences in scale means ranged from 0.41 of a point for the scale of *cooperation* to 0.71 of a point for the scale of *investigation.* Investigation is seen as a key area for all classes to improve upon and schools need to follow this aspect up carefully as they look to a more constructivist means of teaching.

The upper and lower-stream data were also considered in terms of their *actual* and *preferred* responses for the seven scales of the *WIHIC.* The purpose of this was to determine how ambitious each stream was for change to happen to their current mathematics class. It can be seen from Table 4.9 that in every scale the upper-stream is desirous of a greater change in their situation than the lower-stream. This is evidenced by the 'differences' column on the table which gives the differences between the upper-stream and lower-stream 'gap' between *actual* and *preferred* responses on the scales. One possible explanation for this could be that the upper-stream is more ambitious academically and therefore is looking more idealistically at the *preferred* responses. Given the input from the qualitative data, it is of concern that perhaps it is more the lower-stream seeking less change than the upper-stream seeking more change. There seemed to be an overriding feeling from the lower-stream students in the interviews that the lower-stream is where they belong, this is how it is, this is what they deserve and seeking change was futile.

There are interview responses from lower-stream students that support this fatalistic approach. When asked their opinion on streaming itself, their responses included:

> *Jenny: I think it's an excellent idea because it gives the chance for the students who actually want to learn to do so.*

> *Jim: I believe that if we are all put in separate classes it is a lot more effective because those who have the capability to do better cannot because of the surroundings they are in and must go at the pace of those who struggle.*

> *Cassie: Some people are better at things than others and so it is good to have different classes.*

These students are saying that they are in a lower-stream for a reason and that is where they belong. They seem to be more concerned about the possibility of them and their classmates slowing down those in the upper-stream than about their own potential to achieve more than what they are currently doing in mathematics.

Upper-stream students also look to their lower-stream colleagues when answering that they believe streaming is best for all students:

> *Chad: We should have students of the same ability together so that no student will be left behind.*

Michael: I think it is a good idea to have the classes separated because that way the people in the less academic classes get more attention and can go at the slower pace . . . .

Jenny: It's better because then people in the same class don't look down on themselves because they can't keep up.

One perceptive student from an upper-stream class made the comment that though she prefers to be in a streamed class working with people at a similar level to her, she can see the social reasons against streaming. If able to be generalised, this would go some way to explaining the poorer perception of classroom learning environments in the lower-stream. She says:

Sue: I feel that other students in my class are very arrogant towards others in lower maths classes as we are doing advanced maths. They constantly taunt other students about their lack of academic ability but at the same time never try to help others improve, rather destroying other students' self-esteem.

The standard deviation for the differences between *actual* and *preferred* responses for each stream was also higher for the lower-stream, again indicating that there is greater diversity of satisfaction with their mathematics class among the lower-stream.

When asked directly if they felt there was a difference in the classroom learning environments between the upper and lower-streams, the students were very clear in their answers. Apart from the answers discussed earlier that there is a student perception that lower-stream students do not want to work and are automatically going to be poorly behaved, there were also many comments directed at the teacher or the teacher's role in creating a distinction between the streams. The upper-stream students believe that their teachers were stricter, but more relaxed at not having to do multiple explanations to students, sometimes assuming that students in the upper-stream are all equally good at mathematics.

The lower-stream students are well aware that they are often left with the less qualified teachers and feel the teachers do not put all their effort into their classes because the students will probably give up on mathematics anyway. These answers were not given in a vindictive manner but rather in a fatalistic manner indicating that they accepted the current situation and questioned why the teachers should really be interested in their progress given their poor behaviour and probable future.

Many of the outcomes from the interview questions listed above are similar to the findings of Wiliam and Bartholomew (2004) as discussed in Chapter 2, who noticed that teachers would often overestimate the capability of students in the upper-stream, giving them work that was sometimes beyond them. At the same time the same teacher would often underestimate the ability and capabilities of the lower-stream students.

In this study similar outcomes are revealed in that upper-stream students can sometimes be treated as 'same ability' students and sometimes are left behind in class by expectations that are too high. As stated earlier, the opposite is true of lower-stream classes where they are sometimes referred to as the poor behaviour class and treated as such with too low an expectation of work output. This finding was supported by Boaler, Wiliam and Brown (2000)

It is interesting to note that while the heads of mathematics departments will report that classes are divided on an objective 'ability' basis, the teachers in many cases refer to the lower-stream as a poor behaviour class rather than a lower ability class. Another area where this study has similar findings to Wiliam and Bartholomew (2004) is that it is clear from the quantitative data and the interview responses that issues in streaming are more closely aligned to the administration of how the streaming is done and the quality of the teaching practice rather than to the streaming itself.

Chapters 4 and 5, that report the quantitative and qualitative data, both referred to the worrying gap between attitude to mathematics classes and perceptions of classroom learning environments of the upper and lower-streams that differs in students from Year 9 and Year 10. This is perhaps one of the areas where the comment ‘nothing succeeds like success’ carries some credence (Hirsh, Kett, & Trefil, J. (eds), 2002; Alden, 1987). Students who have success at Year 9 in the upper-stream appear to become more positive in Year 10, perhaps thinking about careers requiring mathematics and looking forward to further achievement at a higher level. Unfortunately it appears that the converse is also true that ‘nothing fails like failure’. Lower-stream students along with all other participants to this research see lower-streams as not having the same motivation or behaviour, not able to stay on task, having less enthusiastic teachers and having a poorer attitude to class. As the years go by for a student, failing mathematics as a subject can become a learned response. Utsumi and Mendes (2000) commented on this when they wrote: “As schooling progresses, attitudes towards mathematics become less positive, a fact that may be associated with the decrease in the understanding of the subject or of the content taught.” p241

6.3 Classroom Environments as Perceived by Teachers and Parents

The next research question asked: What are the differences in classroom learning environments between upper and lower-stream secondary mathematics classes as perceived by teachers and parents?

6.3.1 Trainee Teacher Perceptions

It was seen as important in this study to seek the opinions of trainee teachers with regard to their perceptions of classroom learning environments in different types of classrooms including upper and lower-stream mathematics classrooms. The responses indicated that these future teachers were answering more from their recent experiences as students at secondary school than from either their practice teaching or from any pedagogical studies they have completed at tertiary level.

The attitudes towards streaming displayed by these pre-service teachers have several implications for mathematics education in the future. The majority of them were in favour of streaming and they all had their reasons. It is possible that though the sample was a focus group, a minority with differing opinions may not have felt comfortable to speak up. Following are the reasons given for wanting streaming to continue. Firstly was the issue of academic performance. Schools should be catering for students at an appropriate level for each student and only streaming can provide that. Secondly was the issue of equity. There was a belief amongst the groups that if classes comprise mixed-ability, there is no equality of educational opportunity because the bright students are being held back. Thirdly were the pragmatic reasons. Teachers work hard enough without having to prepare multi-grade work for their classes. Finally were the historical reasons. Streaming worked for them as students and there is no reason why it should not work for current and future generations.

Along with these strongly held opinions were the comments that indicated in many cases, a negative feeling among the trainee teachers for the lower-streams. Lower achieving groups were seen as badly behaved and not wanting to learn. It was seen as unfortunate if a teacher is allocated a lower-stream class before they get some experience in dealing with that 'type of setting'.

It is a concern that given the opinions of these future teachers, current attitudes towards streaming as a practice may be self-perpetuating. It is further evidence that while there are measured differences in student perceptions of classroom learning environments between the streams of a mathematics class, these differences may be more a product of the culture of the lower-streams as influenced by the school and the teacher rather than being a product of streaming itself.

It is reported by Hallam and Ireson (2003) that:

> Teachers' beliefs about ability grouping are influenced by the type of groupings adopted in the school where they work, the subject they teach, their experience and qualifications. As pedagogical practices are known to be influenced by beliefs, these findings have important implications for teacher training. (p. 343)

In the light of this statement and as an outcome of this study it is recommended that the issues involved with ability grouping form part of the course of study in teacher training departments.

6.3.2 Teacher Perceptions

The mathematics teachers who took part in this study believe that streaming is the correct method of dividing classes in order to get the most out of each student. In fact Cahan and Linchevski (as cited by Zevenbergen, 2005) referred to British findings that showed 80 percent of mathematics teachers did not believe having mixed-ability classes was good practice compared to 16 percent of science teachers and 3 percent of English teachers. This study also found there to be at least 80 percent of mathematics teachers supporting streaming.

Secondary teachers in general were aware that the issue of streaming is a valid topic for discussion, as reported in interviews. Their answers give away the fact that they know there are philosophical reasons why streaming down to as young as Year 9 may not be a sound practice and they also know that teachers with dedication and specific competencies can bring success to the teaching and learning in mixed-ability classes.

Outweighing these reasons are the overwhelming practical issues of mixed-ability classes and the organisational and political reasons why streaming should continue. From the qualitative data collected it seems that these reasons fit into one of two categories: student welfare and philosophical reasons or parental demand and political reasons.

Student welfare reasons revolve around the belief that students deserve to have the opportunity to reach their potential. The point is made that if we really value the students as individuals, we would support streaming. Students must be allowed to work at their own unique level which can only be achieved by streaming. Unfortunately, the literature shows (eg. Wiliam & Bartholmew, 2004) as does the qualitative data taken from the students, that streaming can do the opposite to what these teachers are suggesting. Once classes are streamed it appears that in some cases teachers disregard the fact that they still have a class of individuals and not one identical group of learners. In fact teachers of mixed-ability groups, and often the same teachers as for the streamed classes, tend to demonstrate more their ability to care for the individual. One upper-stream student made this very point in the interviews:

> *In my class everyone is at a totally different level, and because you are going so fast, you don't get enough time to ask questions. (upper-stream)*

Parental demand is always difficult for schools to negotiate, but teachers are well aware of what parents want in terms of streaming. Section 6.3.3 discusses parent perceptions of streamed classes. Teachers are aware that parents see streaming as the best way to cater for their child's individual needs. One Head of Department quoted parents' desires as the reason they still stream their mathematics classes. Current research in the literature appears to play little part in the operating philosophy and decision making of a school in this particular circumstance.

Other reasons quoted by teachers for perpetuating streaming are that streaming leads more to desirable subject and career choices, or that the rapport between teacher and student is stronger when the teacher's time is not fragmented between students of differing abilities. One teacher supported streaming by suggesting that streaming gives students an opportunity for "all students to realise that uniqueness and authenticity comes from being honest about oneself and accepting that some talents are different but of equal value." It could be difficult to convince a lower-stream student that their mathematical abilities are different to those in the upper-stream but they are of equal value.

There were some teachers who acknowledged the disadvantages of streaming and were concerned that it could limit some students' views of themselves and success. Several teachers made mention of the fact that catering for students' learning styles is probably more vital than streaming by ability. Others made the comment that teaching a mixed-ability class requires certain skills that not all traditional teachers have and that despite its shortcomings the students were still more advantaged with streaming. The fact that streaming is easier for the teachers in terms of workload, was not mentioned though it is likely to be an underlying reason for many.

When the teachers were asked particularly about the difference in classroom learning environments they see between the upper and lower-streams, their comments were diverse but had recurring themes. There was a common acceptance that the main differences between the two streams were in terms of the students' behaviour and application. There was evidence of stereotyping both streams into students who find mathematics easy in the upper-stream and hard in the lower-stream or students who want to work in the upper-stream but who are not motivated in the lower-stream or students who are keener on socialising in the lower-stream than those in the upper-stream. There were also generalisations made about the differing attitudes of students in different streams and the boredom of the students in lower-streams.

There was evidence in the data from the study of an underlying acceptance of streaming as a practice even though teachers were aware of the pedagogical disadvantages of the practice. Teachers were even able to pinpoint specific and undesirable aspects of streaming such as the growing gap between the quality of the classroom learning environments between upper and lower-stream classes for students in Year 9 and Year 10. They also noticed the greater deterioration of the boys with regard to their satisfaction with their learning environment compared to the girls' tacit approval of their learning environment.

Teachers were convinced that their impact on the students makes the greatest difference to the classroom learning environment and that if they were given the time and training, they could facilitate learning more successfully in lower-streams.

6.3.3 Parent Perceptions

While the perceptions of teachers to streaming are based on their experience in a school environment and are therefore somewhat institutionalised, the interviews with parents in this study indicated that parents' opinions are very much more based on a clinical approach as to what they perceive is best for their children. Parents of upper-stream students are very clear that they believe streaming is the best practice for all students. They do not comment on any potential sociological effects of streaming but rather talk about the fact that placing students where they feel comfortable learning with people of similar ability is a sound practice. They appear to trust that the school has placed their child in the correct stream and that this is beneficial to them. They do not appear to have negative perceptions of the practice of streaming and are unaware of philosophical questions such as whether it is possible that all students may be placed in the correct stream, how it is possible to divide students into those who can and those who cannot, what effects streaming may have on students' careers, or what effects a students rate of maturity may have on their placement into a class.

Many old fashioned ideas proliferate that are sometimes less than politically correct. Examples of these are comments made that lower-streams should be doing more practical things that they can understand, or that smarter kids should be with their intellectual equals so they can communicate better. Even parents of lower-stream students were in agreement that streaming is the best option for all students.

Section 5.3.6 reports the results of two particular interviews with parents, Louise and Urma. These interviews help to validate the fact that parents seem to have total trust in the school and in particular, the practice of streaming. Given that the British Medical Journal had teachers rated in the top four of the world's most trusted professions (Kmietovicz, 2002), the results of this study are not anomalous. In the case of Louise it does seem an extreme result since her child is in a lower-stream class of poorly behaved students disrupting him from his work. Again it can be seen that the practice of streaming is so widely accepted that it is rarely questioned in schools used in this study except perhaps in academic circles associated with the sample schools.

In the interview with Urna, she had an answer for every possible disadvantage that may accompany streaming. It had benefited her children and she as a parent had been a large part of her children's success also. Those in lower-streams were seen to be lower in ability, not supported from the home and disruptive because they did not really want to do the subject and had friends with a similar lack of motivation who distracted them. The thought that there could be another way of doing things could not be entertained even though there was an acceptance of a significant disadvantage for lower-stream students in terms of classroom learning environment.

These two interviews, though different in context and motivation, still echoed the same thoughts as those of the majority of the stakeholders in education who were part of this study. The perception is that streaming is a good practice and there is really no workable alternative while acknowledging that there is a large gap between the classroom learning environments of the upper and lower-stream classes.

6.4 Differences in Streamed and Mixed-ability Classes

The third research question asked whether there is a difference in the perceived classroom learning environments in mixed-ability classes when compared to streamed classes

Table 4.10 compares classroom learning environment perceptions between the upper-streams and the mixed-ability classes. The upper-streams are more positive about their classroom learning environments than are the mixed-ability classes in all scales except *investigation*. In the areas of *teacher support, involvement* and *cooperation* the mixed-ability groups were particularly more negative than the upper-streams. The interviews with the students explained some of this difference. The traditional teaching approaches being adopted by teachers of the mixed-ability classes were not causing the students to feel supported by the teachers. Some were feeling left behind, some were bored with their work and involvement was out of the question when there was such a wide variety of abilities to cater for.

In all but the scale of *investigation*, the upper-stream students were more positive about their classroom learning environment. This *investigation* scale proved to be one that created some anomalies. The upper-stream students rate this scale poorly because they know what is possible and would ideally like this area to improve. Indeed the difference between their *actual* mean scale score for *investigation* and their *preferred* mean scale score for this scale was 0.78, by far the largest difference between the two scales for the upper-stream.

The fact that there is a large difference between the way upper-stream and mixed-ability students perceived the *cooperation* that existed amongst students in the class may be both an indication that the upper-stream students work well together, and also that the mixed-ability students do not. With a large range of student ability within the class, one could expect that there may be several pockets of students working at different rates and that there may be little *cooperation* happening between those pockets. An innovative teacher may be able to arrange the class dynamics so that the students with different abilities help one another which could have brought the perceived rating for *cooperation* closer to the rating given by the upper-stream.

The student qualitative data supported the fact that students in mixed-ability classes see streaming as providing a better classroom learning environment for them in the future. One student said: "Sometimes it gets annoying when our teacher needs to explain things we already know." Another student believed the learning environment in lower-stream classes is inferior because the students there are more disruptive. She still believed that streaming is the right path to take (primarily because she would be in an upper-stream). She is therefore anticipating positively the prospect of getting out of a mixed-ability class and getting into an upper-stream class because those same students that she believes are a distraction to her now in a mixed-ability class would be a distraction to those students who were placed in a lower-stream class. It is her belief that students find themselves in lower-stream classes because they are distractive and do not settle to work rather than because of mathematical ability.

The students in mixed-ability classes who believe that mathematics classes should remain as mixed-ability classes base their views on the fact that a varying ability range within a class lends itself to students helping students. The interviews highlighted a minority of talented mathematics students who believed it was more important to keep the classes mixed so as not to create a 'behaviour ghetto' in a lower-stream. One such socially aware student said:

> *I like it the way it is because although sometimes it gets annoying when our teacher needs to explain things we already know, we – students good at maths – can help out our friends when the teacher is busy with someone else, helping them move through their work quicker than if they had to wait for the teacher every time they needed help.*

As stated earlier, it takes an innovative and well organised teacher to create a classroom learning environment that is conducive to such a cooperative effort.

The mixed-ability group is seeking greater change in their classroom learning environments than are the upper-stream. Table 4.9 indicates that in the areas of *teacher support* and *cooperation* the difference between the *actual* and the *preferred* classroom learning environments is much greater for the mixed-ability classes than for the upper-stream. This is consistent with previous discussion. Not only do the mixed-ability classes rate *teacher support* and *cooperation* least positively in their classes, but they want to see the greatest change. They recognise the issues and are looking forward to the opportunity of being streamed in the future to overcome these issues. It is unfortunate that society and accepted school practice have instilled this solution into the students' minds. It tends to make the current system self-perpetuating and prevents the school community from recognising the limitations of the streaming model.

Comparing the mixed-ability classes with the lower-stream classes provides some interesting results as shown in Table 4.10. The gap between the classroom learning environment perceptions of the mixed-ability classes and the lower-stream classes is not so distinct. In some cases the lower-stream gave more positive responses but in other cases the mixed-ability groups were more positive. One example is in the area of *task orientation* where the mixed-ability classes are clearly more positive about that aspect of their learning environment than are the lower-stream whereas for the scale of *student cohesiveness,* the lower-stream were more positive than the mixed-ability classes.

While the mixed-ability classes believed they had a more positive classroom learning environment in the areas of *teacher support, task orientation*, *investigation* and *equity*, the perceived environment was more positive for lower-stream students in the areas of *student cohesiveness, involvement*, and *cooperation*. Whether it is fact or fiction that students in lower-streams are grouped that way because of similar ability, similar behaviour and similar motivation, it is clear that the students in the lower-stream see themselves as a cohesive group while the mixed-ability students are well aware that their group is greatly diversified.

When comparing the classroom learning environments of lower-stream with mixed-ability students, the scale of *investigation* comes up for discussion again. The mixed-ability class clearly see themselves as doing more investigation than the lower-stream class. The point arises again that lower-stream students would benefit greatly by being exposed to more investigative techniques.

It is clear from Table 4.9 presented earlier in this thesis, that the mixed-ability classes seek more change than their lower-stream counterparts. This is true for every scale of the *WIHIC* and is statistically significant for all but the scale of *equity*. The fact that the lower-stream is less ambitious for change is difficult to understand except for the fact that the mixed-ability classes have ambitious, potential upper-stream students who are frustrated with their present situation and want change while the lower-stream students are resigned to their position and are content with their environment whether it is a poor one or not. Students in the lower-stream do not express a great desire for change even though the way they rate their classroom learning environment is not particularly positive. This again illustrates the fact that lower-stream students in general remain content with their position and do not feel a need nor have any expectation for a change in their circumstances. Alternatively, these students could be fatalistic in that they do not expect change or even consider it to be a possibility.

Putting the whole picture together, mixed-ability classes fit in between upper and lower-stream classes in terms of their perception of the learning environment of their mathematics classroom. While all three groups report a *preferred* classroom environment as more positive than the one they experience, the mixed-ability group is looking for more change than either the upper-stream or the lower steam. This is probably for two different reasons – the upper-stream are more satisfied with their environment and do not require dramatic changes, while the lower-stream seem locked into a situation that they see suits them or they deserve and therefore do not see change as possible. Mixed-ability students on the other hand can see the flaws in their classroom learning environment and want to see a change. The way they see change occurring is to progress to a streamed class where they can be in an upper-stream and experience the more positive classroom learning environments current upper-stream students experience.

6.5 Attitude to Mathematics Classes

For discussion now is the connection between a student's attitude to mathematics and their perceived classroom learning environment and how this varies between streams.

For each of the 10 questions of the 'Attitude to Mathematics" survey, the upper-stream students' responses rated more positive than the lower-stream students' responses (Table 4.13). The mean difference between upper and lower-stream ratings on this survey was 0.38. The standard deviation for the attitude scores for the lower-stream was higher than for the upper-stream, indicating a larger spread of answers in the lower-stream. Given that this was also the case with the learning environment instrument (*WIHIC*), it would indicate that there is a positive correlation between the students' attitude to mathematics and their perceptions of their mathematics classroom learning environments. That is, a positive attitude towards mathematics may contribute towards creating a positive perception of a classroom learning environment. It would appear that the opposite also applies. Indeed, Table 4.15 indicates that there is a positive correlation between attitudes to mathematics classes and the scales of the *WIHIC*, particularly for the scales of *teacher support, task orientation,* and *investigation*. Again this is consistent with the earlier reported finding that these very scales are the ones that most clearly differentiate the varying streams.

There is much to be learnt from the tables of attitude data broken down by group.

While Table 4.12 gives an indication that upper-stream students have a more positive attitude to mathematics classes when the sample is viewed together, a closer look shows that there is considerable variability between the groups. For example Table 4.14 shows that the overall attitude score for upper-stream Year 9 students is not more positive than for the lower-stream as would have been expected given the overall data. A closer look shows that upper-stream students had a more positive attitude to the question that asked whether they were interested in finding out where mathematics can be used (Table 4.13). This is consistent with higher ability students and also consistent with their desire for more investigation in class as shown by the *WIHIC* data. The questions where the lower-stream is more positive than the upper-stream are the ones that measure their enjoyment of mathematics classes. Perhaps at Year 9 level the students are more relaxed and able to enjoy the more variable activities teachers should be giving lower-stream Year 9 students.

It is worthy of note in Table 4.12, which records a summary of the differences in attitude between the streams by category of student, that there are significant differences in attitude between Year 9 and Year 10. The mean attitude score for upper-stream students progressing from Year 9 to Year 10 changes from 3.14 to 2.91, indicating that attitudes are more positive for upper-stream students in Year 10 than in Year 9. Along with this conclusion is the result for lower-stream students that the mean attitude score for Year 9 is 3.11 compared to 3.55 for Year 10, possibly indicating that lower-stream students' attitudes to mathematics classes becomes more negative as they progress through school. This result provides some explanation for the considerable gap between perceived classroom learning environments in streamed classes. It is a concern to watch the upper-stream become more positive and the lower-stream become more negative as they proceed through school. Indeed it supports the literature which speaks about the sociological issues associated with streaming. (Ascher, 1992; Slavin, 1995; Ansalone, 2002)

The discussion of differences in the results between the attitudes of the males and females in the sample is an interesting one. Though the differences between upper and lower-stream scores for each gender is more pronounced in the upper-stream, there is no real difference between the overall attitudes of males and females. This is surprising given that female perceptions of classroom learning environments were measured as more positive than for males.

In interviewing students about their attitude to mathematics classes it became evident that a person has to take responsibility for their own attitude, but when it comes to classroom learning environments, many external factors can have an influence on any one learning environment. It was evident therefore that boys became far more critical of these external factors and thus rated their learning environment more negatively. The girls were more willing to take responsibility for their classroom learning environment. They removed the blame factor and rated their environments more positively. It should be noted that the girls' responses were more variable across both streams, as evidenced by the higher standard deviations. (0.88 for girls compared to 0.80 for boys)

Table 4.12 contains data on the difference between upper-stream and lower-stream students grouped by whether they are native English speakers or whether they have English as a second language. Any discussion of the non-English speaking students' attitudes to mathematics class needs to be conducted alongside their perceptions of their classroom learning environment. It is clearly evident that overseas students have a more positive attitude to mathematics as a subject than do their native English speaking counterparts (3.05 for English speakers compared to 3.15 for non-English speakers). This attitude score would be influenced by the large Asian contingent of students in a couple of the sample schools who have a strong affinity with mathematics. The interview data provided sufficient evidence that for the sample, Asian students have high expectations placed on them with regard to their performance in mathematics.

In opposition to this positive score is the fact that these same students rate their classroom learning environments more negatively than do the English speaking students. The summary table (Table 4.12) shows that the ESL students in the upper-stream had the most positive mean attitude score. Table 4.18 shows that the same students have perceptions about their classroom learning environments that are more negative than their English speaking classmates. Schools should be aware that they need to work towards harnessing the positives in the overseas students' attitudes towards mathematics and work towards creating environments where minority students such as these can feel positive. The scale of the *WIHIC* in which these students are most concerned is with *teacher support*. Having international students in schools can provide a good revenue for the school, but schools must be equipped to provide for these students in a way that will help them see their classroom learning environment in a more positive way that reflects their positive attitude towards mathematics as a subject.

When the students were interviewed regarding their attitude to mathematics classes and the factors that affect their attitudes, it was very apparent that the students saw a clear connection between their general attitude and their attitude to mathematics classes. This reflects the quantitative data in that their attitude to mathematics classes and their perception of their classroom learning environments are positively associated. It also reflects the theory of Tourangeau and Rasinski (1988) discussed in Chapter 2, who believe that attitudes expressed are dependant upon what is resident in long term memory. While the survey used in this study asks about current attitudes to mathematics classes, the attitudes expressed by students are built on more than their current circumstances.

While the interview question on attitude did not mention classroom learning environment, students did put the two concepts together in their answers, further illustrating the correlation between the two factors. Most students saw that if their classroom learning environment improved, it would positively affect their attitude to the class. At the same time they say that their general attitude to life which they brought to the mathematics class affects their attitude to that class. A two-way connection between attitude to mathematics classes and their perception of their classroom learning environment is evident in their answers. One student commented that the practice of verbal bullying by others in the classroom affects her attitude to the class in general. This is clearly a classroom learning environment issue.

At the centre of an improved learning environment and therefore an improved attitude to the class was the teacher. The students see the teacher as pivotal in the creation of a classroom learning environment that will effect their attitude to mathematics classes. Typically students said that if their teacher was not so good, they certainly would not enjoy their class so much and this would affect their attitude. They also commented that how the teacher approached the class could inspire them to do a lot better. Typical responses reported that they believed students' attitudes to the mathematics class could be positively affected if the teachers were more understanding and helpful and were able to contain problems within the classroom that are distractions to learning.

As reported in Chapter 2, Carter and Norwood (1997) discuss the relationship between teacher attitude and student attitude. There is a two way effect where each party can and does influence the other. Every comment made by students in response to the interview question on the effect of the teacher in the classroom proved Carter and Norwood (1997) to be accurate. One student said that the teacher impacts on his attitude the "most out of anything."

In one intense interview, a student who thought very deeply about the questions said that even though it is obvious that students will bring their general attitudes into the classroom with them, it is possible for isolated pockets of positive experiences during the day at school to have the effect of sending the students home with a more positive attitude:

> *If a maths class was a place where learning was encouraged and fun, where teachers cared about your well-being, then I think that some people would begin to look forward to or at least appreciate the time spent in the maths classroom, which could always lead to a better attitude of life even though only one aspect has changed.*

Just as has been found in other parts of this discussion, while the main question for this research was on the perceptions of classroom learning environments as experienced by upper and lower-streams of mathematics classes, the answer usually comes down to the teacher. It is the attitudes, practices and teaching style of the teacher that finds itself in the centre of the discussion rather than the practice of streaming itself. This is supportive of the notion that 'classroom' is a major determinant of attitude to mathematics as stated earlier.

6.6 Variations by Gender and Cultural Background

Do perceptions of classroom environments and attitudes to mathematics vary by gender and cultural background and do these variables show up more in an upper or lower-stream?

6.6.1 Variations by Gender

There is a clear distinction between the perceived classroom learning environments of boys and girls. Girls see their learning environment in a distinctly more positive way than do the boys. Table 4.16 illustrates that this was the case for all seven scales of the *WIHIC*. The scales of *student cohesiveness* (0.23 difference), *cooperation* (0.31 difference) and *equity* (0.11 difference) showed the greatest differences in perception between girls and boys. This result was validated by the interview data where boys and girls were both able to pick out the problems with their classroom learning environments but the boys were more intolerant of the aspects of their classroom that they see as being easily fixed. While the girls saw the issues, they were more resigned to the fact that this was how it was and the teachers were doing their best.

While boys made comments such as: "Our class has no fun at all", the girls said: "Teachers do their best to ensure the student is reaching their best potential." Boys' answers are more dogmatic and uncompromising where the girls' answers are softer, showing more compassion and understanding both to the teacher and to fellow students. The differences in personal attributes may account for some of the differences in perceptions of classroom learning environments between the boys and girls.

When the differences between girls' and boys' perceptions of their learning environment were analysed by stream (Table 4.17) rather than as a total sample, the results for the upper-stream and lower-stream still showed separately that the girls were more positive about their learning environment with the main differences again being in the scales of *cooperation* and *student cohesiveness*. Given that the results show the same trends across the sample, it is possible that they reflect a fundamental difference in male/female attributes and levels of maturity.

The results of this study which identify girls as being more positive attitudes towards class and more positive perceptions of classroom learning environment, support the findings of research conducted by Ireson and Hallam (2005) who reported that the liking for school in general among a large sample of secondary students was greater among the girls in their study than among the boys.

Other studies which have measured perceptions of classroom learning environments that have been conducted have arrived at the same conclusion that girls view their learning environments more positively than boys even though their achievement in some cases is lower than the boys. Goh and Fraser (1998) found this to be true for primary mathematics students in Singapore. Martin (2003) found that many personality attributes of girls caused them to be more positive about their learning environment. Tocci and Engelhard (1991) found it to be true for Thai and American students.

6.6.2 Variations by Cultural Background

When considering cultural background in terms of perceptions of classroom learning environment, there is quite a difference in the way Australian students see their classroom learning environment as compared to the students from other cultural backgrounds. The most worrying aspect of this difference is found in Table 4.18 where it is clear that the major areas of perceived difference are in *teacher support* and *equity*. It may be that students who have difficulty understanding the language feel marginalised by the teachers despite the teachers' best efforts or it may be that the traditional 'whole class' approach that many of the teachers still adopt is not suitable to the students who are struggling to understand. If these international students witness the Australian students understanding what the teacher is saying and going on with their work, it becomes logical to expect there to be a significant gap in perceived equity.

When broken down by stream (Table 4.19), it is still clear that international students feel disadvantaged in the same areas of *teacher support* and *equity*. The only significant difference between the upper-stream overseas students and the lower-stream overseas students is that the upper-stream mathematics students who do not have English as their first language have a greater gap in perception of classroom learning environment. *Task orientation* takes over as being the area where their perception is most different from the native English speaking students. This is most likely a reflection of their frustration with not being able to achieve because of the language barrier.

As discussed in Section 2.10, the use of investigative techniques and other variations of classroom practice will help the second language students to develop their skills in the language of mathematics. It is easy for the teacher to treat these students as primary level in mathematics because they are primary level in literacy. These students may often be ahead of similar aged Australian students in mathematics content and understanding. It is a concern that the scale of *investigation* on the *WIHIC* was rated the lowest by all sections of the sample. It is possible that this area could be of help the literacy students.

In the lower-stream it is *teacher support* again that shows the greatest difference (0.23 difference on scale mean score) between how the English speakers and non-English speakers view their classroom learning environment. When interviews were conducted with overseas students, particularly Asian students, a discrepancy emerged. These students have a positive attitude towards the subject of mathematics but a negative perception of their mathematics classroom learning environment. Their attitude towards mathematics as a subject is positive because it is instilled in them by family and culture from a very young age. One student said that in Korea most students are tutored in mathematics from a very young age and they are led to believe that it is the most important subject. In Australia they also feel more positive about mathematics because they see it as one subject they will be able to deal with, even though their language skills have not developed. They also know of a number of other Asian students who have come before them in their new Australian school who have succeeded in mathematics. Their expectations for success are high. To explain why their perception of their classroom learning environment does not match their attitude to the subject, students made it clear that often they are placed below their mathematical aptitude because of their language deficit. They find that students in their classes are poorly behaved and do not take the work seriously and are therefore distracting. Another issue is that they feel intimidated in using their emerging English skills because of embarrassment that results when they are unable to communicate their thought effectively. In their traditional classrooms in their home country the only person they have to interact with is the person sitting next to them.

It is interesting that the discrepancy between the attitude to mathematics and the perceptions of classroom learning environment for these students was also encountered in a study by Aldridge and Fraser (2000) who discovered that students in Taiwan have a more positive attitude to Science classes but a less positive perception of their science class learning environment: "Although students in Australia held more favourable perceptions of the learning environment, it appears that students in Taiwan had more positive attitudes towards their science class." (p.233). The study by Aldridge and Fraser was conducted in Taiwan in the students' home environment during science classes whereas this study had the overseas students in Australian mathematics classrooms. Both studies found there to be an anomaly between student attitude and perceptions of classroom learning environment. This outcome is worthy of further investigation.

It would appear that these students would benefit from a more constructivist approach to learning with group work being beneficial for them. There would be barriers to the success of this method. Firstly there is the hurdle of getting the students to actually use their English and participate and secondly students would find that a classroom organised around group processes would be even more foreign to them than a traditional Australian classroom. In Asia most classrooms are traditional in nature. One point that needs to be made in adding meaning to the quantitative data is that though these students rated *teacher support* low in the *WIHIC*, it may not always be the fault of the teacher because the students in many cases feel intimidated and do not choose to speak. In the case of *student cohesiveness* it is entirely possible that these students are more content working by themselves rather than risk embarrassment with their lack of English language skills.

6.7 Summary

This chapter has brought together the quantitative and qualitative data into a discussion of findings relevant to the research questions. This discussion has looked at streamed learning environments as experienced by students followed by a discussion of how teacher and parents perceive learning environments in streamed classes. The discussion includes a comparison between how mixed-ability and streamed classroom learning environments are perceived. The link between attitude to mathematics class and perceptions of learning environments is then looked at. Finally a discussion of how different genders and cultures perceive their learning environments and how this compares to their attitude to mathematics class is included.

Many outcomes and their implications from the quantitative and qualitative data collected in this study are discussed in this chapter, with specific reference to comment directly from student participants in this study.

Chapter 7 will provide a conclusion to the study, outlining its findings as they relate to the research questions, implications, limitations and further research that may be undertaken to following this study.

CHAPTER 7

CONCLUSIONS

7.1 Introduction

There is a significant amount of research on streaming as a practice in school mathematics. (Bishop, Clements, Keital, Kilpatrick, & Laborde, 1996). This has been reviewed and reported on in Chapter 2. The field of classroom environment research is a well established practice in science and mathematics education and is well documented (Aldridge & Fraser, 2000) as is the area of attitudes to mathematics classes (Cornell, 1999). This research is unique in that it brings together these three areas of the literature and studies the perceived differences in classroom learning environments and student attitudes to the subject when mathematics classes are streamed. The literature in this combined area of interest is significantly less than the sum of the parts.

The tools used for the quantitative part of the study have been shown to be reliable and valid when used with this sample. They have been previously validated in a variety of situations and have shown the same characteristics as have been found in this study. The qualitative data served to further validate the quantitative data by providing narrative support and further explanation to results gleaned from the quantitative data collection. A portion of this study revealed support for previous research. For example, the existence of a relationship between attitude and student perceptions of mathematics classroom environment was established (eg. Adolphe, 2002; Rickards, 1998). Though this study was able to conclude that there are significant differences in perceived classroom environments between the streams of a mathematics class, it is by studying the individual scales that important outcomes become evident. This chapter will provide a summary report of the major findings of the study (7.2), a discussion of the implications of the study (7.3), a discussion of the limitations of the study (7.4), a list of the possible areas where further research could be conducted (7.5), and some concluding remarks (7.6).

7.2 Major Findings of the Study for Each Research Question

This section will systematically provide a summary of the major findings for each research question.

Research Question 1.

What are the differences in classroom learning environments between upper and lower-stream secondary mathematics classes as perceived by the students?

While Chapter 2 contains examples of where streaming, classroom learning environments and attitudes to mathematics classes have been studied in the past, there is no account of any study that has researched these three variables together and the inter-relationships between them. There are substantial findings from this study that practitioners could use to help understand their student clientele and cater better for their needs.

One of the most significant findings from this study is that lower-stream mathematics classes report significantly less positive perceptions of their classroom learning environments than students in upper-stream mathematics classes. While this in itself is not a radical finding, the finding of significance was that the lower-stream had less desire for change. The areas rated most negatively by the lower-stream students were in *teacher support* and *task orientation*. With each of the stakeholders used in this sample, it was evident that in their opinion, the quality of classroom learning environments revolve around two main factors – *task orientation* and *teacher support.*

Interviewing the students confirmed that there is a common perception of what happens in lower-stream classes. Whether the student was from an upper-stream, a lower-stream or a mixed-ability class, they all focused on either the behaviour and motivation area or on the perceived quality of the teaching that happens in lower-stream classes. There was an evident and concerning apathy with regard to how lower-stream classes are conducted. This concern is somewhat amplified when it is realised that several of the schools sampled only have two classes at each year level – an upper-stream and a lower-stream. The question has to be asked about the impact of this type of perception on up to half of a year level. Another question is whether or not the students actually have a choice when there are only two classes. For example, what if 75 percent of the year level fitted the school's criteria for entry to an upper-stream class?

Again with regard to the teaching in streamed classes, it became apparent when interviewing the students that the teaching seems to be focused on a single ability level. Students in the upper-stream often feel overworked and left behind whereas students in the lower-stream are in some cases not encouraged to excel and fall into a fatalistic attitude of underachievement.

Another finding of the study that could be addressed with professional development and time is that students at all levels rated the scales of *involvement* and *investigation* very low. It is evident from a research point of view that some of the perceptions students have of their learning environments, particularly in the area of *involvement* and *teacher support*, could be enhanced if more innovative teaching techniques including investigations were used. These would help cater for different learning styles, different languages and different ability levels.

Research Question 2

What are the differences in classroom learning environments between upper and lower-stream secondary mathematics classes as perceived by teachers and parents?

Findings from interviews with trainee teachers, practising teachers and parents all indicate that there is an institutionalised and accepted culture of streaming in the sample schools. There is political pressure to keep streaming mostly for the benefit of the upper-stream students. While each of these groups has vastly different levels of knowledge and experience of the education system, their conclusions are all similar. They all accept that lower-stream classes have poor classroom learning environments compared to upper-stream classes but at the same time also accept that streaming is the most satisfactory way to provide appropriate levels of instruction for all.

Research Question 3

Is there a difference in the perceived classroom learning environment in mixed-ability classes when compared to streamed classes?

The mixed-ability classes surveyed indicated a perception of their classroom learning environments not as positive as the upper-stream but not as negative as the lower-stream. As a group they fit in between the streamed classes. There is one difference that tells a valuable story. When the measure of *actual* perceived environment was compared to the measure of *preferred* perceived environment, the mixed-ability group showed the greatest discrepancy. The mixed-ability group was least satisfied with their classroom learning environment. Interview comments from mixed-ability students indicated that they are fully ready to be streamed in the coming years so that they will not get bored in class and can achieve at their level. From what they have heard and from what they are experiencing, streaming is an institutionalised process, it is what they are expecting for their future, and it is necessary for their success.

Research Question 4

What is the connection between a student's attitude to mathematics and their perceived classroom learning environment and does this vary between streams?

Another finding of the study was that there is a correlation between attitude to mathematics classes and perceptions of learning environments in mathematics classes. This was consistent with the literature. The concern generated from the study was that students in lower-stream Year 10 classes report more negative attitudes towards mathematics classes and also more negative perceptions of their classroom learning environments than the lower-stream Year 9 students. The opposite is true of the upper-stream classes where Year 10 students report more positive attitudes and perceptions of their classroom learning environment than upper-stream Year 9 classes. By streaming, schools are actually being instruments to widen the gap between the attitudes and perceptions of students towards mathematics as a subject. Also with regard to attitude, students believe that their attitude to life in general has an impact on their attitude to mathematics classes.

Some students even pointed out that positives that happen at school and in particular in mathematics class can have a positive or negative impact on their general attitude.

It also needs to be taken into account that the personality of the student may have an impact on their attitude to the subject and to their perceptions of learning environments. Some of the interview data indicated that students were aware that their own personality influences their attitudes and perceptions.

Research Question 5

Do perceptions of classroom learning environments and attitudes to mathematics vary by gender and cultural background and do these variables show up more in an upper or lower-stream?

When gender differences were examined, it was found that girls had a more positive perception of their classroom learning environment while boys were more demanding in their expectations of their mathematics class. The interview data showed that while girls recognise the limitations of their classroom learning environment, they are more accepting of it and more tolerant of the people and circumstances that contribute to it. This finding was generally true for upper-stream, lower-stream and mixed-ability classes, but was most pronounced in the upper-stream classes.

Secondly, students from the sample who spoke a language other than English at home had a more positive attitude to mathematics classes than the rest of the sample but a more negative perception of their mathematics classroom learning environment. This finding was especially true for the upper-stream students who reported that their high expectations for success in mathematics were not being met by the learning environments in their mathematics classrooms. This was a finding that needs to be noted by schools. If a school is willing to take international students then it needs to be able to cater for their needs. They are not experiencing the same satisfaction in mathematics classes as their attitude to mathematics as a subject should predict. The reasons for this which are evident from the data were that *teacher support* and *equity* for the sample in this study are in fact related. Again the need for a more diverse teaching approach that will help these students reach their potential in mathematics is evident. Teachers would not be trying to create a lack of equity in their classes, but by treating everybody the same in a 'whole of class' type approach, students with specific needs or who are at the extremes of the ability range within the class are rating *equity* very low for those classes.

Conclusion

The major findings of this study from a student point of view are that the issues brought about by streaming could in many cases be overcome if teachers would employ a more constructivist approach to their teaching. Such approaches could cause the lower-streams to become motivated to learn mathematics because they are using a student preferred learning style. The upper-stream could learn concepts over facts and may feel less inclined to become bored and pressured. The mixed-ability group could be taught more as individuals and may not feel so intimidated by the different abilities in their class. Through group work they could improve *student cohesiveness* and *cooperation*. The overseas students could have the opportunity to work in groups and learn 'academic' English from their classmates instead of from just their teacher.

7.3 Implications of the Study

There are significant implications from this study for students, teachers, parents, school administrators and teacher training departments.

Firstly, there are differences between the perceptions of classroom learning environments in upper and lower-stream mathematics classes for teachers, parents and even trainee teachers. In most cases, including the students themselves, it was an expectation that the learning environment would be inferior in a lower-streamed class and yet streaming is still perceived by teachers as the best method of organising mathematics classes. The implication here is that all stakeholders in the education process may be accepting of an inferior situation. Lower-stream students showed in their responses to both the quantitative and qualitative items that they are accepting of the situation and are seeking less change than the upper-stream students.

The results also imply that if education systems made a resolution that streaming was no longer acceptable in our society, very few teachers, schools or even teacher training institutions would be ready to cater for the needs of the mixed-ability classes that would be established. There is a significant implication for teacher training institutions and the way future mathematics teachers are trained to think about their career. As with all teaching, the ‘Pareto Principal’ applies. This principle says in this specific case that the top 20 percent of those who succeeded in mathematics at secondary school will be teaching the bottom 80 percent of the ability range in their mathematics classrooms. (Reh, 2005, p. 76). It may be that teacher trainees, having in most cases come out of upper-stream mathematics classes at school, support the process that helped them succeed. Teacher training institutions need to discover ways to not only teach constructivist methods of teaching and learning to their students before they graduate, but to discover ways of helping the students to become committed to the idea of using these methods in their future classrooms. The results of this study indicate that teachers need to see even streamed classes as a group of mixed-ability students with different needs and different learning styles.

Connected to the concept of teaching styles is the result that showed investigation in mathematics classes to be perceived very poorly. The implication is that teachers could do more to involve the students in investigative techniques and to care more for the problem solving aspect of student learning.

Given that the results indicated that student perception of classroom learning environments in lower-streams were lower in Year 10 than in Year 9, while upper-streams showed a more positive perception of learning environments in Year 10 than Year 9, the implication is that schools need to address this situation. For many schools eliminating streaming would be a difficult option, especially in the states that have prescribed curriculum specific to achievement levels of students. Possible ways to help with this situation could be for the school to give a more positive image of the lower-stream, to place motivational teachers in the lower-stream, to put more resources in the lower-stream classroom, to encourage more group work, more use of information technology and more individualised instruction in the lower-stream.

Chapter 2 of this study contains many references to researchers who have reported the inequity associated with streaming. The scale of *teacher support* had prominence in this study when looked at in association with student attitudes and perceptions of classroom learning environments from the different streams. One outcome of this study is that teacher input into the learning process is a key factor in shaping the students' attitudes and perceptions of their learning environment. As pointed out by Gutierrez (as cited in Boaler, 2002): "Our greatest hope for providing equitable teaching environments is to focus on teachers' practices, investing our time and resources in the teachers who enact reform curricula." (p. 253)

With regard to the level of *teacher support* being of paramount importance to student attitude and perception of their learning environment, Ireson and Hallam (2005) say that: "For pupils, it is the teacher's ability to provide support and help for learning that is of importance. Students understand the significance of their work in school and want to be supported." (p. 307)

This research also found that students who come from overseas to Australia and have English as a second language struggle with the learning environments of mathematics classes. This implies that teachers and schools need to become more aware of individual students in the class who may want to succeed but have language as a barrier to learning.

7.4 Limitations of the Study

Only one type of school was chosen for the sample. Selecting a homogeneous sample in terms of type of school ensured that more variables were not being introduced that would be difficult to account for in the results. In Australia there are 25 Seventh-day Adventist secondary schools. This research surveyed all Year 9 and 10 mathematics students and a sample of the teachers from 7 of those 25 schools. These are independent Christian schools but are all state registered and using state curricula. They all have mathematics teachers with recognised degrees and teaching qualifications.

Although it is a limitation to only use one type of school, the schools surveyed cover four states of Australia and cover varieties of schools such as a growing school in the middle of rapid urban development on the northern outskirts of Brisbane, a Sydney Western suburbs school, a regional school, a boarding school in Western Australia and an inner city Sydney school. Using schools with the same operating philosophy helped to homogenise the sample. The fact that only one type of school was used in the sample helped to individualise the study. Though operating under one philosophy, the implementation of this philosophy is quite different in each school. Certainly the cultural mix in each school varied dramatically with some schools almost exclusively 'White Australian' while the Sydney schools, for example, had a large multicultural mix. It should also be noted that each of these schools are available to the general public who want private education and are not limited to those of particular religious persuasions. It should be noted that the Christian ethos must impact on the responses of all participants and should therefore be considered a contributing factor when considering the responses.

Another limitation of this study is that quantitative data were only taken from the students. Data from teachers and parents is confined to qualitative data in the form of extended questions either face-to-face or by email. Student perceptions of classroom learning environments was the main focus of the study but interview data from teachers and parents provided useful additions to the quantitative data.

7.5 Opportunities for Further Research

There were many variables introduced into this study that would warrant further research. For example, the study has measured the perceived differences in classroom learning environments between upper and lower-streams of middle secondary mathematics classes. If, for example one of the schools surveyed had a two stream Year 9 class in mathematics and there is found to be a significant difference between the upper and lower-stream in terms of perceived classroom learning environments, how can it be established whether the reason for this is simply the teacher or if in fact it is a sociological reason attributable to streaming? Further research to help answer this question could be undertaken. The use of the *Questionnaire on Teacher Interaction (QTI)* for a similar sample may add another dimension to the role the teacher plays in the different perceptions of learning environments experienced by different streams.

Investigation is perceived to be sadly lacking in maths classes. The scale of *investigation* stood out as an anomaly in most calculations. As this was not a focus of this study, further research could be conducted to understand why this is so. Do teachers understand the place of investigation in mathematics classes? Do they have access to enough resources to help them provide investigation experiences for their students? Could it be possible that students are investigating but do not know it?

If schools are to persist in streaming, what type of teacher would be better suited to the lower-stream classes? The evidence from this study is consistent with the literature that often the most skilled teachers are placed with the upper-streams. Even the students in lower-stream classes recognise that their teachers are often not the most skilled teachers the school has available. What can be done to change the image of lower-stream classes and to help students change their perception that the teacher does not care?

As an outcome of the qualitative data collection, it appeared that the level of involvement of students in their classroom had a lot to do with their own personality as well as with the environment set by the teacher. Student personality is a factor not accounted for in the quantitative data but was seen to play a part as the interviews were conducted. This was evident in answers from students that indicated personality factors such as shyness or openness, or fear of embarrassment. The use of a personality inventory such as the Myers-Briggs, in combination with a learning environment inventory would make an interesting study.

This study has taken students whose first language is not English and compared their perceptions of their classroom learning environments to those of English speaking students. While the results did show that there was a difference between the two groups in terms of these perceptions, interview data further indicated that there is a large range of responses within the non-English speaking group of students. While this study reports students of different languages as one complete group, research needs to be conducted on the differences between different cultural groups and their perceptions of their mathematics classroom learning environments in Australia. For example, interviews indicated that Asian students see things differently to Pacific Island students. In what ways do their attitudes and perceptions of their mathematics classroom vary?

With regard to overseas students, the discrepancy between student attitude to mathematics classes and their perception of their mathematics classroom learning environment needs to be given more study. Given that Aldridge and Fraser (2000) encountered the same anomaly in the *WIHIC* scales when studying Taiwanese students, further study in this area is justified.

One of the findings from this study was that as students progress from Year 9 to Year 10, the upper-stream students showed an improvement in both attitude and perceptions of their classroom learning environment while for the lower-stream classes there was deterioration in both of these measures. This observation would be worth pursuing further in a longitudinal study over several years to track the attitudes and perceptions of classroom learning environments of the same classes as they passed from Year 9 to Year 10. In this study the conclusions were made from different cohorts of students in Year 9 and Year 10.

As with studies by Margianti and Fraser (2002) and Aldridge and Fraser (2000), this study identified from the factor analysis multiple loadings between the scales of *student cohesiveness* and *cooperation*. Further research could be undertaken to establish if there is something unique about the samples that may cause this to happen when other studies have found these scales to be self-contained.

7.6 Summary and Concluding Remarks

This study is a unique venture into the field of classroom learning environments in mathematics classrooms as they relate to streamed classes and mixed-ability classes. It also takes into account actual and preferred classroom learning environments, attitudes to mathematics classes, male and female differences and English speaking and non-English speaking students. This study utilised both quantitative and qualitative methods and sampled students, pre-service teachers, practising teachers and parents.

The results from this study have once again showed the *WIHIC* to be a valid and reliable instrument. Many conclusions were able to be drawn from the results that have implications for the way teachers actually teach in their classrooms and the way schools or mathematics departments allocate their students and teachers to various streams. The very question as to whether in fact schools need to stream at all may be asked given the results of this study. A further question can also be asked: Is it streaming in itself that is the issue introduced in this study or is it the way administrations of schools and teachers relate to the streamed classes?

While the conclusions reached in this study have been derived from mathematics classrooms in private schools, there is reason to believe that the results obtained from other types of schools and the principles developed from these results may be applicable to all types of schools and across different subject areas. It is hoped that the findings from this study will add to the already significant bank of knowledge in the literature on classroom learning environments but specifically that they will make a new contribution in the area of streaming in mathematics classes.

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APPENDICES

Appendix A

Information sheet for principals and teachers

1. The aim of this project is to establish the differences in the perceptions that students in Year 9 and 10 mathematics classes have of their classroom learning environment. Of particular interest are any differences between different streams of mathematics classrooms.

2. The participants will be asked to fill in a survey of 66 questions giving their perceptions of their actual classroom learning environment and also their preferred classroom learning environment. The survey should take the participants around 15 minutes to complete. Students will also be invited to include their email address so that further qualitative questions can be put to them. Both the providing of the email address and the answering of emails is of course optional.

3. All surveys and transcripts of interviews and emails will be kept confidential. Teacher's names are collected but only for the purpose of identifying classes as streamed or otherwise. Teachers' names are transcribed into numbers as the first step in the data handling. No participant will be identifiable in any published or non-published work.

4. There are no risks identified for participants but there are potential benefits to each school as generic information which does not identify student or teacher is fed back to the school.

5. If you have any issues with this process please let me know: Peter Kilgour – 0414 772 182.

6. The study is being conducted through Curtin University of Technology in Perth and has been approved by the university ethics committees. The Secretary of the ethics committee can be contacted if there are any concerns. All enquiries can be made to the Secretary on 9266 2784 or hrec@curtin.edu.au

Appendix B

Instructions for implementing 'Maths Class Research'

Many thanks for agreeing to help with the implementation of this survey.

Remember to make sure students know that **this research is for a university project and accurate completion will benefit students in the future**.

They should also know that their class teacher will not see or know what they write. This could affect their answers. They should also know that they can withdraw at any time without prejudice.

Instructions for students:

Please fill in your details:

- Note that your name and email address are optional.
- If you put your email address in, the researcher will contact you by email to ask questions about you and your mathematics class. Your comments will be kept confidential from school and teacher. It would be very helpful if you were to give your email address.

Section 1.

Please answer Section 1, Question 1-10. Follow the example given carefully to make sure you understand.

Section 2

Every one of these 56 questions should have 2 numbers circled. That is an answer circled in the light grey column and an answer circled in the dark grey column.

The **light grey column** is where you answer about **the way you think your class is now**.

The **dark grey column** is where you answer about **how you would like your class to be**.

Please do not leave out any questions.

Appendix C

Report to Teachers on Preliminary Findings

Dear Maths Teacher

Over the last few months I have been at some of your schools and administered some surveys to your students. I am not finished the write-up yet but I thought I might give you some very general preliminary findings and ask you just a few questions. Your answers to these questions will be vital for me to finish the thesis I am working on.

I wanted to thank you for allowing me into your school to run my surveys with your Year 9 and 10 students. The results are coming through as significant and I should be finished by September and able to give you some feedback about how your school's maths classes perceive their classroom learning environments. Obviously the ethics clearance doesn't allow me to pass on to you specifics that may point to individual teachers or students.

I would do nothing to compromise the confidentiality of the students or the teachers and for that reason the results will have to be quite general and will therefore apply in varying degrees to different schools.

Taking the whole seven schools together, the general findings so far are:

1.Students in upper-streams perceive their learning environment significantly more positively than those in the lower-streams.

2. Students in both streams seem to accept that lower-stream students do not behave as well and are not generally on task as much as upper-stream students.

3. Girls generally perceive their learning environment more positively than do boys from the same class.

4. Out of the seven scales that were measured (*Student Cohesiveness, Teacher Support, Involvement, Task Orientation, Investigation, Cooperation and Equity*), *Student Cohesiveness* and *Equity* rated the most positive. This is a credit to the teachers who are creating comfortable and equitable environments in their classrooms. The areas of *Investigation* and *Involvement* rated lowest. In fact *Investigation* which includes problem solving, practical tasks and experiments rated very low. This is a result of curriculum pressures to get through the allocated work. Research shows that lower-stream students definitely benefit from a more hands on approach and when looking at professional development for maths teachers, these sorts of sessions could well be worthwhile in seeking to improve student outcomes.

5. Even though the upper-stream classes rated their classroom learning environment the highest, they were also the most demanding in that they were looking for the greatest improvement. That is the gap between their *actual* environment and their *preferred* environment scored the highest.

6. For those of you with mixed-ability classes, they sat right in between the lower-stream and upper-stream. There are some frustrated learners in these classes who, when being taught by a traditional teacher, become a little frustrated at being held back.

7. For those of you with international students, while their attitude to maths was very high, their perception of their classroom environment was very low indicating that we could do more for the second language students – even in maths.

Now to the questions:

Can you comment on the differences you have experienced between a lower-stream and an upper-stream in terms of *classroom environment? A possible definition of 'classroom environment' is below.

*Classroom environment can be interpreted under the following categories:

(a) Do the students get on well together?
(b) Are the students making full use of your skills?
(c) Do the students get involved in their learning?
(d) Do the students generally get on with their work?
(e) Do the students work together on problem solving?
(f) Is there a general feeling of cooperation in the class?
(g) Do all students feel like they are treated equally?

I do appreciate your time in helping me with this.

Peter

Appendix D

The Survey (not the exact formatting as in the student form)

Maths Class Research

Your Name (optional): ____

Teacher's Name: ____________________________________

School: ____

Year: _____ Male ☐ Female ☐

Main language spoken at home: _______________________

Email Address (optional): ___________________________________

Section 1: Your Attitude to Mathematics Lessons

Items 1-10 below consist of a number of statements about any maths lessons you might have in this class.
You will be asked what you think about these statements. There are no 'right' or 'wrong' answers.
Your opinion is what is wanted. It would be most helpful if you answer every question please.

For each statement, draw a circle around

1	2	3	4	5
if you disagree with the statement		if you are not sure		if you agree with the statement

For example if you agree that you like maths lessons you would fill in the following:

1	I look forward to mathematics lessons	1	2	3	4	(5)

Now fill in the following table:

		Disagree		Not Sure	Agree	
1	I look forward to mathematics lessons	1	2	3	4	5
2	Mathematics lessons are fun	1	2	3	4	5
3	I enjoy the activities we do in mathematics	1	2	3	4	5
4	What we do in mathematics is among the most interesting things we do at school	1	2	3	4	5
5	I want to find out more about where mathematics can be used	1	2	3	4	5
6	Finding out about new things is important	1	2	3	4	5
7	I enjoy mathematics lessons in this class	1	2	3	4	5
8	I like talking to my friends about what we do in mathematics	1	2	3	4	5
9	We should have more mathematics lessons each week	1	2	3	4	5
10	I feel satisfied after a mathematics lesson.	1	2	3	4	5

SECTION 2 Your Perception of Your Maths Class

	ACTUAL					PREFERRED				
Student Cohesiveness	Almost Always	Often	Some times	Seldom	Almost Never	Almost Always	Often	Some-times	Seldom	Almost Never
1. I make friendships among students in this class.	1	2	3	4	5	1	2	3	4	5
2. I know other students in this class.	1	2	3	4	5	1	2	3	4	5
3. I am friendly to members of this class.	1	2	3	4	5	1	2	3	4	5
4. Members of the class are my friends.	1	2	3	4	5	1	2	3	4	5
5. I work well with other class members.	1	2	3	4	5	1	2	3	4	5
6. I help other class members who are having trouble with their work.	1	2	3	4	5	1	2	3	4	5
7. Students in this class like me.	1	2	3	4	5	1	2	3	4	5
8. In this class, I get help from other students.	1	2	3	4	5	1	2	3	4	5
Teacher Support	Almost Always	Often	Some times	Seldom	Almost Never	Almost Always	Often	Some-times	Seldom	Almost Never
9. The teacher takes a personal interest in me.	1	2	3	4	5	1	2	3	4	5
10. The teacher goes out of his/her way to help me.	1	2	3	4	5	1	2	3	4	5
11. The teacher considers my feelings.	1	2	3	4	5	1	2	3	4	5
12. The teacher helps me when I have trouble with the work.	1	2	3	4	5	1	2	3	4	5
13. The teacher talks with me.	1	2	3	4	5	1	2	3	4	5
14. The teacher is interested in my problems.	1	2	3	4	5	1	2	3	4	5
15. The teacher moves about the class to talk with me.	1	2	3	4	5	1	2	3	4	5
16. The teacher's questions help me to understand.	1	2	3	4	5	1	2	3	4	5

	ACTUAL					PREFERRED				
Involvement	Almost Always	Often	Some times	Seldom	Almost Never	Almost Always	Often	Some-times	Seldom	Almost Never
17. I discuss ideas in class.	1	2	3	4	5	1	2	3	4	5
18. I give my opinions during class discussions.	1	2	3	4	5	1	2	3	4	5
19. The teacher asks me questions.	1	2	3	4	5	1	2	3	4	5
20. My ideas and suggestions are used during classroom discussions.	1	2	3	4	5	1	2	3	4	5
21. I ask the teacher questions.	1	2	3	4	5	1	2	3	4	5
22. I explain my ideas to other students.	1	2	3	4	5	1	2	3	4	5
23. Students discuss with me how to go about solving problems.	1	2	3	4	5	1	2	3	4	5
24. I am asked to explain how I solve problems.	1	2	3	4	5	1	2	3	4	5
Task Orientation	Almost Always	Often	Some times	Seldom	Almost Never	Almost Always	Often	Some-times	Seldom	Almost Never
25. Getting a certain amount of work done is important to me.	1	2	3	4	5	1	2	3	4	5
26. I do as much as I set out to do.	1	2	3	4	5	1	2	3	4	5
27. I know the goals for this class.	1	2	3	4	5	1	2	3	4	5
28. I am ready to start this class on time.	1	2	3	4	5	1	2	3	4	5

29. I know what I am trying to accomplish in this class.	1	2	3	4	5	1	2	3	4	5
30. I pay attention during this class.	1	2	3	4	5	1	2	3	4	5
31. I try to understand the work in this class.	1	2	3	4	5	1	2	3	4	5
32. I know how much work I have to do.	1	2	3	4	5	1	2	3	4	5
Investigation	Almost Always	Often	Some times	Seldom	Almost Never	Almost Always	Often	Some-times	Seldom	Almost Never
33. I carry out investigations to test my ideas.	1	2	3	4	5	1	2	3	4	5
34. I am asked to think about the evidence for statements.	1	2	3	4	5	1	2	3	4	5

35. I carry out investigations to answer questions coming from discussions.	1	2	3	4	5	1	2	3	4	5
36. I explain the meaning of statements, diagrams and graphs.	1	2	3	4	5	1	2	3	4	5
37. I carry out investigations to answer questions that puzzle me.	1	2	3	4	5	1	2	3	4	5
38. I carry out investigations to answer the teacher's questions.	1	2	3	4	5	1	2	3	4	5
39. I find out answers to questions by doing investigations.	1	2	3	4	5	1	2	3	4	5
40. I solve problems by using information obtained from my own investigations.	1	2	3	4	5	1	2	3	4	5
Cooperation	Almost Always	Often	Some times	Seldom	Almost Never	Almost Always	Often	Some-times	Seldom	Almost Never
41. I cooperate with other students when doing assignment work.	1	2	3	4	5	1	2	3	4	5
42. I share my books and resources with other students when doing assignments.	1	2	3	4	5	1	2	3	4	5
43. When I work in groups in this class, there is teamwork.	1	2	3	4	5	1	2	3	4	5
44. I work with other students on projects in this class.	1	2	3	4	5	1	2	3	4	5
45. I learn from other students in this class.	1	2	3	4	5	1	2	3	4	5
46. I work with other students in this class.	1	2	3	4	5	1	2	3	4	5
47. I cooperate with other students on class activities.	1	2	3	4	5	1	2	3	4	5
48. Students work with me to achieve class goals.	1	2	3	4	5	1	2	3	4	5

Equity	Almost Always	Often	Some times	Seldom	Almost Never	Almost Always	Often	Some-times	Seldom	Almost Never
49. The teacher gives as much attention to my questions as to other students' questions.	1	2	3	4	5	1	2	3	4	5
50. I get the same amount of help from the teacher as do other students.	1	2	3	4	5	1	2	3	4	5
51. I have the same amount of say in this class as other students.	1	2	3	4	5	1	2	3	4	5
52. I am treated the same as other students in this class.	1	2	3	4	5	1	2	3	4	5
53. I receive the same encouragement from the teacher as other students do.	1	2	3	4	5	1	2	3	4	5
54. I get the same opportunity to contribute to class discussions as other students.	1	2	3	4	5	1	2	3	4	5
55. My work receives as much praise as other students' work.	1	2	3	4	5	1	2	3	4	5
56. I get the same opportunity to answer questions as other students.	1	2	3	4	5	1	2	3	4	5