

EMPATHIC CLIMATE AND LEARNING

OUTCOMES:

**A Study Of Teaching Empathy In Relation
To Mathematics Learning Outcomes**

By

Finian Buckley

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Dublin City University Business School,

Dublin City University,

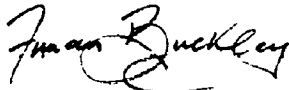
Ireland

Supervisor Professor John Hurley

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DECLARATION

"I hereby certify that this material, which I now submit for assessment on the programme of study leading to the award of PhD is entirely my own work and has not been taken from the work of others, save and to the extent that such work has been cited and acknowledged within the text of my work

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Registration No 88700739

Date 11/06/1993 "

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To Mary B

ABSTRACT

This study examined the influence of Empathic Teaching Climate on Mathematics Learning and Mathematics and General School Self-Concepts, in sixteen schools in Dublin, Ireland. The study required the design development and validation of the Student-Teacher Interaction Questionnaire (STIQ), which measures specific behavioural indices of classroom Teaching Empathy. The research monitored the effects of Teaching Empathy on students (N=387) in their first year of secondary schooling, as they completed the prescribed mathematics module on Sets and Venn Diagrams. Overall findings indicate positive effects of Teaching Empathy on student cognitive and affective learning outcomes in mathematics. Results indicated that Teaching Empathy is composed of two separate factors. The first of these, the Personal Focus of Teacher factor, is shown to positively influence Mathematics Learning outcomes. The second factor, Supportive Teaching Style, recorded a significant positive effect on Mathematics Self-Concept outcomes. The processes by which these influences take place are suggested. Some interesting gender differences are also reported which appear to imply a differential theory of the perceived importance of Teaching Empathy, based on a student's sex.

CONTENTS

| | | |
|-------------------------|---|------------|
| DECLARATION | | 1 |
| ACKNOWLEDGEMENTS | | ii |
| ABSTRACT | | iii |
| CONTENTS | | iv |
| PREFACE | | ix |
| CHAPTER 1 | | 1 |
| 1 0 | INTRODUCTION | 2 |
| 1 1 | Strides Towards a Theory of School Learning | 2 |
| 1 1 1 | Determinants of Achievement | 7 |
| 1 1 2 | Bloom's Theory of School Learning | 11 |
| 1 1 2 2 | Bloom's Quality of Instruction | 16 |
| CHAPTER 2 | | 21 |
| 2 0 | COGNITIVE ENTRY CHARACTERISTICS | 22 |
| 2 1 | Introduction | 22 |
| 2 1 1 | Cognitive Entry Characteristics Measured | 27 |
| 2 1 2 | Achievement in Mathematics Influencing Factors | 32 |
| 2 1 3 | Mathematical Ability Appraised | 34 |
| 2 1 3 1 | Task Analysis of Mathematical Problem-Solving | 37 |

| | | |
|------------------|--|-----------|
| CHAPTER 3 | | 47 |
| 3 0 | AFFECTIVE ENTRY CHARACTERISTICS | 48 |
| 3 1 | Motivational Influences on Learning | 48 |
| 3 1 1 | Understanding Motivation | 52 |
| 3 1 2 | Weiner's Attribution Theory | 54 |
| 3 1 2 1 | Causal Dimensions | 55 |
| 3 1 3 | Motivation and Affect | 65 |
| 3 2 | Self-Concept and Motivation | 69 |
| 3 2 1 | Self-Concept Characteristics and Structure | 71 |
| 3 2 2 | The Multidimensionality of Self-Concept | 72 |
| 3 2 3 | Hierarchical Structure of Self-Concept | 73 |
| 3 2 4 | Gender Differences in Self-Concept | 75 |
| | | |
| CHAPTER 4 | | 80 |
| 4 0 | EMPATHY | 81 |
| 4 1 | Introduction | 81 |
| 4 1 1 | Empathy and the Social Milieu | 82 |
| 4 2 | Definitions of Empathy | 83 |
| 4 3 | Empathy in Counselling/Psychotherapy | 92 |
| 4 4 | Empathy Learnt or Innate? | 95 |
| 4 5 | Empathy and Individual Differences | 100 |
| 4 5 1 | Empathy, Altruism and Prosocial Behaviour | 102 |
| 4 5 2 | Personality Adjustment and Empathy | 104 |

| | | |
|------------------|---|------------|
| CHAPTER 5 | | 108 |
| 5 0 | EMPATHY IN EDUCATION | 109 |
| 5 1 | Introduction | 109 |
| 5 2 | Empathy and Learning Outcomes/Achievement | 110 |
| 5 3 | Empathy in the Classroom Manifestations | 114 |
| 5 4 | Literature Summary | 122 |
| | | |
| CHAPTER 6 | | 126 |
| 6 0 | RESEARCH HYPOTHESIS | 127 |
| 6 1 | The Experimental Setting Summarised | 129 |
| 6 2 | Student Subject Sample | 135 |
| 6 3 | School Subject Sample | 137 |
| 6 4 | Teacher Sample | 138 |
| 6 5 | Instruments Employed | 140 |
| 6 5 1 | The Self-Description Questionnaire-II | 140 |
| 6 5 1 1 | Reliability of the SDQ | 144 |
| 6 5 1 2 | Construct Validity of the SDQ | 145 |
| 6 5 1 3 | Sex Effects and the SDQ | 146 |
| 6 5 2 | The Student-Teacher Interaction Questionnaire | 147 |
| 6 5 2 1 | Stages in Instrument Development | 147 |
| 6 5 2 2 | Reliability of the STIQ | 153 |
| 6 5 2 3 | Validity of the STIQ | 154 |
| 6 5 3 | Mathematics Ability Test | 158 |
| 6 5 4 | Mathematics Module Assessment | 160 |
| 6 6 | The Learning Task | 165 |

| | | |
|-------------------|--|------------|
| CHAPTER 7 | | 167 |
| 7 0 | RESULTS | 168 |
| 7 1 | Statistical Treatments Employed | 168 |
| 7 2 | Correlate Effects | 183 |
| | | |
| CHAPTER 8 | | 191 |
| 8 0 | DISCUSSION | 192 |
| 8 1 | Summary of Results | 192 |
| 8 1 1 | Mathematics Learned Assessed | 192 |
| 8 1 2 | Mathematics Self-Concept Outcomes | 193 |
| 8 1 3 | General School Self-Concept Outcomes | 194 |
| 8 2 | Outcomes Appraised | 196 |
| 8 2 1 | Mathematics Learned Outcomes Appraised | 198 |
| 8 2 1 1 | Gender and Mathematics Learned Outcomes | 208 |
| 8 2 2 | Mathematics Self-Concept Outcomes Appraised | 211 |
| 8 2 2 1 | Gender Differences and Mathematics Self-Concept Outcomes | 215 |
| 8 3 | Conclusions | 219 |
| | | |
| CHAPTER 9 | REFERENCES | 226 |
| | | |
| CHAPTER 10 | APPENDICES | 269 |
| Appendix A | Test Answer Sheet | 270 |
| Appendix B | Booklet for Test Administration | 272 |
| Appendix C | Classification Background of Irish Education | 277 |
| Appendix D1 | The Self-Description Questionnaire-II | 286 |
| Appendix D2 | The dimensions of the SDQ-II employed | 292 |

| | | |
|------------|---|-----|
| Appendix E | Teacher Empathic Behaviour Scale as Assessed by Experts | 297 |
| Appendix F | The Student-Teacher Interaction Questionnaire | 299 |
| Appendix G | Mathematics Ability Test | 302 |
| Appendix H | Mathematics Module Assessment | 304 |

PREFACE

This research proposes to explore the influence of *Teaching Empathy* on student mathematics learning, in the classroom instructional situation of the first year of second level education. Mathematics and this particular period of student education are deliberately selected, as students' indicate more *non-ability* related problems with mathematics learning than with most other school subjects. The first year of second level education sees all students at a common starting point in terms of the mathematics subject matter to be covered and in terms of the novelty of their mathematics teacher. However, the goal of investigating the influence of *Teaching Empathy* on mathematics learning cannot be investigated isolated from the many other factors which influence student learning in the classroom situation. Thus a clearer representation of the part *Teaching Empathy* may play in such a process can only be understood in the context of a review of the accepted literature outlining the major variables which influence classroom learning and in particular mathematics learning.

Chapter One begins this review of the literature on the determinants of school learning, by considering the complexities of this field of research and the problems associated with the valid measurement of learning outcomes from the instructional situation. While research has indicated that the determinants of classroom learning and achievement are many, some theorists have identified a small number of specific variables that embrace and explain much of the variance recorded in school learning. There is agreement among educational researchers that two major student characteristics determine to a great extent, achievement in the learning situation. These can be referred to generically as a student's *previous learning history* and their *motivational disposition* to that subject being taught. These influences are characterised by the graphic representation

(see page 13) proposed in Bloom's model in his Theory of School Learning. Although the content of Bloom's theory has been widely questioned, the framework of his model is still useful in the understanding of the major variables which influence student learning. To review the current literature on the importance of student past learning history and motivational dispositions on classroom learning, it is possible to continue to employ the *shape* of Bloom's model, while replacing his content with the more acceptable and complete modern conceptions and formulations.

Chapter Two initiates this procedure by beginning with a review of what most educational researchers consider the most important predictor of school learning, namely a student's previous learning history. This learning history is referred to as the Cognitive Entry Characteristics a student possesses when facing a new learning task. To further understand this concept in terms of modern research, the theory and research of current cognitive researchers such as Sternberg, Anderson, Siegler, Rumelhart & Norman and Mayer, is reviewed in the context of the specific task analysis processes and skills required for mathematical learning and problem solving. This specific understanding of the sub-processes of mathematical reasoning is necessary at this stage as the present study proposes to assess student baseline mathematics ability as a measure of their Cognitive Entry Characteristics, as they enter a new learning situation. Such an insight into the task analytic processes involved in mathematics learning may also be of use in determining the actual interactive effects *Teaching Empathy* may have on student mathematics learning processes.

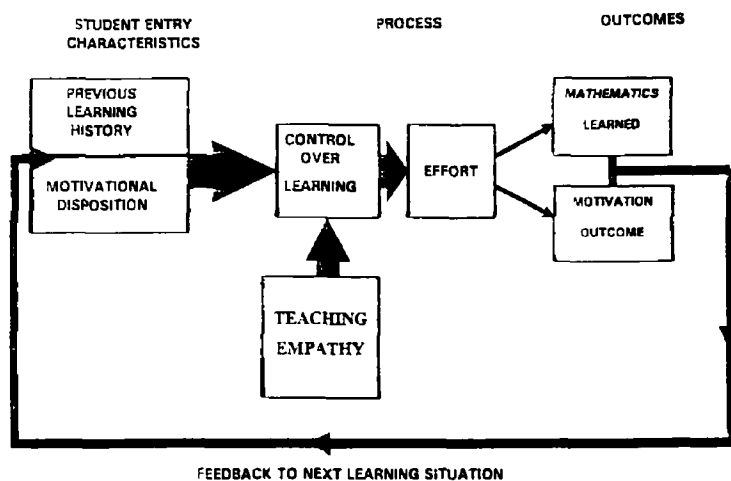
While a student's previous learning history is a significant variable in the prediction of future learning success, so too is a student's motivational disposition. In **Chapter Three**, motivation (referred to as a student's Affective Entry Characteristics) its' intricacies and importance in

educational research are reviewed and applied to the present study. The review begins with an introduction to research which consolidates the importance of motivation as a significant influence on student learning outcomes, but also suggests that it should be viewed as an instructional goal in itself. Perhaps the most complete and comprehensive attempt at a conceptual theory of motivation in recent years is that of Bernard Weiner. This complex theory of attributional processes is reviewed in full and is integrated with the work of other prominent writers in motivational research. It is clear that the affective manifestations of motivational thought can have a significant bearing on a student's performance in a learning situation. Resulting feelings include confidence, pride, anxiety or guilt depending on the situational characteristics. These feelings are also linked with a student's conception of their own ability and control over the learning situation. Student self-conceptions are of such importance in the understanding of student investment in the learning process, that the second part of Chapter Three concentrates on a fuller understanding of self-concept and integrates it with the motivational theory described before. The review of the importance of a student's motivational disposition concludes with the understanding that self-concept measures, and for this study, measures of mathematical self-concept, offer a valid index of a student's motivational disposition on facing a new mathematics learning situation.

Thus far the review has examined the two most important influencing variables in school learning, a student's previous learning history and motivational disposition. As stated earlier, the goal of the present research is to investigate the influence of *Teaching Empathy* on student mathematics learning outcomes (i.e. the amount of mathematics learned and mathematics motivation outcomes). In **Chapter Four** the concept of empathy is introduced and its' origins, determinants and definitions are described. To gain a complete understanding of the concept, its' prominence in psychotherapy/counselling is also reviewed. Research

indicating the significance of empathy in areas such as altruism, prosocial behaviour and effective communication are also examined

Chapter Five takes empathy to the classroom and reviews the evidence available which suggests that *Teaching Empathy* does have a positive influence on student learning. While much of the evidence cited is correlational, some more insightful research in recent years has indicated that the facilitative behaviours of empathic teachers assist student composure in learning situations and thus increase their learning potential. It is based on such findings that the premise of the present research hypothesis is set. Explicitly, that in the mathematics learning situation, *Teaching Empathy* will influence student motivation attributions by reducing anxiety levels, thus allowing students recall with more confidence the essential mathematics skills and processes needed to translate and encode the new mathematical material facing them. This lessening of anxiety and ability to recall the relevant strategies and knowledge, allows students invest more effort on the task at hand. As a consequence, student learning or achievement rates should increase and their motivational disposition to mathematics should also improve. The figure displayed below attempts to display this process graphically.



Chapter Six introduces the methodology and procedure of the study and also describes the breakdown of the population sample employed (16 schools, 387 students). The specific measures of the variables being

evaluated are outlined, as are the reliability and validity statistics of these measures. In particular the development and validation of the test of *Teaching Empathy* (Student-Teacher Interaction Questionnaire), specifically designed for this study, is described in full (p 147-158). Factor analysis of this scale reveals that Teaching Empathy is composed of two distinct factors, (a) A *Personal Focus of Teacher* factor and (b) A *Supportive Teaching Style* factor. The experimental procedure of the study is described and detailed in full.

Chapter Seven outlines the results of the statistical treatment of the data collected. Following the descriptive statistics, the experimental hypotheses are outlined and the statistical treatment employed to test their validity are described. Effectively the results indicate that *Teaching Empathy* does indeed have a significant influence on student mathematics learning and on student mathematics self-concept. Further secondary findings, such as gender differences recorded in mathematics learning outcomes and in *Teaching Empathy* evaluation are also described.

The final chapter, **Chapter Eight**, begins with an outline summary of the results described in Chapter Seven. The discussion then expands to look at the possible learning process by which *Teaching Empathy* influenced student mathematics learning. In particular the results which indicated the significant effect of the *Personal Focus of Teacher* sub-component of *Teaching Empathy*, on the amount of mathematics learned, is discussed in detail. Also examined is the finding which indicated that the Supportive Teaching Style component of *Teaching Empathy* has a positive influence on student mathematics self-concept outcomes. The model displayed on page 220 indicates the suggested process which may have taken place. Other interesting results such as the differential influence of student sex and teacher sex on outcomes are also reviewed and discussed.

CHAPTER ONE

1 0 INTRODUCTION

1 1 STRIDES TOWARD A THEORY OF SCHOOL LEARNING

Recent educational commentary has emphasised the need for increased professional accountability from the teaching profession, regarding the outcomes of schooling Eccleston and Borkin (1989) highlight this trend, reporting a steady increase in the degree of emphasis placed on accountability in educational reviews in recent years This perspective is perhaps predictable when critiques on educational effectiveness such as the review by Meighan (1989), conclude that the modern education system has been found wanting, and observes possibly a little harshly, " We do not know how to do it " (p 103)

Holt (1969) in his popular treatise on " How Children Fail " in our schools, calls upon the teaching profession to recognise that if it is to genuinely call itself a profession it must accept some degree of responsibility for the fact that students do not always achieve the objectives of schooling To attribute all student failure to variables such as environmental factors is to abdicate objective professional responsibility, according to Holt

In traditional terms educational accountability has tended to be assessed by reviewing the learning increments of the subject student population These assessments typically are focused on the formal student learning

assessment system, which almost invariably evaluate student performance on the Cognitive Domain alone (see Gleeson, 1985) While this inequity in assessment is understandable when one reviews the relative ease of evaluating cognitive outcomes relative to suggested affective or psychomotor goals, it does however lead to an over concentration by teachers (notably teachers under pressure of accountability appraisal) on the tangible assessable (factual) aspects of the subject he/she teaches. This perceived lack of emphasis on affective goals for example can have serious consequences for teaching styles and the way teachers formulate their personal objectives for classroom instruction and thus interaction.

The above example exemplifies the difficulties faced when we begin to investigate the determinants of academic achievement/failure. Highlighting this, Gleeson (1985) asks the question that when assessing educational outcomes, what is more important, the Product (grades, points, career) or the Process (personal development, curiosity, learning how to learn)? It is not that educational objectives do not incorporate such ideals as social adjustment, emotional awareness, and appreciation of aesthetics, they do, in fact the stated objectives of the Irish secondary education system mirror closely Blooms Taxonomy of Educational Objectives (Bloom *et al* , 1956, 1964) However, as stated earlier the criticism often levelled at the formal assessment programme (Junior Certificate and Leaving Certificate Examination) is that it appears to concentrate almost

entirely upon assessing and evaluating student performance on the Cognitive Domain of the stated objectives. Nevertheless, understanding the problems implicit in the assessment of the different objectives should not detract our attention from the importance of the unassessed affective and psychomotor domains in the umbrella of educational evaluation.

Dreeben (1968) reminds us that the **effect** of schooling is to create a set of well-organised mental structures that parallel the various curriculum programmes, both those that are named (e.g. literacy, mathematics, science) and those that are implicit (e.g. curiosity, self-discipline, courtesy). While noting this stated desired "effect", the "actual effect" assessed by the schools and used as an achievement referent is generally only half of the educational story. It is important to be aware of this inequity in educational assessment before one reviews the literature on academic achievement, as the research cited deals almost entirely with cognitive gains (or losses) by the subjects as measured by standardized assessment tests. An implicit tenet of this thesis is that *if the affective objectives of education are neglected and divorced from the cognitive objectives then this inequity will be reflected in the style of communication between the teacher and the student. The focus then becomes the management of student learning alone, neglecting the aim of increasing student intrinsic desire to learn.*

Further on this point, Getzel and Thelen (1960) remind us that schools should be recognised as a social system, with its goals dependant upon the roles and expectations of its own micro-system structure Morrish (1976) adds a cautionary note stating that "educational systems are more resistant to innovation than industrial or business enterprises" (p 55) Expanding on this, Archer (1982) suggests, that as with other social systems, schools take on a form and life of their own over time, a functioning which may have little to do with their original purpose or goal This understanding is shadowed by the fact that all individuals participating in a school setting, do not share the same objectives of schooling (see, Madaus, Airasian, & Kellaghan, 1980) Recent research by Sullivan and Leder (1992) on what influences teachers thoughts and actions when teaching, indicated that *students* exert an enormous amount of power over what actually takes place in the classroom This student influence on the classroom process can distort the original objectives of the teacher and indeed school, not to mention the student-teacher interactive dynamic

As teaching involves at the very least the interaction between teacher, pupil and the environment, it seems only appropriate that the goals of

the recipients of the teaching, the students, should also be taken into account when assessing learning outcomes Allen (1986) identifies two central classroom *student* goals

(A) Pass the course exam

(B) Socialise

Raven's (1977) survey of students in second-level schools revealed that students felt that the schools' cognitive objectives, such as achieving in public examinations, were being catered for quite adequately in the system However, students felt aggrieved that objectives, which Kellaghan (1989) describes as non-cognitive, were not being attended to by schooling These included areas such as development of self-confidence, initiative, active education, and relevant practical areas such as relationship education or sex education

Thus if the fostering of student learning, improvement of learning outcomes and desire to learn, are to be central to the objectives of education, then classroom learning must *not* be viewed from the teachers viewpoint alone but must also take into account the goals of the students Shuell (1986) would appear to foster the approach that effective teachers must be aware of the processes or *thinking of the learner* seated before them, before the desired learning outcomes can be achieved Such a perception is strongly advocated in this research

As educational researchers it is important that we integrate this knowledge into an effective explanation on learning outcomes. This is not made any simpler when prominent researchers such as Wang, Haertel and Walberg (1990) indicate that there are up to a dozen significant determinants of Learning (see also, Martin & Briggs, 1986)

1.1 1 Determinants of Achievement

The briefest of consultations of the psychological abstracts clearly indicates that research into the determinants of academic achievement provides a myriad of variables which appear to have some influence on learning outcomes. Research shows that factors as varied as a student's rated physical beauty to the effects of raised environmental lead levels (Silva et al, 1988), have a causative influence on student attainment. Martin and Briggs (1986, p 26) in their discussion on the broader influences that effect student rates of learning, list several determinants

- *Home environment,
- *Intelligence,
- *Motivation,
- *Public policy,
- *Self- esteem,
- *Pupil attribution,
- *Time on task,
- *Teacher-pupil relations
- *Quality of instruction
- *Method of instruction,
- *Learning strategies,
- *Attitudes and values,
- *Peer influences,
- *Instructional media

At first glance, such a list would lead one to wonder if schools can at all hope to influence and empower their students, when so many variables appear to mediate in student learning. Calfee (1981) keeps the notion in context when he reminds us that school is man made (thus subject to the vagaries and inadequacies of any human formulation), and schooling is but a tool created by man which provides an alternative to the survival of the physically fittest mode of the instinctual age. It must also be understood, as Simon (1981) so eloquently explains about man, " that the apparent complexity of his behaviours over time is largely a reflection of the complexity of the environment in which he finds himself" (p 56). As referred to earlier, school should be recognised as a social system, its goals dependant upon the roles and expectations of its own micro-system structure, as well as the effect of the macro-social system in which it is located (Getzels and Thelen, 1960). Thus the challenge to educational researchers and practitioners alike, is to explain in a concise format the principal factors that determine student attainment, is a difficult and complex task.

Bloom (1976) in his "**Theory of School Learning**" suggested a utilitarian template upon which to begin the process of integrating the ideas discussed above. Bloom claimed in his theory, that up to 50% of the variation in achievement at any set of learning can be attributed to what he refers to as Cognitive Entry Characteristics. Translated, he is

saying that roughly 50% of the variation in achievement in learning tasks can be accounted for, controlled, or determined by educational procedures which ensure that most of the students possess the necessary cognitive entry characteristics required by the subsequent learning task (as evidence he reviews thirteen studies involving nearly 7,000 subjects where the correlation between arithmetic/algebraic aptitude and later achievement were in a range from + 63 to + 88) Therefore a student's previous learning history in any given subject domain is a critical predictor of future achievement in that domain While this previous learning history could refer to learning that has taken place both inside and outside the school system for subjects such as mathematics, he would see previous learning history as being analogous with prior classroom learning

Bloom also claims that a further 25% of variance in student achievement in classroom assessment can be attributed to what he terms Affective Entry Characteristics (motivational variables) Thus by looking at two specific learning variables (these are described further below) Bloom claimed that a significant proportion of the variance in school learning could be accounted for

This model although not without criticism and methodological flaws, does offer in a historical sense, a useful classification system from which to

integrate more recent and comprehensive reviews of the factors which influence learning outcomes

As stated, Bloom's theory is not without considerable criticism. His theory was primarily advocating a mastery learning model which he saw as curing much of the ills of present day classroom learning. However many educational researchers, while acknowledging the theoretical significance of Bloom's theory, question the accuracy of the real climate application of his findings. Greeno (1978) in such a review of Bloom's theory, describes parts of Bloom's philosophy as being an overstatement of what takes place in the classroom. This claim is reiterated by Cox and Dunn (1979) who warn of the "psychological trap" they see as implicit in Bloom's mastery learning formula, leading to unfeasible goal setting by teachers. Thus much of the validation research used by Bloom's theory is based on mastery learning research, some of which is questioned (see Arlin, 1984), indicating that generalisation of his applications are less than reliable. However as asserted earlier, from a historical point of view Bloom's framework is worth reviewing in that it sets a shape for many of the models that have succeeded his. It also demonstrates a recognisable conceptual framework from which to view a student's approach to a learning task, which is still useful, while having due regard for the now censured inferences Bloom drew from his findings. It is with a view to the conceptual attractiveness, rather than the (questioned) inherent validity

of Bloom's model, that it is incorporated as a guide for the building of a frame of reference for the rationale of this research. Thus the models' failings are viewed as attractive in that it allows the opportunity of spurring the growth of a more comprehensive formulation from the enterprising, though somewhat erroneous, conclusions outlined by Bloom.

1.1.2 Bloom's Theory of School Learning

Bloom (1976) introduced a theory which attempted to identify the variables which account for much of the "error" in the schooling process and brought together evidence to determine the amount of error contributed by each variable and the effect of controlling or altering this variable. Building on the work of Carroll (1963), Bloom in essence, aimed to determine a small number of variables which accounted for much of the variation in achievement in school learning tasks. His theory highlighted the individual differences involved in learning, in contrast to many previous Learning Theories which sought to establish generalisations about learning. A central assumption in Bloom's theory is that the "History" of the learner is at the core of school learning, and their school achievement/failure. Bloom argued "if each learner entered each class as a "tabula rasa" or with similar relevant histories, it is assumed that much of the differences in school achievement would disappear" (1976, p 13). There exists a wide

variety of recent research to support this claim of differential student experience and its influence on further learning outcomes (e.g. Sternberg, 1985, Calfee, 1981, Lesgold & Curtis, 1980)

Elaborating, Bloom identified two specific "Student Characteristics" (part of their histories), the individual brings with him/her to the learning situation, which are major determinants of achievement/failure. Firstly, for each learning task the student's level of the prerequisites for learning (Cognitive Entry Behaviours or Cognitive Entry Characteristics) is one vital measure of the student's history he/she brings to the learning situation. Secondly, the individual's motivation for the learning to be successful (Affective Entry Characteristics), is Bloom believed, a result of prior experiences with learning tasks which the student regards as similar or related. This tenet is in general supported by other education theorists and researchers (see for example, Bandura, 1982, 1991, Dweck, 1975, 1986, Weiner, 1984)

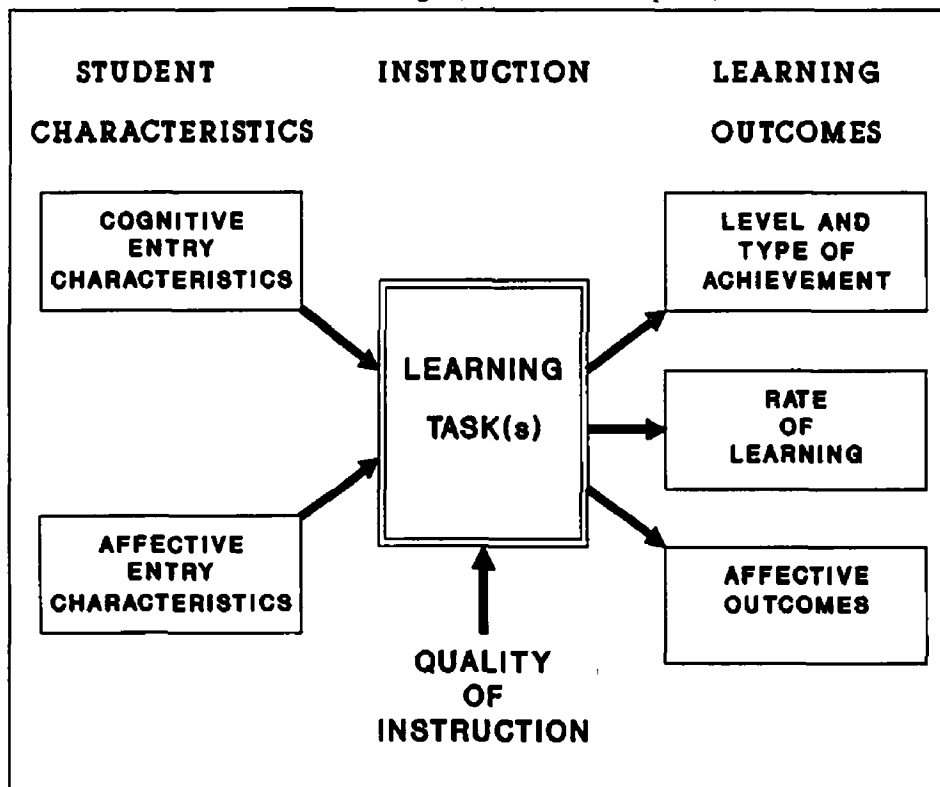
The theory adds one further variable, "The Quality of Instruction" which is seen as the final component mediating learning outcomes. Bloom's model of the theory (Fig 1), indicates how the varying student characteristics are brought to the instructional situation, and are combined here with the quality of instruction, and thus the Learning Outcomes are determined.

Bloom treats these learning outcomes under three headings

- a) Level and Type of Achievement (Cognitive gam)
- b) Rate of learning
- c) Affective Outcomes (motivation to face future tasks)

Thus from these outcomes it can be surmised that the entry characteristics can be modified (positively, if successful mastery learning takes place and perhaps negatively if not) It is evident that

Figure 1 Major Variables in the Theory of School Learning (*Bloom, 1976, p 11*)



the quality of instruction is open to modification, indeed Bloom identifies several critical factors involved in the process of instruction which can mediate learning outcomes. He states *"in spite of the determinism imposed by the effects of initial cognitive entry characteristics and affective entry characteristics, we have become more and more certain that the quality of instruction can have powerful effects on learning"* (p 110)

Bloom differentiates clearly between Teacher Characteristics and Quality of Instruction. Although while claiming that teacher characteristics rarely account for more than 5% of variation in student achievement, he does concede that more sensitive and sophisticated studies of such characteristics may identify more significant interactions in the future.

He takes the view that it is the teaching and not the teacher that is central in the learning process, and it is the environment for learning in the classroom and not the physical characteristics of the location that is important for school learning. While agreeing with the point of the importance of the learning environment, this research would not agree with Bloom's view that the teacher is not a central variable in the success of school learning. Rather, implicit in the formulation of this study is the point that the teacher, and his/her skills and ability, are inextricably linked to the teaching style adopted. Bloom does not appear to support

such a view of teacher characteristics and their place in classroom interaction and teaching effectiveness

Another criticism Bloom levels at contemporary educational research is that many observational studies of student-teacher interaction focus too much on the ways in which the teacher manages the students rather than the ways in which the teacher manages the learning. This point has received reproach from Barr and Dreeben (1977) who indicate that Bloom's mastery approach ignores the reality of the constraints of the true classroom environment, which does not lend itself to what they call *a tutorial model*

To reiterate, this is one of the major points that **the present research diverges from Bloom's thinking**. While agreeing with the idea that the Quality of Instruction is a vital variable in the level of student achievement, the contention that this quality of instruction and teacher characteristics are entirely separate is not theoretically adopted and advocated by this present research. Rather, it is proposed that the two are strongly linked. It seems more likely to this writer, for example, that a teacher high in empathy, would actively employ this disposition in the instructional situation (consciously and unconsciously), thereby affecting the management of **"both"** the learning and the students.

1 1 2 1 *Bloom's Quality of Instruction*

In reviewing Bloom's formulation of quality of instruction some gaps in the completeness of his contents become apparent. When Bloom refers to quality of instruction he is specifically referring to simply four identifiable and measurable characteristics.

These are as follows:

- (1) Cues
- (2) Reinforcement
- (3) Participation
- (4) Feedback and Correctives

Cues, Bloom claims, help the student understand what he/she is to do in the learning situation. An able teacher provides a variety of cues to help the student understand the task to be engaged. Cues can differ in strength and in meaningfulness and in the form in which they are presented (verbally, visually, tactile, etc.,) and thus can be sensed in many different ways by pupils with differing primary sensual orientations. The identification of cues as a distinct and important classroom variable comes from the research of earlier theorists such as Kounin (1967) and Wright and Nuthall (1970). Again in this research study, it is felt that an empathic teacher is excellently disposed to identify the cue relevancy level of each child and to understand the form in which each pupil

would be most receptive to the information being presented. This postulation will be developed further in Chapter Five when the significance of Teacher Empathy in classroom interaction is discussed.

Regarding *Reinforcement*, it has long been agreed that reinforcement of some kind is important during or after each part of the learning process. Reinforcement can be varied by teachers in strength and in quality and can include items as diverse as food to a frown. The research on the importance of reinforcement in the classroom situation is extensive and is somewhat more involved than that presented by Bloom (see for example, Brophy, 1981, Morgan, 1984). Although not reasoned by Bloom, it is argued in this research study that an empathic teacher would attend more readily to the relevance and differential effect of reinforcement on individual pupil performance. This point will be examined more closely in Chapter Five.

Participation levels to Bloom are one of the most effective ways of estimating the quality of instruction in any general classroom learning situation. Bloom admits that participation levels are intrinsically linked to relevant and adequate reinforcement, along with interesting and clear cues. In this research study it is submitted that a teacher employing high levels of accurate active empathy, should gain more

active participation from pupils, due to the very nature of this skill/ability

Feedback/Correctives are essential according to Bloom, if mastery learning is to be achieved. They are important in that they identify for each student *when* they have learned and the *level* to which they have learned. Correctives more specifically suggest to students where they have not achieved and suggest areas that should be reviewed for improved results. Variables such as Feedback and Correctives have been long identified as important mediators of student learning (see, Deci, 1975, Stipek and Weisz, 1981, Cullen, 1985)

In summary, Bloom believes that Quality of Instruction can account for between 20% to 25% of variance in student learning. However, it is noted that students who have developed effective learning and study habits will be less affected by poor quality of instruction than would individuals who have perfected less effective and robust learning strategies. Thus Bloom implies that it appears that more capable learners will be less influenced by varying qualities of instruction than would less capable pupils. This point is disputed by Resnick's (1977) review in which she outlines how upon implementation of Bloom's model it is in fact the capable students who will suffer. Hurn (1978) also voiced concern about such maximising of student learning, suggesting that it can

lead to considerable time wastage for high ability students Bloom does write that "very good quality of instruction may overcome negative initial affective characteristics " (p 110) While agreeing with such a viewpoint, this research project would speculate that high quality, empathic teaching, can lead not just to motivational changes but also consequentially to the *level* of cognitive entry characteristics Bloom's postulation does not in its present form admit to the possibility of such a perspective having a significant influence on school learning Thus it is the contention of this study that Bloom's model is not complete enough in its design to take full account of the importance of quality characteristics such as teacher empathy and its influence on student classroom learning

To understand clearly Blooms theory and its place in this research proposal, it is necessary to look in greater detail at Bloom's "Cognitive Entry Characteristics" and "Affective Entry Characteristics " The justification for this procedure is that while having indicated that Bloom's theory may be flawed in application, it does on a surface level, offer a conceptual framework to review other theories and research which identify *prior learning history* and *motivation* as perhaps the two most important variables in the prediction of student task learning outcomes In the review of Bloom's model it is proposed to integrate some of the more recent and in-depth conceptualisations of the variables that

influence school learning. Many of these focus on areas of more intricate perspicacity than Bloom conceived of and are essential to the understanding of this study (see for example, Siegler, 1981, 1983a, Flavell, 1985, Sternberg, 1984). Such a review will conclude with an extended formulation based on the framework of Bloom's model, which will serve as the criterion for the understanding of the cognitive processes which influence classroom learning and attainment.

CHAPTER TWO

2 0 COGNITIVE ENTRY CHARACTERISTICS

2.1 INTRODUCTION

The concept of Cognitive Entry Characteristics postulates that each student enters each new learning task situation influenced by their *individual* history of previous development and learning. The phrase Cognitive Entry Characteristics is a discerning one, in that it describes appropriately the available cognitive history a student possesses approaching a new learning task. This conception is not peculiar to Bloom, as it is seen as one of the central tenets researchers of the cognitivist understanding of learning. While Bloom fails to highlight this cognitive process factor, it is described by Shuell (1986) as one of the obvious reasons for the departure of many researchers from the traditional views of learning to the more complex and applicable conceptions of cognitive psychology.

The emphasis in learning research, in the last two decades, has shifted from the strict behavioural outcomes of a student, to a focus on the actual processes of acquisition of knowledge and knowledge structures, and changes in states of knowledge (see, Greeno, 1980a). Thus as Shuell (1986) states in his review, the cognitive conception of learning is projected as one which considers learning as a cumulative process, involving the interaction of prior knowledge as represented in memory with the knowledge to hand of the new task being confronted. Bloom

does not adequately deal with the *process* of learning or of knowledge acquisition in detail in his outline of cognitive entry characteristics. Therefore to follow Bloom's model rigorously at this point would be to forfeit the fuller understanding of the processes of learning gained by recent cognitive researchers.

While researchers in the field of cognitive psychology have yet to produce a conclusive theory of school learning, significant strides in that direction have been made and justify review. In this direction, Siegler (1983a, 1983b) outlines an information-processing model of cognitive development which draws heavily on the developmental stages of Jean Piaget and the formative work of Rumelhart and Norman (1978). Siegler's research extends Piaget's thinking, notably in his *rule assessment approach* to a variety of Piaget's problem solving tasks. He developed from his findings a set of generalisations on cognitive development in domain-specific areas, which demonstrate much of the basic tenets of contemporary cognitive thought. These include

1 For a given concept, rules developed later (developmentally) are more highly correlated than earlier ones, with the correct rule in their predictions over a whole range of tasks testing for that concept.

Chapter Two - Cognitive Entry Characteristics

2 There is a marked similarity in reasoning across concepts when an individual has little knowledge about the concepts than when they have more. Thus it appears that when faced with a task with relatively little knowledge, an individual will rely on general all-purpose fall-back rules.

3 Adequate encoding ability is central to developmental progress. Poor encoding of relevant task stimuli may lead to the student not taking advantage of set experiences designed to lead them to develop and acquire more advanced rules. He would believe that different students who use the same problem-solving rule may differ in the adequacy in which they attend or encode the important features of a problem task. It appears competent encoding can result in improved learning ability.

While Siegler's research also has its critics (see, Strauss & Levin, 1981, Wilkening & Anderson, 1991) it gives an insight into the sequential process detail, cognitive theorists are employing in an effort to understand learning in a functional way.

A similar approach was adopted by Anderson (1980, 1981), although it differed from Siegler's one-dimensional conception in that it involves a multilevel integrationist model of the development of knowledge structures.

A further review by Vosniadou and Brewer (1987) again mirroring widely the work of Rumelhart and Norman (1978), highlights the modification

process of prior knowledge in the learning situation, particularly the role of *Restructuring*. Specifically they stress the consequence of *weak restructuring* (see Chi, Glaser, Rees, 1982) and *radical restructuring* (see Wiser and Carey, 1983) in the restructuring of domain-specific knowledge, indicating the relevance of radical restructuring in the emergence of new theories from existing knowledge structures. Such research allows an insight into the process of schema change involved in the acquisition of new knowledge and offers an understanding of how individual differences occur in the learning situation. Thus we begin to get an insight into how individuals begin to differentiate in terms of how they use existing knowledge differently to solve novel or complex problems, some being more adept and successful than others.

Sternberg (1977) also proposed a process analysis of analogical reasoning which identified six cognitive processes:

- (1) Encoding the component terms which constitute the analogy
- (2) Inferring the existent relationship between the first two terms of the analogy
- (3) Mapping a higher-order rule which relates the first to the third term of the analogy
- (4) Application of the inference and mapping to the third term in order to generate an appropriate fourth term
- (5) An optional vindication step in which one of the answers provided by the above sequence is selected as being the closest to the ideal answer produced by the application process (see Sternberg, 1985, for additional components at this point)
- (6) Solution is translated into a response

This form of conceptualisation of cognitive process analysis has been applied in various instructional settings with some success (see, Carpenter, Moser, & Romberg, 1982, for application in addition and subtraction task learning) It was also seen by Wang and Lindvall (1984) in their review of individual differences and school environments, as an important move from the observation of student learning solely by outcome to a more productive analysis of the process of learning by the individual student

Other writers such as Horn (1976) and Cattell (1971) emphasise the importance of the organisation and incorporation of prior knowledge or educational experience into functional systems for future retrieval and application to future educational situations Johnson-Laird (1985) have emphasised this sequential learning process in their cognitive analysis of deductive reasoning Similar conclusions have been reflected in research by Byrne and Handley (1992), which looked at cognitive strategies employed in meta-deductive reasoning and problem-solving

As stated previously, Bloom agreed that previous learning history (cognitive entry characteristics) will determine the level at which each student enters the new learning task, but he did not highlight the complexity of the various processes which are involved in such a broad statement Based on such research, cognitive theorists would regard

students' ability to deal with and interact with new task content, as a reflection of their previously adopted learning strategies (although not invariant). Thus in this research, it is the cognitive conception of learning that is adopted, and integrated into Bloom's more surface level framework of Cognitive Entry Characteristics. If we are to accept this cognitive conception of the influence of prior knowledge and the process by which it influences future learning experiences, it is critical that there exists a method of evaluating these cognitive entry characteristics.

2.1.1 Cognitive Entry Characteristics Measured

Having accepted that cognitive entry characteristics, in the form reviewed above, are significant predictors of future learning success, it is critical as educators that we have a means of measuring and evaluating these characteristics. School learning in a general sense is laid out in a form in most curricula, such that excessive neurological or intellectual capabilities are not required. That is to say that the majority of students that have progressed to second level education in Ireland (12 to 13 years of age approximately) are in mental ability terms, capable of completing the basic Junior Certificate programme (the first three years of second level education). However, it is recognised that despite this, groups of students show considerable variation in achievement across the most fundamental of tasks (see for example, Lapointe, Mead & Phillips, 1989). The explanation of the origin of this variation therefore

appears to lie not in any great neurological defects of students but rather in types of knowledge previously accumulated, as discussed earlier, along with the skills and competencies the learner brings with him/her to the learning situation from previous learning experiences and how he/she applies them to the task on hand. It is next to impossible to conceive of any learning task which does not depend in some way on previous learning of some sort. Take the following example where a student is asked to solve 326×157 . This problem assumes an understanding of the verbal cues requesting problem solution, it assumes perhaps prior experience with a writing instrument, and the consequent psychomotor skills involved. This is before any appropriate schema are called from memory and pertinent problem-solving and solution strategies set in progress. If these prerequisites are not present then any amount of reinforcement or enhancement of the quality of teaching will not lead to task mastery. This is not to assume that the relevant learning/teaching has never taken place, but rather whether this information is "available" to the student at the time of learning task presentation. This idea of availability refers to the pupil being able to remember and integrate effectively specific relevant information as required, when facing a new task. It is worth repeating again that it does not necessarily imply that the relevant teaching has never been experienced.

Chapter Two - Cognitive Entry Characteristics

Most cognitive theorists would view the concept of "Aptitude" as referring to this availability of relevant capacity, information and skills when facing a learning task (e.g. Snow & Lohman, 1984). As aptitude tests propose to measure previous related learning in the home, school or the larger environment, Bloom also suggests that tests of aptitude may be useful indicators of a student's Cognitive Entry Characteristics. It should be stressed that aptitude tests are gross indicators of prior learning, but they do seem to have predictive relevance to later learning of specific school subjects (e.g. Calfee & Venezky, 1968, Lenke, Bligh, & Kane 1971, where the relation between arithmetic aptitude scores and later achievement were + 69 and + 83 respectively). Entwisle and Hayduk (1978) reported studies which asserted that scores from students in first grade were predictive of their achievement through to the completion of their educational experience. In a review of over 34 aptitude/achievement studies, Bloom (1976) concludes that the results "suggest that the upper bound for the relation between measures of presumed cognitive entry behaviours and achievement in a subject is approximately + 70" (p. 46).

At this point it should again be stressed that the presence or availability of the cognitive entry characteristics does not guarantee the research findings on selected school subjects, as Bloom claimed that the evidence indicates that cognitive entry characteristics account for about 50% of

Chapter Two - Cognitive Entry Characteristics

the variation in the achievement on sets of learning tasks. Most modern cognitive theorists would not disagree with this point and many reviews would indicate that other variables do mediate the attainment rate of the Cognitive Entry Characteristics (see for example, Clark 1982, for a review of Aptitude-Treatment-Interaction studies) and such treatment effects will be assessed in further sections of this study.

What is evident is that cognitive entry characteristics do influence subsequent achievement, which in turn determines cognitive entry characteristics for the next course or learning task. Although this formulation on the face of it appears to be a deterministic cycle, this is not quite the case. Sternberg (1985) in his expansion of "a triarchic theory of human intelligence" points out that elements of intelligent performance can be taught, particularly if metacognitive strategies are influenced (see also, Feuerstein, 1980, Rosenholtz & Simpson, 1984, Sternberg, Kerton & Powell, 1982, for further support of this position). Horn (1986) also proposed a view of intelligence which clearly identified a flexibility in the nature of its composition (also see Howe, 1989, 1990). Recently, Lucurto (1988) reporting on Nature V's Nurture research on IQ, reviews a variety of research, including adoption studies, which support the fluidity/malleability conception of intelligence (also see, Bouchard & Segal, 1985, Schiff & Lewontin, 1986). Given this evidence, the malleability of aptitude or IQ is still an area of earnest contention.

among researchers. It is important to note that the amount of change or elevation in scores cited by some researchers are quite small and would not be regarded as statistically significant increments.

Thus it appears that while aptitude appears to be a relatively stable and valid measure of previous learning history, it is not fixed or deterministic in its composition (see also, Sternberg and Frensch, 1991). Bloom cites studies by Anderson (1973) and Arin (1973) among others, in which mastery learning technique was employed, as an example of how cognitive entry characteristics are alterable with corrective feedback and guidance after each task assessment (see also, Sfondilias & Siegel, 1990). Snow (1980) when looking at such issues suggested that such variance in aptitude or ability could be attributed to differences in developed **solution processes** he found between high and low ability students (these will be discussed in greater detail later in this chapter). However there is no suggestion that the deficient solution processes of low ability students could not be ameliorated with tuition.

Having ascertained that aptitude tests appear to be among the most valid measures of cognitive entry characteristics as described, it is now appropriate to look closely at the processes and knowledge such tests measure. As this study is concerned specifically with student performance in mathematics, it is important that an insight is gained

into the prerequisites of mathematical ability/aptitude and the Cognitive Entry Characteristics required for scholastic success in that domain

2.1.2 Achievement in mathematics Influencing factors

Husen (1972) reported rather pessimistically that "the amount of instruction did not seem to bear any significant relationship to the performance on the mathematics test" (p 34). In his investigations he found that total time spent on mathematics instruction accounted for only 3% of the variance in student scores. Coleman (1975) reports similar results in the International Education Association (IEA) studies in reading, literature, and science. The combined effect of home and school accounted for an average of 24% of the variance in achievement measured. When home were considered first, they explained 18% of the variance while school effect accounted for an additional 6%.

Welch, Anderson, & Harris (1982) in a detailed and extensive study involving 2,216 17-year-old students, found that an average of 28% of the variance in mathematics achievement was related to non-school variables (home and community influences). However, contrary to the previous studies cited, the authors identified substantial effects due to the amount of mathematics studied, an additional 31% of variance was accounted for by this variable. This finding may be

explained by factors such as those indicated by Holmes and Croll (1989), which showed a significant relationship between academic achievement and the amount of time spent on homework, with variables such as class background, parental educational history, etc , controlled for

However, the best predictors of mathematical attainment and explanations of variance in achievement are not typically as complex and hidden. The concept of Mathematical Ability as measured by standardised tests has been empirically shown to be significantly related to mathematical attainment in the school setting (e.g. Payne, 1963, Saber & Feldt, 1968)

As early as 1938 theorists such as Thurstone were proposing that **Number Ability** (what is now known as **Mathematical Ability**), was an extremely important composite of human intelligence. This belief is supported by Psychometric/Differential approach to the nature of human intelligence, which looks at intelligence in terms of measurable factors. Accordingly, while the universal determinants of mathematics achievement are varied, it would appear that specifically, measures of a student's mathematics ability are significant indicators of the level of mathematics achievement. Thus it is appropriate to look expressly at the composition and determinants, of what current researchers refer to as, mathematical ability.

2.1.3 Mathematical Ability appraised

Carpenter, Corbitt, Kepner, Lindquist and Reyes (1980) quote the following problem which was given to 70,000 children in the United States as part of the National Assessment of Educational Progress.

" Lemonade costs 95 cents for a 56oz. bottle. At a school fair, Bob sold cups holding 8ozs. for 24 cents each. How much money did Bob make on each bottle?"

For this problem, only 11% of the 13-year-olds and 39% of the 17-year-olds were able to produce the correct answer. It appears that in spite of years of training in mathematics, many students cannot generate correct answers to basic problems. The development of mathematical ability -a central goal of our schools- seems to be a goal that is not being met (Mayer, 1985).

As referred to earlier, over the last two decades the vogue in cognitive psychology has led to the prominence of the Information Processing approach to the study of human abilities, and intelligence in particular. Applied to the concept of mathematical ability the information processing approach takes a task-analysis viewpoint. Sternberg (1977) maintains that any mathematical problem can be

broken down into information processing components, i.e., into simple mental operations, skills, and knowledge that are required for problem solution. Then mathematical ability is defined as all the cognitive operations, skills, and knowledge that are components of mathematical tasks. Herein lays a link with Bloom's (1976) cognitive entry characteristics. Mayer (1985) also points out that careful analysis of mathematical tasks encountered, reveals that several types of knowledge may be central to representing and solving problems. He lists the following:

- * **Linguistic Knowledge** referring to knowledge about the English language, such as how to parse a sentence into parts of speech, or what various words mean
- * **Factual Knowledge** referring to knowledge of the world, such as units of measure
- * **Schema Knowledge** referring to knowledge of problem types, such as the difference between work problems and motion problems
- * **Strategic Knowledge** referring to knowledge of how to develop and monitor a solution plan
- * **Algorithmic Knowledge** referring to a procedure for carrying out a planned operation, such as how to compute in long division

Further to all this knowledge, Salsbury (1984) in a review of the research, indicates that in order for students to perform a complex cognitive task such as solving a mathematical problem, they must first learn to rapidly and automatically perform many underlying subskills. This interaction of distinct declarative knowledge (knowledge about things represented in memory as an interrelated network of facts) and procedural knowledge (knowledge of how to perform various skills), was further developed by J R Anderson (1982, 1983) in his ACT* theory of learning. An alternative view was outlined by Rumelhart and Norman (1978, 1981) which identified *three* means by which existing schemata are modified by new learning, *accretion*, *tuning* and *restructuring*.

Accretion refers to the encoding of new information in terms of existing schemata. New information is added to the preexisting schema knowledge without there being any changes to the structural organisation of the existing knowledge. This comparative integration of new information with existing knowledge and strategies, is central to high level mathematical processing according to Webb (1991).

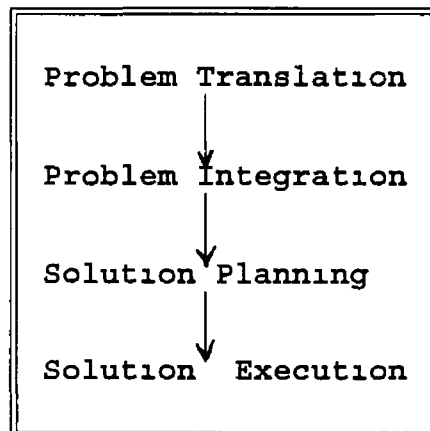
Restructuring refers to the process by which new schemata are constructed in the light of the new information. Finally, *Tuning* describes schema evolution by the extended modification and revision of existing schemata, according to experience in different situations. Tuning may

assimilate schematic structural reorganisation This evolution is reminiscent of Piagetian accommodation where there is also a gradual refinement of existing schemata contingent upon additional experiences This flexibility of schema evolution is characterised as a significant ability which may differentiates expert problem-solvers from novices (see, Dowker, 1992)

2.1.3.1 *Task analysis of mathematical problem-solving*

Having viewed the general process involved in approaching a problem, the specific task-analysis of mathematical problem-solving has revealed that there are at least four major steps involved in the arrival at a solution (Mayer, 1985)

These are as follows



Using these *components* of the problem solving process outlined above, we may be able to identify specific areas a student is having difficulties with, in contrast with being merely able to state that he/she

has poor mathematical ability. In essence such outlines allow us to look directly at and identify specifically the on-task functioning aspects of an individual's previous learning history or cognitive entry characteristics, in the mathematics area.

Therefore the phrase cognitive entry characteristics becomes distilled into a defined set of processes and procedures a student employs when facing a mathematics task. The importance of understanding these processes is therefore central to an appreciation of the functioning and mediation of cognitive entry characteristics on mathematics learning.

A review of research carried out on the *Problem Translation* phase of the process indicates that many individuals differ in their ability to comprehend linguistic expressions or may lack the appropriate knowledge for representing relations (Greeno, 1980b, Trabasso, 1977, Venezky & Breger, 1988). Montague, Bos and Doucette (1991) specifically identified deficits in problem representation strategies as being one of the significant differences between high achieving and learning disabled students responses to mathematics problem-solving. Turner, Trew, Hunter and McQuoid (1990) in a longitudinal study carried out in Northern Ireland also found that the most prominent error identified in their population of early secondary school students, was one of failing to represent or translate the question before them accurately.

The *Integration* phase, indicates that problem understanding requires specific knowledge of problem types Owen and Sweller (1989) upon exploring the nature of mathematical expertise, established that experts possessed a network of schemata that permitted rapid classification of a problem type Such swift integrative processes allow prompt progression to the solution planning phase The research investigating the origins and development of such integrative schemata is mixed Individual differences in the development of this schema may be related to individual experience and familiarity with certain mathematics problems (Hinsley, Hayes, & Simon, 1977, Mayer, 1981, 1982), perhaps student personality type (Tatsuoka, Linn & Tatsuoka, 1988) or even Hemispheric dominance (Dunn, Sklar, Beaudry & Bruno, 1990) Siegler (1988) identified "good knowledge of problems" as being one of the distinguishing characteristics of perfectionist mathematics problem-solvers over average or poor students It has also been argued that the adoption of specific integration schemata is developmentally related (Fuson, 1982, Greeno, 1980b) This process has been described as "a memory access process" by Kaye, Post, Hall and Dineen (1986), who identified a developmental advancement in the complexity of such schema in a population of child and adult problem-solvers

The Solution Planning phase has been another point of variance as individuals differ greatly in the general problem-solving heuristics they

adopt Goldman (1989) identifies this planning of solution strategies as a critical step in the problem-solving process. Schoenfeld (1979) has indicated that solution planning strategies are rarely explicitly taught to students, but if they are, success rates can be increased significantly. Mosley (1986) has replicated these findings with university students deficient in mathematical ability, by giving them a Formal Logic course before they took their mathematics module, which it is claimed provided the students with the necessary independent problem-solving/analytical abilities (see also, Angoli & Krantz, 1989, Palinscar & Brown, 1987, Pressley, 1986).

In the *Execution phase*, individuals may differ greatly in the speed, depth and accuracy, with which they execute a problem. For example as we get older, we memorise solutions to many commonly occurring mathematical problems (e.g. 10×10). We soon learn the answer to such a problem and retort the solution without being consciously involved in step-by-step integrated processing (Fuson, 1982). Bereiter (1985) gives an interesting insight into this transition to accepted declarative knowledge, in a review of the Learning Paradox.

It is in the execution stage, that Kirby and Becker (1988) reported that most students with arithmetic learning problems reported difficulty. Their performance (forty eight 5th graders) was characterised by slow problem

execution times. This may tie with research reported by Goldman (1989) in her treatise on cognitive processes in problem solving, where she describes the close *monitoring* of the course of solution execution as being central to effective problem-solving. It is possible that individuals with poor mathematical skills may be deficient in such solution execution review strategies. Venezky and Bregar (1988) also related the importance of controlling and monitoring of the solution execution process, suggesting that with effective problem-solvers there is a significant amount of controlling, monitoring and forward processing to ensure the correctness of the execution. Montague (1991) reported from interviews with gifted students that they consciously used solution/execution strategies when solving problems, as compared with an unaware approach used by more learning disabled students.

Sternberg (1985, 1988) outlines in his triarchic theory of intelligence a list of stages in component task performance functioning. While Sternberg's full theory is too extensive to summarise here, the outline of the what he refers to as metacomponents of intelligent task performance, are allied in form to Mayer's task-analysis as outlined above. Sternberg identifies seven metacomponents prevalent in intellectual functioning:

- (A) A decision process on just what the problem is that needs to be solved
- (B) The selection of lower-order components

- (C) The selection of one or more representations or organisations of information
- (D) The selection of a strategy for combining lower-order components
- (E) The decision regarding the allocation of attentional resources on task subcomponents
- (F) Solution monitoring
- (G) Sensitivity to external feedback

The similarities of Sternberg's views with the task-analysis framework as described by Mayer (1985), into which the work of other prominent theorists has been integrated, is clear in the above outline

Having viewed the sequential processing involved in mathematical problem-solving, it can be recognised that deficiencies in any one of these subskills/components, can be implicated in poor mathematical performance by a student (Brown & Burton, 1978) The research on such errors has contributed much to our understanding of the processes and steps students employ in the problem solving process

Klausmeier (1980) reviews the independent differences students exhibit in problem-solving situations and offers a four level conceptual development model through which students proceed, not along maturational lines (as Piaget would suggest), but dependant on learning

and experience. The model attempts to explain individual differences in cognitive task analysis by indicating that the development of a concept by an individual at level two (Identity level) can lead to a very different interpretation than an individual who develops the same general concept but is at level four (Formal level). Further research on error representation has been evaluated by Brown and Burton (1980) and by VanLehn (1983) which indicate the procedures used by students when specific procedural skills/subskills are missing. In general it is suggested that when a student faces such a lack of specific skill/knowledge they fall back on a generalised problem-solving method which is often not appropriate.

Some recent work on the nature of expert problem-solving (see Chi, Feltovich & Glaser, 1981, Chi, Glaser & Farr, 1988) has given an additional insight into the difference between the method of problem representation employed by experts and novices in various domain-specific areas. However, the diagnosis of which particular subskill the student is deficient in, is a somewhat complex problem for practitioners. The question many researchers at present are debating is whether these components/skills can be taught independent of subject matter (see, Derry & Murphy, 1986, Tennyson & Park, 1980, Tennyson & Cocchiarella, 1986, for a reviews of the debate). The general consensus among educators and psychologists at present does seem optimistic.

Chapter Two - Cognitive Entry Characteristics

Thus if cognitive entry characteristics are to be characterised in this study by students level of mathematics ability as surmised earlier, the preceding sections have indicated the step-by-step skill and knowledge utilisation process students use in the completion of mathematical tasks. It is also apparent from the above review that an individual's cognitive entry characteristics or history, is central to success at any academic task and more clearly as we have seen, in mathematical task activity.

An individual's cognitive aptitude is not however, the only significant determinant of success, be it in mathematics or any other school subject. In recent years a growing volume of research has accumulated which suggests that traditional cognitive explanations of mathematical thinking ignore any affective input in the process and for this reason are flawed. Ginsburg and Asmussen (1988) support this theme when they speculate that overlooking affective and emotional experiences students have in mathematical education, gives a distorted view of students' achievement (or failure) histories. They claim that such issues demand attention when it is clear that most of our students possess the necessary skills in reasoning, encoding, abstraction and memory for mathematical reasoning and yet do not achieve in the subject. This position is endorsed by McLeod (1988) who stressed that student emotions experienced during mathematical reasoning are important variables in student performance levels. Research on learning strategies reported by Pokay and Blumenfeld

(1990) indicated that while student metacognitive strategy use influenced achievement in geometry tasks, the students self-concept in geometry also had a significant effect on learning levels. Rodriguez (1978) in a study of 115 seventeen-year-olds indicated that while mathematical aptitude was a significant factor in the prediction of mathematics achievement, a student's attitude or motivation toward the subject also had an important effect. This view is supported by many researchers working in the area of school achievement (e.g. Ames, 1984a, Ball, 1984, Boekaerts, 1987, Dweck, 1986, Keller, 1987, Weiner & Kukla, 1970)

Thus it is evident that while mathematics ability (i.e. the ability to employ problem-solving strategies effectively) is an important predictor of mathematics attainment, there also exists an important affective aspect which plays a significant role in student performance. Bloom (1976) integrates this affective factor into his theory of school learning as an important causal variable in scholastic achievement. Bloom prefers the term "Affective Entry Characteristics" to motivation, but stresses that the two terms are not contradictory. As with Cognitive Entry Characteristics depicting previous learning history, Affective Entry Characteristics refer to the specific affective and emotional history each learner brings to the learning situation and how this history influences the student's approach to the situation. He identifies these Affective Entry

Chapter Two - Cognitive Entry Characteristics

Characteristics as the second most important influential factor in student achievement. The influence of these affective variables will be reviewed in the following chapter.

CHAPTER THREE

3 0 AFFECTIVE ENTRY CHARACTERISTICS

3 1 MOTIVATIONAL INFLUENCES ON LEARNING

As indicated in Chapter Two, Bloom (1976) preferred the term affective entry characteristics to motivation as in its essence it suggests more accurately the emotive dispositional aspect of motivation in the educational setting. He does however, regard the concepts as essentially synonymous and interchangeable.

Bloom (1976) explains the influence of this concept in the following way

each of our learners has had a somewhat different history before beginning the particular learning task(s). Further we may assume that each student perceives and has been effected by his history and previous experience in a different way. Thus even if it were theoretically possible for two individuals to have had identical learning histories we can still conceive of them as perceiving these histories in different ways. Furthermore we also assume that each individual's initial perception of the particular learning task may be different and that each individual will perceive a particular learning task in relation to his previous experiences and history. The important point for initial affective characteristics is the student's perceptions and what effect they have on his approach to the learning task in question (Bloom 1976 p 75/76)

Bloom emphasises that affective entry characteristics can have effects on two levels of student learning, the macro-level on students' learning at an entire module or programme level, and the micro-level on students'

learning of a particular learning task While Bloom's conception of the importance of motivational influences is supported by most of the researchers working in the field of cognitive learning research, he does not fully encompass the finer detail of the concept which has received elevated interest in recent years In this section Bloom's conception of affective entry characteristics will be expanded upon integrating the most recent research concerning the importance of affective factors in school learning, leading to a more complete formulation than that proposed by Bloom

While it is widely accepted that motivation (or as Bloom preferred to label it "affective entry characteristics"), does play a significant role in scholastic achievement, it is less clear how these motivational influences develop intrinsically and intervene in the learning process d'Ydewalle (1987) highlights this lack of clarity when he stresses that motivation is a hidden variable in the actual classroom and can only be studied indirectly making critical investigation problematic That is to say that the behavioural indices of a student's motivational status are not always clearly visible in classroom interaction or observation In effect, to measure student affective characteristics, requires the application of specific report or questionnaire type techniques to capture the internal subjective affective mediators experienced by each student Given this problem regarding the clarity of affective influences on

school learning, many writers have attempted to conceptualise motivational origins, their manifestations and rationale

The proliferation of research in the area is justified by the potential that a complete understanding of motivational variables could reveal. If students' motivation is more amenable to *change* than their measured ability, then scholastic achievement could be enhanced directly in the classroom

Ball (1977) supports this positive view of motivational enhancement (Ball refers to "entry skills") and claims that teachers who understand student motivation can lift students with low level affective entry characteristics to do better than they might otherwise have been expected to do. Tomic (1989) observed that several teacher behaviours, exhibited in the classroom can significantly influence student attitudes to the subject being taught (in this case mathematics) and thus their performance. Page (1958) in an insightful study of 7,000 students in 74 classrooms indicated clearly that teacher encouragement and personalised motivational feedback had significant effects upon student achievement, and particularly in the case of low ability students

Why then, it may be asked, are our schools not universally successful in generating this increased achievement through motivational understanding? The explanation may well lie in the phrase "*understanding student motivation*" Bloom (1987) in a call to educationalists to highlight the urgency of the quest to understand student attainment variables, especially in view of the fact that some like motivation are open to modification, argues vehemently and somewhat emotively that "it is a crime against mankind to deprive children of successful learning when it is possible for virtually all to learn at a high level" (p 508)

Ames (1984a) takes the importance of motivation a step further when she says "while motivation is a mediating construct in achievement, motivation may also be viewed as a goal in itself and this has not been addressed in most of the literature" (p 178) Handley and Morse (1984) lend credence to this distinction between motivation not just as an intervening variable, but importantly, as a goal in itself. In their study they identified that student motivational attributes to science prior to learning, were linked to later achievement rates, and significantly to future attitude or orientation to the subject.

A review by Chapman (1988) focused on the perception of a student's self-conception of a task as a predictor of task success, but also noted

that it could be identified as a goal in itself. Thus the relevance of viewing motivational attributes as both causes and outcomes is becoming clear.

3.1.1 Understanding Motivation

Early efforts to understand motivation tended to follow psychoanalytic principles, in that they concentrated on explaining behaviour in the light of physiological drives and instincts. This homeostatic conceptualisation of motivated behaviour seems to neglect facts that are recognised by educators daily, such as the perceived actuality that motivated behaviours are both cognitively and emotionally laden. Also clear is that at times motives are logical and at other times seemingly illogical, sometimes enduring and at others transient.

These factors highlight the complexity of the problem of understanding student motivation, but again should not depreciate the effort to understand it, rather, they should be integrated in any theory, accepting that it will be multifaceted and somewhat complex. This point is stressed by d'Ydewalle (1987) in his critical review of motivation theories, in which he stressed that too often neat effects and explanation are attempted when in reality motivation is a complex multifaceted phenomena.

Perhaps the most recent and comprehensive attempt at a conceptual approach to student motivation is that proposed by Bernard Weiner (1984, 1985, 1986) His theory, " **An Attribution Theory of Motivation and Affect**", is guided by the principle that students, indeed individuals in general, search for understanding, seeking to discover *why* an event has occurred Weiner sees it as important that any proposed theoretical formulation on motivation should incorporate the following

- (1) A theory of motivation must include the full range of cognitive processes
- (2) A theory of motivation must include the full range of emotions
- (3) A theory of motivation must explain rational and nonrational actions, using the same concepts for both

Ball (1984) in an overview of student motivation says of attribution theory that it can be " used in an attempt to integrate some of the vast array of motivational constructs " (p 315), and this is one of the most attractive attributes of the formulation Lazarus (1991a) emphasises the importance of Attribution Theory in the quest for a complete understanding of motivation as it outlines as fundamental, the incorporation a full range of human emotions, a fact which other

formulations often neglected. However it should be pointed out that the theory is not quite faultless, indeed Weiner (1984) himself admits that many problems still remain but the building blocks for future elaboration and extension are laid down.

As much of this study involves the consideration of aspects of student motivation (affective entry characteristics), prior to and after the learning task, a more indepth review of Weiner's theory seems appropriate to the understanding of the theme of the present thesis.

3.1.2 Weiner's Attribution Theory

Basic to Weiner's formulation is the maxim that individuals act on the perceived world rather than the real world (e.g. the distorted body perception a sufferer of Anorexia Nervosa perceives of him/herself, see, Hudson, Pope, Jonas & Yuvgelun-Todd, 1983).

Frequently one's thoughts and behaviours are determined by one's self-concept, which it can be accepted, creates an entirely subjective interpretation of the world. Bereiter (1985) on speaking of the concept of self, reminds us that it also is a cognitive construction. Thus Weiner believes, concern with the self lies at the core of human experience and thus must be an integral factor in any theoretical formulation in the field of human motivation.

As stated earlier the guiding tenet of attribution theory is that individuals strive for understanding, and search to discover "WHY" events occur. A causal attribution answers the question why, e.g. "why did I fail the mathematics test?" It should be noted that a causal search is not entered into in all situations as psychologically this would not be practicable, rather it is usually entered into only when there has been an unexpected outcome. In the above instance the function of a causal search would be to reduce surprise and feelings of uncertainty. Another function would be to aid future goal attainment in that knowing why one has failed may increase one's future chances of success, as certain steps may be taken to avoid repeat failure.

From this it can be seen that attribution analyses are functional or as Weiner states "attribution theory falls within the broader study of cognitive functionalism" (p 19)

3.1.2.1 Causal Dimensions

As an individual enters a causal search to discover why a certain outcome (e.g. failing an examination) has occurred he/she has begun to look at the underlying properties of the causes or the causal dimensions.

Chapter Three - Affective Entry Characteristics

Upon appraising the situation the individual initially appears to check as to whether the dimensions of causality are located within the person (e.g. ability, intelligence, study methods), or outside the person (e.g. task difficulty, poor teaching, ill health on the day of the examination)

This Internal-External distinction of perceived personal control is borne out by several other theorists, notably Rotter (1966), Bandura (1977), deCharms (1968), and Deci (1975). Weiner refers to this dimension as

Locus

Rotter (1966) developing Social Learning Theory highlighted the importance of "Locus of Control", which was defined as a generalised expectancy for internal or external control of reinforcements. To have internal control or to be an *internaliser* implies that an individual believes that an outcome is contingent on his/her behaviour or on relatively stable internal characteristics such as intelligence. External control or an *externaliser* would feel that the outcome of an event is contingent upon factors beyond his/her control (e.g. task difficulty, poor teaching, luck).

Rotter's conception is somewhat more sophisticated than the above explanation would imply. For example in clarifying the relationship

Chapter Three - Affective Entry Characteristics

between locus of control and academic achievement he adds that the child's expectation that a particular behaviour will bring a particular reinforcement is not the only predictor of the occurrence of that behaviour. The "value" of the expected reinforcement is also an important variable, as would be the case for a student who does not value gaining a high grade in a certain subject. He/she may not study effectively for the examination even though he/she believes that gaining a high grade is contingent upon effective study techniques and effort.

Bandura (1977, 1986) developing from his work on social learning theory, emphasises the importance of an individual's perceived self-efficacy and outcome expectancies. Basically the theory merges somewhat with Weiner's locus formulation in that individuals who judge themselves low in self-efficacy have difficulty in coping with the demands pushed upon them by the environment. This is a result of their dwelling on their own personal deficiencies and thus potential difficulties are seen as more formidable than they really are. Bandura (1991) elaborates this to show how anxiety and avoidant behaviour are co-effects of low self-efficacy. In effect, it assumed that an individual will do anything to avoid reinforcing or being pushed to accept a negative self-conception of their ability (see, Tesser and Campbell, 1984).

The converse is true for individuals with high feelings of self-efficacy as they focus their attention and energy on the demands of a situation and are spurred to greater effort by obstacles. In a sense they are energised by the challenge. Birney, Burdick and Teevan (1969) in the context of low self-efficacy individuals, distinguished between three types of fear of failure:

- (1) Fear of self-devaluation
- (2) Fear of social devaluation
- (3) Fear of non-ego punishment (e.g. material loss)

DeCharms (1968) in a similar tone writing on self-determination, distinguishes between individuals who perceive themselves as *origins* and *pawns*. Those who perceive themselves as origins are of the belief that "what he is doing is the result of his own free choice, he is doing it because he wants to do it" (deCharms, 1968, p 381). A pawn is one who feels that outcomes are largely contingent on outside factors. It is notable that deCharms like Weiner sees the educational environment as a primary factor in the development of children's conceptions of themselves as being in control of situations or having their destiny beyond their control. DeCharms concluded that children involved in personal causation training showed a greater tendency toward intrinsically motivated learning and consequently increased achievement scores significantly (deCharms, 1976).

Chapter Three - Affective Entry Characteristics

Allied to this self-deterministic view of deCharms is Deci's (1975) work on intrinsic-extrinsic motivation, which argues that intrinsically orientated individuals would reflect deCharms' pawns in their perceived control of the learning situation. However, it should be noted that although these two theorists are similar to Bandura and Weiner in that they are interested in personal control in learning, their perspectives do differ.

DeCharms and Deci, as Stipek and Weisz (1981) summarise "measure children's perceptions of control over achievement 'context' (i.e., do they have control over the selection of tasks), attribution theorists focus on perceptions of control over the factors affecting the achievement 'outcome'" (p. 128).

Weiner while accepting the importance of these internal-external distinctions among causes has identified shortcomings in this one-dimensional stance. He gives an example to clarify this contradiction. If an individual fails a mathematics examination due to perceived lack of ability or aptitude then this would lead to lowered expectancy for future success. This would be an internal causal attribution. However, if the individual fails the examination due to perceived lack of effort (also an internal causal attribution), this

does not necessarily have a similar effect on the expectancy of future success. To explain this disparity, Weiner introduced a second dimension of causality which he called "Stability" or "Constancy".

Constancy differentiates causes by analysing the stability over time of the causes identified. For example, an attribute such as aptitude or physical appearance tends to be *relatively* unchanging, whereas other internal causes such as mood or effort can vary greatly over a relatively short time span. Thus, mathematics aptitude would be seen to be temporally stable (i.e., enduring) and thus is a predictive attribute of future outcomes. On the other hand, effort or temporary illness would be perceived as transient in nature and thus would not be a strong predictor of future success or failure.

Despite this extension of causal dimensions to accommodate the perceived stability of the causal properties, other anomalies were identified (see, Abramson, Seligman, & Teasdale, 1978). The problem highlighted was that causes can differ in their cross-situational generality. For example, one could fail a mathematics examination due to perceived lack of mathematical aptitude (internal and mathematics specific), or due to perceived low intelligence (internal and global).

Thus the concept of Globality was introduced as an aspect of constancy

Summarising, the causal dimension of **constancy** is made up of

- a) Temporal stability
- b) Cross-situational generality (Globality)

A third dimension of causality is also proposed to account for the fact that while failure of an examination due to lack of effort engenders punishment or negative feedback, failure due to illness does not engender punishment. Of note in this example is that both causal attributions are internal and situation-specific, but beget differing resultant emotions. This would appear to contradict the constancy dimension. To allow for this, Weiner introduced a Responsibility dimension. Taking the above example of effort and illness as the causal factors in the failure of an exam, effort can be identified as being under the control of the individual whereas illness may be beyond the control of the individual, thus controllability is a factor that must be accounted for under the heading of responsibility.

Also under the heading of responsibility comes the question of intention. Again one could fail an examination because of poor effort or because one did not employ the correct examination technique. In this situation both causes could be seen as internal, unstable and

controllable, but the resultant comments from a teacher would be more negative toward the lack of effort causation, than the poor examination technique. It appears that effort and technique employed, differ in their intentional quality. Weiner cites the following to indicate the need for the differentiation of controllability and intentionality " in some circumstances (e.g., negligence) there can be high controllability with low intentionality, while in other instances (the psychopathic killer who does not consciously want to kill) there is low controllability over an intended act" (Weiner, 1984 p 22)

To summarise, Weiner has identified five causal dimensions:

- 1 **Locus**
- 2 **Constancy**
 - a Temporal Stability
 - b Cross-situational generality (globality)
- 3 **Responsibility**
 - a Controllability
 - b Intentionality

Looking at the causal factors subsequent to outcomes is only half of the issue when trying to understand student motivation, an equally pertinent question is of the future consequences of these causal ascriptions. Weiner contends that expectancy of future outcomes is dependant upon

the perceived constancy or invariance of the cause of the prior outcome. For example, success in a mathematics examination ascribed to a stable factor such as mathematics aptitude would lead to greater expectancy of future success than would success due to luck which is unstable (see, Kovenkloglu & Greenhaus, 1978, Weiner, Nierenberg & Goldstein, 1976, Dweck, 1975)

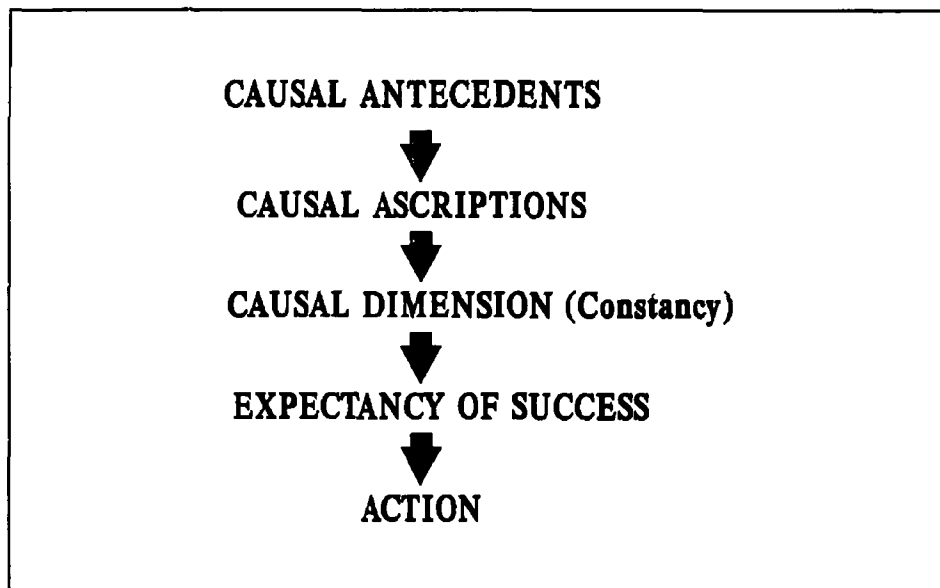
Many attributional change programmes (e.g. Anderson & Jennings, 1980, Dweck, 1975) have been quite successful developing renewed motivation and achievement in students tending to attribute failure to lack of ability (stable) and who were approaching a point of withdrawal from tasks due to fear of failure referred to widely as *learned helplessness* (see, Seligman, 1975, Miller & Seligman, 1982). An essential ingredient of these change programmes, which puts Weiner's theory in the working context, is the input of the experimenter who manipulates the learning content and provides feedback at a level which helps the student alter his/her causal perceptions. This feedback implies an implicit understanding by the experimenter of the entry characteristics (both cognitive and affective) of the student. This sensitive understanding helps the experimenter shift the causal perceptions of the student from say lack of ability (internal) to lack of effort (internal but controllable). The causal dimension then also shifts from stable and uncontrollable to

unstable and controllable which can in turn can lead to higher expectancy for future

To summarise thus far an attribution theory of motivation posits that Antecedent information (e.g., past history of examination failure) implies a cause for present failure. The stability of this cause in turn influences the expectancy of subsequent success or failure, which in its own right effects persistence and future behaviour.

In effect this sequence can be seen as a process or series of steps one goes through following task completion and as one faces a new task or challenge.

Figure 2 Causal Attribution Sequence



As mentioned earlier this sequential procedure is not necessarily executed consciously, as over time the process or routine becomes inherent in the individual's schematic approach to causal ascription of task success or failure. This sequence, outlined by Weiner, is summarised and displayed in **Figure 2** above.

Returning to the second premise of Weiner's conceptualisation, that any theory of motivation must include a full range of emotions, this aspect is central to the rationale of this thesis.

3.1.3 Motivation and Affect

"Cognitions are considered sufficient determinants of feeling states" (Weiner, 1984, p. 28). This point is abundantly clear I believe to any educator who has worked with students, especially students with learning difficulties. Whether cognitions determine the feeling states or feeling states influence cognitions is still an area of contention (also see Leven, 1992). However when failure is experienced, feelings of worthlessness are experienced, notably when the student attributes the failure to lack of ability on his or her part. Beckman (1970) and Dweck and Goetz (1978) demonstrated this point in research, the latter stating "this perception of failure as insurmountable is associated with attributions of failure to invariant factors, such as lack of ability, and is accompanied by seriously impaired performance" (p. 2). Diggory

(1966) even uncovered evidence of students experiencing suicidal fantasies in the aftermath of failure Lazarus (1991b) in a recent review of the importance of emotion in human existence, cites the centrality of affect and emotion in the study of causality in motivation Cullen (1981) has shown that affect such as anxiety, frustration and anger have been recorded in children as young as eight years of age who fail in school

Heckhausen (1982) reported a study which indicated that the affective factors related with self-conceptions do influence performance in examination situations He revealed that students who possessed high levels of *Fear of Failure*, spent a considerable amount of time, in examination situations, on thoughts which reflected worry about the threat the examination held for their self-esteem These task interference worry cognitions and emotions were not experienced by students high in *Hope of Success*, on the contrary they appeared to forget about *themselves* when concentrating on the relevant task

In a more detailed study which links with the process of cognitive thought progression involved in task completion, as discussed earlier, Benjamin, Mc Keachie, Lin and Holinger (1981) described how anxious students in test situations found difficulty in processing information (i.e. encoding, retrieving, etc. information) This point is also reported by Wine (1982)

and reviewed by Heckhausen (1991), where individuals who assess their ability as low, record a considerable amount of thoughts and feeling during task completion, which question their competence and heighten emotionality. Such thoughts and feelings contributed nothing directly to the solution of the task faced and were identified as task-impeding or task-irrelevant (also see, Stiensmeier, 1985). Interesting research by Kirkland and Hollandsworth (1980) observes that such anxiety experienced by students facing examination situations is not a mere consequence of lack of ability, but can also be brought about by the cues which indicate a potential threat to self-esteem or self-conception (also see, Dweck, 1986).

Specifically in attributional terms, emotions such as pride tend to be associated with personal identification with success (internal locus). Guilt feelings tend to be experienced when failure is due to personally controllable cause such as lack of effort or persistence. Guilt may also be experienced in the case of success if that success is attributable to factors such as luck, cheating or the significant help of others. Anger is often experienced when for example personal failure is perceived to be due to factors controlled by others. This may be experienced if failure were due to persistent interruption of study by others or due to poor tutoring by a teacher.

Chapter Three - Affective Entry Characteristics

It has already been seen that causal ascriptions and dimensions lead to particular behaviours, but it is also important to realise that the affect associated with these, influences future behaviour as well. Thus there appears to be an **attribution --> emotion --> action** sequence.

This sequence appears to be intuitively probable in that if one succeeds at an examination and ascribes the success to ability and effort rather than cheating or luck, then one will face the next examination with some degree of confidence. Evidence supporting this sequence has been produced (e.g., Riemer, 1975, Meyer 1980), although Heckhausen, Schmalt and Schneider (1985), have claimed that while internal attributions have a strong affective response, the affective response to external factors is not always as predictable. The overall conclusion seems to be that affective responses tend to be particularly potent when they suggest a need for revision of one's self-concept or self-esteem.

Individual Self-conception and self-esteem or the more elaborate formulation of self-guides proposed by Van Hook and Higgins (1988), appear to play an extremely important role in both the affective and cognitive inputs and outputs of motivation theory. Therefore it is appropriate to review this area in more detail to gain a fuller understanding of the process by which self-conceptions influence individual motivational make-up.

3 2 SELF-CONCEPT AND MOTIVATION

Bereiter (1985) describes the notion of a unified self-conception as a "superordinate cognitive construction" (p 214). An individual's self-concept is identified as one way in which the thinking and cognitive processing of human beings can be perceived as unique from artificial intelligence systems. Bereiter sees one's self-concept as integral in the integration of affective schema into cognitive schema processing in learning/problem-solving situations.

The evidence of a significant link between self-concept and achievement is considerable. A Scandinavian study conducted by Sandven (1976), with 3,500 students indicated that self-image may be the most basic factor in the lack of realisation of academic potential. Purkey (1970) has also shown that there is a positive association between school achievement and self-concept.

Wiggins (1987) has also provided support for this relationship and Mwamwenda and Mwamwenda (1987) identified a similar association in a population from Botswana. Bell and Perret-Clermont (1985) explain this phenomenon remarking that students' recorded school history is intrinsically linked with their perception of themselves.

There does appear to be foundation for this claim as Crocker and Cheeseman (1988) have shown that children as young as six years, can

and do, rank themselves in the classroom situation. Finally, Wattenberg and Clifford (1972) reported from their study that self-concept is a better predictor of reading success than IQ scores. Students with poor self-concepts attained considerably less in reading skills than did students with positive self-concepts.

Marsh, Smith and Barnes (1983) assert that the importance of the study of self-concept lies not only in the recognition that the improvement of self-concept is a valuable educational goal in its own right but that it is also linked to the improvement of other outcomes, such as academic achievement (also see, Caslyn & Kenny, 1977, Shavelson & Bolus, 1982). Returning to Bloom (1976), when he sought tangible ways of measuring affective entry characteristics he argued that, "academic self-concept is the strongest of the affect measures in predicting school achievement and is likely to be the one best index of affective entry characteristics" (p 96 & 97).

Bloom citing evidence (e.g., Kifer, 1973, Dolan, 1974, Crosswhite, 1972) proposes that academic self-concept can account for about 25% of the variation in school achievement after elementary school. In essence what Bloom is stating is that motivation, which he refers to as affective entry characteristics, is best represented and measured in the classroom situation by academic self-concept. The importance of such

self-conceptions in motivational research was seen earlier in Weiner's treatise on Attribution Theory

As self-concept, and more specifically academic self-concept, is central to the objective and rationale of this thesis, a more detailed review of the characteristics and structure of the hypothesis is necessary

3.2.1 Self-Concept Characteristics and Structure

It is worth stating again that the interest and study of self-concept is valuable not alone from the point of view that improved self-concept is a desired educational goal, but also from the assumption that self-concept enhancement may serve as a vehicle for the improvement of specific areas such as academic achievement (Marsh, Smith & Barnes, 1983, Shavelson & Bolus, 1982, Wylie, 1979) Tritt (1991) remarks, that in any learning task one's self-concept is being formed, challenged, extended and threatened. It is this apparent volatility and flexibility that has led to increased research in the structure and development of self-concept

Self-concept has been described by Shavelson, Hubner and Stanton (1976) as an individual's perception of self, these perceptions are formed from interactions with significant others, attributions of his or her own

behaviours, and experiences with the social environment Heckhausen (1991) remarks that self-concept while eclectic in form, relates to information-processing, the regulation of emotion as well as motivational processes Such a multifaceted view of the structure of self-concept is also the conclusion of Markus and Wurf (1987) in their recent review of the subject In the model presented by Shavelson, Hubner and Stanton (1976), the structure was hypothesised to be both multidimensional and hierarchical It was further suggested that self-concept becomes increasingly more multifaceted with age

3 2 2 The Multidimensionality of Self-concept

The question of the multidimensional nature of self-concept proposed by Shavelson et al (1976) in their model, has been addressed in several studies, and findings support this conception of the construct

Marsh, et al (1983) designed an instrument to measure the seven facets of Shavelson's model These were four nonacademic self-concept scales (Physical Abilities, Appearance, Relations with Peers, and Relations with Parents) and three academic scales (Reading, Mathematics, and All School Subjects) The results obtained supported Shavelson's multidimensional proposal in that the correlations among the factors tended to be very small Allied to this, student and teacher ratings

of student self-concept showed significant agreement and notably agreement on each dimension was relatively independent of agreement on other dimensions. These and other evidence (also see, Marsh, Barnes, Cairns, & Tidman 1984, Marsh & O'Neill, 1984, Marsh, Smith, & Barnes, 1985, and Byrne & Shavelson, 1987) emphasising the distinctiveness of each dimension while noting the implicit correlations demonstrate that self-concept cannot be adequately understood if the multidimensionality of its structure is ignored.

3.2.3 Hierarchical structure of Self-concept

There is strong evidence for the existence of a hierarchical structure of self-concept (see, Kihlstrom & Cantor, 1984). Shavelson's model proposed such a hierarchical structure of self-concept, with perceptions moving from inferences about self in sub-areas (e.g., of Academic such as Reading or Mathematics) to broader areas (e.g., Academic or Non-academic), and finally to General self-concept.

This structure suggests a pattern whereby correlations between subject-specific self-concepts (e.g., Mathematics self-concept) and academic self-concept are highest, between academic self-concept and

general self-concept next highest, and finally, between subject-specific and general self-concept lowest. This hierarchy has been empirically supported for several age groupings (Byrne 1986, Fleming & Courtney, 1984, Shavelson & Bolus, 1982), however some recent evidence has led to a modification of the original hierarchy.

This hierarchical structuring of self-concept was based loosely on the hierarchical models of academic abilities. However Marsh (1984) in studies involving his Self-Description Questionnaire (SDQ- a self report self-concept questionnaire developed from Shavelson's model) demonstrated that self-concepts in mathematics and verbal areas are nearly uncorrelated, even though measures of mathematical and verbal ability/achievement are substantially correlated with each other and to the corresponding self-concepts.

To account for this separation in the two areas of academic self-concept, Shavelson proposed a modification of his earlier hierarchical structure introducing second order factors representing nonacademic, academic-verbal, and academic-mathematical self-concepts (Byrne & Shavelson, 1986). Subsequent research has obtained evidence which supports and affirms Shavelson's revised hierarchical structure (Byrne & Shavelson, 1987).

3 2 4 Gender Differences in Self-concept

It is pertinent at this point to refer to sex differences in self-concept research. Wylie (1979) in her review of self-concept research concluded that there was no evidence to suggest sex differences in self-concept at any age level. However she did not rule out the possibility that sex differences in individual subfacets of self-concept may be lost when these facets are combined to give an overall self-concept score.

Research from Australia has noted such a trend, with a large sex difference in self-concepts of Physical Abilities, favouring boys, and Reading favouring girls, but overall self-concept scores remaining unaffected by these subfacet anomalies (Marsh, Barnes, Cairns, & Tidman, 1984).

Byrne and Shavelson (1987) in a comprehensive study investigating sex differences in self-concept, identified gender differences inherent in its' structure. Observed was that General and Academic self-concept correlated higher with mathematics self-concept than with English self-concept for male subjects. The reverse was true for females in that General and Academic self-concept correlated higher with English self-concept than with mathematics. It was also noted that Academic self-concept correlated more highly with mathematics grades than with

Chapter Three - Affective Entry Characteristics

english grades for male subjects. Again the reverse was true for female subjects. Marsh, Smith, Marsh, and Owens (1988) replicated these findings in an interesting study on the effects of transition from a single sex to a coeducational school on student self-concept and academic achievement.

These observations support the substantive findings referred to earlier that girls have recorded higher English self-concepts and lower Mathematics self-concepts than boys. In conclusion it should be noted that these gender differences in individual subfacets of self-concept do not represent significant deviations in overall self-concept mean comparisons across the sexes.

This section of the research review has looked closely at Motivational influences on learning (or Affective Entry Characteristics as Bloom refers to the concept). Using Blooms model as a base to introduce more recent conceptions of motivational/affective influences, it is apparent that student affective entry characteristic levels, on entering a learning situation, can significantly influence the measure of learning and thus learning outcomes. The influence of a student's mental and emotional state when facing a learning task or problem clearly influences the manner in which he/she approaches the assignment. In fact from the literature reviewed, there is a suggestion that the affective or emotional perspective

Chapter Three - Affective Entry Characteristics

of the student facing the task can significantly influence cognitive functioning despite the level of ability that student may possess

In searching for a technique to quantify student motivation that would include such an affective aspect, it appears that Weiner's Attribution Theory linked with the work of Achievement Motivation theorists offered the clearest insight into the dynamics of individual motivation. The network of a typical schematic process in situational motivation analysis, fits closely with the cognitive processes of problem solving schema reviewed in Chapter Two. However, in the motivational situation the presence of a significant affective aspect differentiates the process profoundly. This affective aspect was seen to be represented by the mediation of one's self-conception in the attributional analysis of task success or failure. In the review Weiner's introduction of the importance of the self-concept as the generator of causal ascriptions was extended by introducing recent research on self-concept by researchers such as Barnes and colleagues and Herbert Marsh.

Closer investigation of self-concept revealed much evidence to support the significance of the construct in task participation, and in achievement rates in the field of school learning. Self-concept, is a construct which is central to the present study, in that it represents the best single method of measuring affective entry

Chapter Three - Affective Entry Characteristics

characteristics The structure of self-concept appears to be multidimensional and hierarchical in nature, exhibiting only minor sex differences in a few specific subfacets

Extensive research on the nature and structure of self-concept, notably by Marsh and his colleagues in Australia, has led to the development of the Self-Description Questionnaires (SDQ) The validity of these instruments has been empirically demonstrated in the studies cited above and the rationale for the importance and inclusion of the instrument in this study will be discussed fully in Chapter Six (Methodology) Thus it appears that affective entry characteristics (motivational factors) are best represented by contemporary cognitive attribution theory, and in turn can best be measured by levels of individual student self-concept (as described by Marsh)

Having looked at the two factors in detail which Bloom (1976) identifies as the most important influences on learning outcomes (Cognitive Entry Characteristics and Affective Entry Characteristics) it is necessary to look closely at the influence the teacher exerts in the classroom

As stated earlier Bloom believes that this influence, which he refers to as "Quality of Instruction", is responsible for *very little* of the variance in learning outcomes This research study would disagree fundamentally with such a deterministic view and rather suggest that

Chapter Three - Affective Entry Characteristics

certain teacher qualities such as "Teaching Empathy" can have a significant influence on student learning, particularly on the affective/motivational attributions outlined in this chapter. The issue of the prospective importance of teaching empathy in the classroom climate, will be reviewed and discussed and evidence to support such a perspective will be presented in the next two chapters, linking it with the insight gained into the cognitive and affective variables that influence learning, which have just been reviewed.

CHAPTER FOUR

4 0 EMPATHY

4 1 INTRODUCTION

In recent decades there has been an explosion in research on teacher characteristics and student learning, some indicating that teacher variables have an important influence on student attainment (e.g. Wright & Nuthall, 1970). However few have looked in detail at the importance of the skill/characteristics, fast emerging as a central facet in social psychological reasoning on interpersonal communication and behaviour (Miller & Steinberg, 1975), namely **Empathy**. This point is supported by Lazarus (1991b) who observes that it is remarkable that psychologists have shown so little interest in such a powerful human ability as empathy.

Empathy is a term used widely and variously in many disciplines including anthropology, law, philosophy, sociology, medical science and psychology. The term empathy has its origins in the Greek word *Empatheia*, which is composed of, *En* meaning *in* and *Pathos* meaning *suffering or passion*. The concept of empathy as we understand it to-day was probably first employed in the late nineteenth century by German philosophers/psychologists using the phrase *Einfuhlen* meaning "feeling into".

It is important that a full and comprehensive understanding of the concept of empathy is gained to follow the theme and integration of the concept in this research proposal

4.1.1 Empathy and the Social Milieu

Meaningful interactions among people requires that they be willing to construe each others point of view (Johnson, Cheek and Smithers, 1983)

Since meaningful interactions are the very basis of human social existence, then it could be inferred that the ability to construe the point of view of others, would be central to cohesive living in our modern social milieu Gruen and Mendelson (1986) a little more specifically state, "responsiveness to the emotional state of another plays a fundamental role in defining and shaping patterns of human nature"

In modern social psychology the ability to construe another's thoughts or feelings is classed as empathic behaviour Redmond (1989) characterised empathy as one of the basic competencies in communication and interpersonal competence, indeed he presented evidence to show that communication competence and perceived empathy are not discrete concepts What exactly then is Empathy?

4 2 DEFINITIONS OF EMPATHY

In Webster's Third New International Dictionary, empathy is defined as

"1 the imaginative projection of a subjective state whether affective, or cognitive into an object so that the object appears to be infused with it

2 the capacity for participating in or a vicarious experiencing of another's feelings, volitions, or ideas and sometimes another's movements to the point of executing bodily movement resembling his"

Katz (1963) descriptively highlights what is involved in the experience of empathy. He states "we feel as if we were the other person we stand in his shoes. We get under his skin we are projected out of ourselves into the other person" (p 3)

Rogers (1951) from a psychotherapeutic viewpoint defines empathy as the ability,

- * to assume the internal frame of reference of the client,
- * to perceive the client as he is seen by himself,
- * to lay aside all perceptions from an external frame of reference while doing so, and,
- * to communicate something of this understanding

Johnson et al , (1983) more economically refer to, "this tendency to apprehend another persons condition or state of mind" Clark (1980) elaborately describes empathy as the unique capacity of human beings to feel the experiences, frustrations, anxieties, sorrows, hunger, aspirations, needs, joy and hurt of others as if they were his/her own Feshbach (1982) one of the most prolific writers in recent times in the area of empathy, says "empathy entails an internal representation in one person, of a psychological experience taking place in another person" She further claims that intense empathic responsiveness may indicate a blurring of the bounds between self and others Similarly, Rogers and Sanford (1984) pictured empathy as "temporarily living in his/her life, moving about in it delicately without making judgements" (p 1,378)

Bryant (1982) sees empathy as more affect laden, when she describes it as a vicarious emotional response to the perceived emotional experiences of others with emphasis on the emotional responsiveness Zajonc (1980) further emphasises this emotional/affective component of empathy in his treatise on Thinking and Feeling, when he points out that thought is never free of feeling and empathic thought is especially feeling rich Thus, it can be seen that the definitions of empathy vary greatly, from affect free mental identification, to the highly charged vicarious feeling of anothers' emotions

This lack of consensus in the definition of empathy among researchers (admittedly from many different theoretical backgrounds), has frustrated reviewers when attempting to highlight what they feel are universally salient attributes of the concept. Choplan, Mc Cain, Carbonell and Hagan (1985) highlight this in their review of measures of empathy. Most measures hitherto, while claiming to measure empathy, appear to measure "either" the affective/vicarious component (e.g. Mehrabian & Epstein, 1972) "or" the attitudinal/role-play component (e.g. Hogan, 1969), but few attempted to measure both. This makes the review and interpretation of empathy research somewhat problematic.

It is only in recent years that theorists and researchers have begun to view empathy as a dual process. Archer, Diaz-Loving, Gallowitzer, Davis and Fouchee (1981) in their research highlight the duality of empathy, claiming it involves both the cognitive process of taking another person's perspective including the emotional perspective. Empathy could be understood to be a complex cognitive-affective process (Eliasz, 1980).

Davis (1983) produced evidence for a multidimensional approach to empathy. He claims empathy should now be considered as a set of related constructs, encompassing both cognitive and affective reactions. A further study conducted by the theorist (Davis, Hull, Young and

Warren,1987), elaborated the success and depth of the dual dispositional perspective This multidimensional perspective is further validated by research carried out by Carey, Fox and Spraggins (1988)

Finally on the theoretical aspect of the concept Feshbach (1975) proposes a tangible working model of empathy She refers to it as

"A Three Component Conceptual Model of Empathy"

Component One (Cognitive)-- The ability to discriminate and identify the affective states of others, that is to be attuned to identifying the affective cues of others

Component Two (Cognitive)-- The ability to assume the perspective and role of the other person That is to understand the situation from the others' point of view

Component Three (Emotional)-- The ability to experience the emotion that is being witnessed in order to be able to share that emotion

Feshbach's model appears to be a well defined polar *opposite* to Luchin's (1950, 1951) description of factors that interfere with an individual's understanding of another

These were

- (1) Centering too much on one's own needs, emotions, and purpose
- (2) Focusing only on one feature of an individual's behaviour
- (3) Possessing fixed and stereotyped ideas concerning the relation between attributes such as physical features and personality traits
- (4) Possessing negative stereotypes toward certain individuals or groups as a result of their colour, race, religion

Empathy appears to be the opposite to Egocentrism, which Johnson (1981) defines as "the embeddness in one's own viewpoint to the extent that one is unaware of other points of view and the limitations in one's perspective" (p 277) Compare this personal view-point with the experiences empathic individuals recorded in a study conducted by Kendall, Finch & Montgomery (1978) Subjects were invited to a talk given by a visiting lecturer The lecturer showing obvious nervousness stammered, dropped his notes and embarrassingly lost his

concentration several times. Compounding the situation he had to leave the theatre to find a missing slide projector. In his absence subjects were asked to complete an Empathy measure (Hogan's QMEE, which is a measure of the cognitive aspect of empathy) and an Anxiety Arousal scale. Those who scored highly on the empathy scale (highly empathic individuals) had also experienced heightened levels of anxiety arousal.

In reviewing emotional development in the study of the development of social cognition, Flavell (1985) attends to the development of empathy as a cogno-affective ability. He suggests three possible levels of *empathic* functioning. The first he cites is *Noninferential Empathy*. This would involve an emotional contagion, the triggering of related feelings to those of the target person. He highlights that there would not necessarily be any relevant social cognition in these situations and the emotional association may be triggered by cues which were perceptually similar to those which are associated with his/her own past painful or happy experiences.

The second level he expands is *Empathic Inference*. In this situation the individual infers something of the feelings of an other, while also having some related feelings him/herself. He remarks that sometimes this inference can be entirely wrong regarding how the other felt (inaccurate

empathic inference) However if the individual did *feel with* the target person, then this could be called accurate empathic inference

The third possible level he comments on is *Nonempathic Inference* This refers to the inference of another's feelings without any relevant feelings being experienced by the person themselves Essentially he is referring to a relatively affectless identification with the target person which because of the lack of the vicarious affective experience, cannot be depicted as empathic

While Flavell's elucidations are insightful, especially from a developmental perspective, there does in the opinion of this writer, seem to be some problems He never really appears to come to grips with the simultaneous interaction of cognitive empathic experience with affective empathic experience (not to mention any physical identification) In other words his conception of genuine empathic experience is explained as an inferential feeling of how another is feeling (*note* only feeling, not thinking) and this may or may not be accurate While the accuracy issue is an interesting point, the rest of his description leave out what for this writer are two important components of the empathic experience, namely the cognitive and to a lesser extent the physical experience As this study proposes to integrate a novel definition of working empathy, it is appropriate that this should be considered here

The definition adopted for this study follows Davis' (1983) model seeing empathy as both a cognitive and affective process and relating to both the cognitive and affective processes of an other. This assumption is supported by Tausch (1988) who agrees that empathy directed to both cognitions and emotions is more realistic than exclusively attending to one or the other. Consequentially the following working definition was proposed

EMPATHY IS THE ABILITY TO

**APPREHEND AND EXPERIENCE THE PHYSICAL STATE OF A TARGET INDIVIDUAL(S)*

**APPREHEND AND EXPERIENCE THE COGNITIVE STATE OF A TARGET INDIVIDUAL(S)*

**APPREHEND AND EXPERIENCE THE AFFECTIVE STATE OF A TARGET INDIVIDUAL(S)*

While this definition takes a similar view to those theorists cited earlier who conceive of empathy as both a cognitive and affective phenomenon, it does have distinctions that are necessary to elaborate upon

While many theorists highlight the affective and cognitive aspects of empathy, few reflect the sense of the physical in the process. While the definition does not suppose the adoption of the physical state of the target individual, it does imply that an apprehension of this state and a focusing on the physical cues available can help one adopt at very least a mental representation of the physical/structural state of an other. This physical cue appreciation is often identified in therapeutic situations as being a

helpful indicator to the counsellor, of the thoughts or emotions of the client. However rarely is the physical state identified as a factor of importance in itself. It is the contention of this research that the physical state of another, if empathised with, can be a significant additional factor leading to a fuller and closer empathic bond with the target person when coupled with affective and cognitive apprehension. It could be seen as being of particular assistance to teachers in the classroom situation, where it may be difficult for the teacher to spend sufficient time with individual students in order to verify the empathic experience he or she apprehended.

In the second and third section of the definition, the expression *experience*, does not imply a capitulation to the experience of the other, rather it implies a vicarious understanding or sensing of that emotion or thought state.

Implicit in the definition put forward by this study, is the understanding that empathic experiences vary in their range of intensity dependant on differential personal and situational factors. There exists some evidence for this variable conception of empathic emotion (see, Betancourt & Blair, 1992, Smith, Keating & Stotland, 1989). This implies that empathic ability is not a purely natural occurrence, presenting with corresponding intensity on all occasions. Rather the affective state of the empathiser,

his/her cognitive state, and the pressures of the situational surroundings may have quite a significant influence on the intensity and duration of the empathic experience. This point may have special significance in the classroom setting which this research concentrates on.

Having looked at the varying definitions of empathy and the problems evident in its measurement, it seems pertinent to look at areas of research and application of the concept.

4.3 EMPATHY IN COUNSELLING/PSYCHOTHERAPY

The importance of the ability of the counsellor to obtain an accurate and sensitive understanding of the experiences and feeling of the client has long been noted as being of paramount importance in helping relationships. Barrett Lennard (1962) explains that in the counselling situation, empathy is an experiencing of the consciousness behind the client's communication. It appears that therapists' level of empathy is closely related to relaxed client self-exploration, which is linked to degree of improvement (Tausch 1969). A survey conducted among 83 practising therapists, of eight different orientations, found that they gave empathy the highest ranking among twelve variables as being the most important determinant of therapeutic success (Raskin, 1974). A study done in South Africa by Van Wyk (1981) indicates that

therapists classified as "poor", differed significantly with regard to the levels of empathy used, compared to therapists classified as "good"

Morris and Sucherman (1974) reported an inverse relationship between reduced levels of therapist empathy and successful therapeutic outcome

Kendall and Wilcox (1980) showed that therapist empathy scores predicted client improvement in hyperactive and uncontrolled children

Therapist empathy has been shown to have a significant positive effect on the recovery of depressed clients (Burns & Nolenhoeksema, 1992)

O'Leary (1982) goes so far as to say that even the counsellors "intent to understand" has value, as the client perceives this effort. The list of evidence highlighting the central importance of therapist empathy in the helping relationship is almost endless (For other examples see, Truax and Carkhuff 1967, Dubnicki 1974, Rosenthal & Harrigan 1983)

O'Leary (1981) concisely points out that this heavy emphasis on empathy as the central core construct of the helping relationship is not surprising when we consider the situation from the client's point of view. She says "empathy means that someone understands him just as he is. Through the experience of this understanding he is able to discuss himself more freely and fully without being distracted by having to remain on guard against criticism he would usually expect in a non-therapeutic situation" (p 26). Frank (1961) reported that many

disturbed persons who did not attend formal psychotherapy, often sought and obtained help from other sources such as friends, clergymen, physicians and teachers, all individuals who were most likely to provide a somewhat empathic atmosphere. Emery (1987) compares the differing conceptions of empathy in the psychoanalytic and client-centered approaches to therapy. Empathy is characterised in psychoanalytic theory as a skill or ability which provides the therapist with a fuller understanding of the client's situation. In client-centered therapy, empathy is used by the therapist to help the client sharpen his/her sense of felt experience. This sharing of moment to moment experiencing between the client and therapist, is considered to be extremely beneficial therapeutically (see, Marcia, 1987, for full review of the meaning and place of empathy in differing psychotherapeutic traditions).

Finally, Collins (1987) in his treatise of empathy in the therapeutic situation, states that empathic experiencing of the client's situation not only facilitates client improvement but may actually lead to further growth on the part of the therapist as well.

It is clear that empathy plays a major role in the psychotherapeutic process, but this begs the question as to whether empathy is but a learnt therapeutic skill or technique? Few would deny that empathy or certain

empathic skills can be learnt (e.g. Black 1984, Higgins, Maracco, and Danford 1981) but is the ability inherent in all individuals?

4.4 EMPATHY LEARNT OR INNATE?

Stotland (1969) explains how most individuals occasionally become vicariously involved with the plight of characters in a novel or a movie, or in newsreports. Clark (1980) believes that the capacity for empathy is uniquely human and is a consequence of the evolution of the most recently developed portion of the brain, the anterior frontal lobe. He speculates that there are three differing degrees of empathic endowment.

Firstly the individual who is born with a highly developed cortical base for empathic function. These individuals feel almost unconsciously compelled to identify and empathise with others. **Secondly**, probably the majority of people, those who have an adequate cortical base, balance the need for empathic as against egocentric behaviour as the situation determines. These individuals according to Clark, would be open to training of their sometimes latent empathic capacity.

Thirdly, hopefully a minority of the population, are those individuals who possess stunted cortical development, for whom only a limited degree of empathic functioning is possible. They are typically the

egocentric individuals in our society, and in extreme cases they are psychopaths, sadists and tyrants

Contrary to Clark's singularly *human* conception of empathic ability, Marler (1983) reported some fascinating research with alarm calls among vervet monkeys. His results indicated that differential affective empathic signalling when under threat of three separate predator types, leopard, snake and eagle, each manifested a differential response. Further evidence implies the presence of empathic ability among animals (see, Plutchik, 1980, Wilson, 1985, Povmekli, Nelson & Boysen, 1992). Brothers (1989) also reviews empathic development from an evolutionary and neurophysiological perspective, identifying a developmental path in both humans and primates, which integrates social signals with neural activity and organisation. While such evidence is indirect it would make ethological sense that an empathic ability would serve an evolutionary advantage, notably in defence against predators and to facilitate living in social groupings.

While such research would argue that empathic ability must have a genetic basis, others would claim that it is an ability that given certain circumstances may or may not become actualised (Staub, 1987). Importantly it has also been demonstrated that empathic skills can be trained and that the effects can be quite positive, especially in terms of

significantly improved interpersonal skills (Brems, Fromme, & Johnson, 1992) It should however be remembered that empathy is not just a skill or ability that is developed or experienced in the mind, as there exists evidence that indicates that when one experiences empathy, there is also a physiological correlate (Levenson & Ruef, 1992, Eisenberg, Fabes, Carlo, Troyer, Speer, Karbon & Switzer, 1992)

In recent years a whole section of empathy research has concentrated on establishing the determinants of the phenomenon (Feshbach & Roe, 1968, Guzzetta, 1976, Hoffman, 1977) Numerous studies reported by Feshbach (1982) indicate that empathic ability in girls may be correlated with maternal tolerance and permissiveness and negatively correlated with rejection, conflict and excessive control For boys she found a negative relationship between boys level of empathy and paternal emphasis on competition She also found that boys who had a wide range of dysphoric experiences tended to be more empathically inclined

Mc Devitt, Lennon and Kopriva (1991) described research which indicated that mothers more than fathers were the encouragers of empathic thought in the family situation They also reported some evidence that would suggest that mothers exerted more pressure on female children than on male children to behave in a more prosocial and empathic manner

Recent research on the early development of empathy has given some interesting perspectives on the possible formative derivation of empathic ability among infants. Thompson (1987) relates how an infant's dependence on its mother (or guardian) results in it being highly attuned and sensitive to variations in maternal affect. He reports that infants as early as the first year are capable of sharing the same emotion as a consequence of the emotional display of another. He adds that these responses are more clearly empathic by the middle of the second year (see also, Martin & Clark, 1982, Zahn-Waxler & Radke-Yarrow, 1982, Cummings, Iannotti, & Zahn-Waxler, 1985). The research to date appears also to indicate that empathic ability appears to develop in parallel with social cognitive development (Zahn-Waxler, Radke-Yarrow, Wagner & Chapman, 1992).

Johnson, Masters and Campbell (1992) studied the link between counsellor theoretical orientation (directive, non-directive, etc.) and found that family processes such as expression of a range of feelings, openness to others, and high levels of indicated empathy, appeared to have significant developmental influences on later therapeutic orientation.

Kalliopuska (1984) investigated links between empathy and social class background, but found no relationship. The relevance of birth order and recorded empathy levels has also been looked into in detail, and some

relationships have been found to exist, although the determinants are not as of yet clear (Moore, 1978)

While research on the global determinants and development of empathy has rendered some interesting insights, the picture is still somewhat clouded. In summary it does appear that the majority of human beings do have the fundamental capacity to empathise and it is also clear that this capacity can be enhanced by training. There does appear to be evidence that empathic ability may be an evolutionary genetic development, which may or may not realise actualisation, depending on early environmental and developmental experiences. Some evidence does suggest that such causal determinants of empathic capacity appear to have their roots in the developmental familial factors. Of particular importance appear to be the quality of relationship with the mother figure and the emotional responsiveness of the parents/guardians.

Research on empathy and individual differences has produced an enormous amount of information which may help us understand the effect an empathic predisposition may have on the personality and behaviour of on such individuals.

4 5 EMPATHY AND INDIVIDUAL DIFFERENCES

Bergin and Jasper (1969) investigated whether or not there existed a relationship between indices of a therapist's intellectual ability or academic achievement and their level of empathy. No relationship was detected and they concluded that scholastic abilities do not necessarily indicate elevated levels of empathy.

This finding was supported by Kupfer, Drew, Curtis, and Rubinstein (1978) who examined the relationship between medical students' college admission test scores and their measured empathy scores. The results concluded that measured empathy reflects individual dimensions separate from those of academic achievement.

Feshbach & Feshbach (1987) in a study of children's empathy levels and achievement in reading and spelling over two years, reported that for girls there was a strong relation between their levels of empathy and achievement. Bonner and Aspy (1984) relate findings from a study they conducted among students' GPA scores and empathy levels. They found that students' formulation and subsequent communication of empathic understanding were related to academic performance (GPA). It has also been recorded that social work education has a positive effect on students' levels of empathy (Keefe, 1976). He also pointed out

that in this study the "best students" had highest empathy scores, and females scored higher than males

Thus it appears that theorists are far from agreement as to whether there is a link between academic ability and empathic ability. It is interesting to ponder upon the idea that empathy may be logically linked to a concept such as reading ability as this could imply a greater mental schematic representation of experiences encountered in literature. Perhaps an emotional or intellectual identification occurs with scenes, individuals and occasions described therein. However this explanation is not as applicable to a "less social" attribute such as mathematics ability. It can be explained, if one refers to an earlier section of this thesis where the importance of reading ability was highlighted as being integral to mathematics achievement. Therefore one could speculate that while empathy has been correlated with mathematics ability, it may be that these high mathematics achievers, as a prerequisite, have elevated reading ability levels. The relationship between empathy and intellectual abilities such as mathematics ability may lay in this level of experience (in a literary sense).

Gallo (1989) expounding the virtues of empathy in education, sees empathy as playing an important role in the fostering of critical and creative thinking, both of which she feels are integrated. It is clear that

further work needs to be done in this area before we can claim to fully understand the underpinnings of the concept and its relationship to individual intellectual/academic ability

Lazarus (1991a) also ponders on this point, commenting that there is a curious lack of psychological research in what he also sees as a potentially important and deterministic concept in the study of human interpersonal relations, at both a personal and group level. He particularly notes the vicarious association that a reader may have with characters in a novel, the reality of this experience, and yet cognitive scientists have spent very little time researching this tangible and impacting human experience.

4.5.1 Empathy, Altruism and Prosocial Behaviour

Perhaps the most prolific area of empathy research has been regarding the links between it and prosocial behaviour, as mentioned earlier. The interest began as thinkers extended the relevance of empathy from the therapeutic helping relationship, to "*real world*" helping situations. As empathy involves taking the perspective of another, either intellectually or vicariously experiencing his/her plight, then in a situation where a fellow human being is in distress it seems logical to surmise that one would lend assistance if possible. Numerous studies have investigated such situations, the majority finding strong positive correlations

(e.g. Coke, Batesou & Davis 1978, Hoffman 1976, 1982, Krebs 1975, Van Ornum, Foley, Burns, De Wolfe & Kennedy 1981) An extension of this research which demonstrated that empathy can lead to the initiation of overt helping behaviour, was the introduction of the concept to the field of attitude change. Again it was indicated that empathic thought about individuals in less well off situations, such as the disabled (Ibrahim & Herr, 1982), the elderly (Wisoki & Telch, 1980), and AIDS victims (Royse, Dhooper, & Hatch, 1987), led to significant positive shifts in attitude.

For some time controversy reigned as to whether theorists were confusing empathy with altruism. While most agree that both may have similar behavioural expressions in emergency or prosocial situations, their underlying mental antecedents differ considerably (see Underwood & Moore 1982).

More recently the research (e.g. Fultz, Baston, Fortenba, McCarthy & Varney 1986, Baston, Dyck, Brandt & Baston, 1988) has turned towards analysing the motivation for empathic helping behaviour, involving ideas such as obtaining social/self rewards (praise, honour, pride) and avoidance of social/self punishment (guilt, shame, etc.). This area has sparked an amount of controversy between theorists who support the egoistic explanation (e.g. Smith, Keating & Stotland, 1989, Archer,

1991, Hornstein, 1991, Krebs, 1991) where there is a personal benefit for the helper, and the altruism/empathy explanation (e.g. Batson, Batson, Slingsby, Harrell, Peekna & Todd, 1991, Kenrick, 1991) for prosocial or helping behaviour. To date no single strong motivational attribute has been identified which explains fully such empathic behaviour (Batson, Dyck, Brandt, Baston, Powell, McMaster, & Griffit, 1988), although some researchers believe there is evidence to suggest that both motives can exist together (Dovido, 1991)

4.5.2 Personality Adjustment and Empathy

Empathy has been linked (positively and negatively) with a host of personality variables with many conflicting results emerging. For example highly empathic individuals were claimed to be more extroverted by Rim (1974) and more introverted by Hogan (1969). Locus of Control is another concept which researchers postulated might be linked with empathic tendencies. Again results conflict, Gough (1974) indicated that empathic individuals (males only) held internal locus of control, while Rim (1974) claimed high empathisers had a tendency for external locus of control. Deardoff, Kendall, Finch, & Sitartz, (1977) found no relation at all between empathy and locus of control. However Choplan et al., (1985) in their review point out that many of these apparently contradictory findings can in fact be attributed to the use of differing measures of empathy as highlighted earlier.

A consistent inverse relationship has been identified between empathy and personality disturbance in general (Hornblow, 1980) and more specifically with problems such as depression (Kupfer, Drew, Curtis & Rubinstein, 1978), anxiety (Hogan, 1969, Davis, 1983) and aggression (Mehrabian & Epstein, 1972). Further research has revealed that there exists a negative relationship between empathy scores and populations identified as delinquent (Lee & Prentice, 1988), child abusive mothers (Letourneau, 1981), and maltreated children (Lamphear, 1985), while a positive relationship has been cited for those who choose medicine as a career (Streit-Forest, 1982).

Personality correlates of high in empathy individuals in general identify a well adjusted, likeable, social animal. Mehrabian, Young & Sato (1988) demonstrated how individuals with high levels of emotional empathy had higher heart rates and had a higher propensity to weep when faced with emotional situations than had low empathy individuals. Greif and Hogan (1973) claimed subjects scoring high on empathy scored highly on interpersonal adequacy. Dymond, Huges & Raabe (1952) went so far as to claim that good empathisers have

- (a) positive family atmosphere and relationships
- (b) positive orientation towards others
- (c) positive and concrete life goals
- (d) positive concept of self

From this they conclude that good empathisers feel secure enough in themselves to have a genuine interest in others. Indeed, Feshbach (1982) cites research she carried out which identified empathic girls as having positive self-concepts. Mehrabian (1988) indicated that females are more empathic than males. This issue was further reviewed by Langtakac and Osterweil (1992) who reported that women tend to be more connected or empathic than men, while they found that males tended to develop in a manner which accentuated their individualness and reinforce the separate or differentiated aspect of their personality. Similarly, Dalton (1983) identified sex differences between males and females empathic ability, females being more empathic. Interestingly, he also obtained that individuals show greater levels of empathy when relating to their own sex.

Kalliopuska (1992) reported that high empathy individuals were less narcissistic and less self-focused and more sensitive to others than less empathic individuals. These high empathy scorers also smoked less and used less alcohol than their less empathic colleagues.

In a general overview, Hogan and Mankin (1970) describe empathic individuals as "likeable". This claim may be related to the fact that individuals high in reflected empathy score highly on communication competence (Redmond, 1985). Miller and Steinberg (1975) boldly state

that "empathic skills and interpersonal communication effectiveness seem almost synonymous" (p 167)

The chapter has tracked the meaning of empathy, its' determinants and the emergence of interest and research in the concept from the professional helping relationship, through to its links with certain personality constructs and individual differences. It is hoped that not alone the significance but the relevance and importance of empathy in all forms of interpersonal contact has been imbued. If empathy is synonymous with effective interpersonal communication then it seems a logical consequence for it to be a dominant and critical factor in education. This point will be reviewed further in Chapter Five.

CHAPTER FIVE

5 0 EMPATHY IN EDUCATION

5 1 INTRODUCTION

Loevinger and Knoll (1983) in their review of research on Personality, map a general movement in theoretical orientation in modern psychology when they say, "some years ago the predominant view in psychoanalysis, behaviourism, and social learning theory tended to be that children were born more or less antisocial and needed to be socialized" (p 135) However they feel the recent research on humanistic phenomena, especially empathy, have altered this view

Goldstein and Michaels (1985) agree with this interpretation when they identify the orientation of American education in recent years as being "affective" or "humanistic" in its approach They state the following of the approach "it is generally an experiential perspective, one which the teaching-learning process is not something done *to* the learner but, instead in which growth emerges largely from the facilitative consequences of a special teacher-pupil relationship" (p 144) *[my italics]*

Abinum (1981) discusses further the positive effects of personalizing education and moving away from the view where by students are perceived as objects to be controlled and filled with information Rogers (1983) in "Freedom to Learn" elaborates from the

psychotherapeutic setting to the classroom stating that " the facilitation of significant learning rests upon certain attitudinal qualities that exist in the personal relationship between the facilitator and the learner" (p 121) Rogers emphasises the notion of facilitation in the school setting, rejecting the traditional teacher centred information giving role He explains this further "When the teacher has the ability to understand the student's reactions from the inside, has a sensitive awareness of the way the process of education and learning seems 'to the student', then again the likelihood of significant learning is increased" (p 125) From these writers it would appear that a more humanistic, student-centered approach to classroom education would have many positive outcomes This claim needs further investigation if this study is to follow such a philosophical stance, introducing the importance of teacher empathy to the formula

5.2 EMPATHY AND LEARNING OUTCOMES / ACHIEVEMENT

Lawrence (1987) in his treatise on the importance of enhancing student self-esteem in the classroom links teacher empathic behaviour to maintenance of student self-concept Berens (1976) also reports that highly empathic teachers had a positive effect on a variety of self-concept ratings This research is encouraging as other theorists (e g Purkey, 1970, Gurney, 1987) have linked positive student self-esteem with school achievement Lay and Wakstein (1985) in a study of the

relationship of self-concept to the third level college achievement of 16,140 black and white students found that the level of self-esteem of white subjects depended on their level of academic success (the levels of self-esteem of black subjects was more related to factors outside academic achievement) Thus for white subjects at least it appears that positive self-esteem is a predictor of academic achievement, which in turn leads to increased self-esteem If empathic teachers can foster self-esteem then this may be a significant variable in the instructional environment tied to scholastic attainment

Cronbach and Snow (1977) lend credence to this speculation when they indicated that Aptitude-Learning Outcomes do vary as a function of instructional treatment variables Chang, Berger & Chang (1981) report an interesting study which rated college students' self-esteem and teacher empathy levels They found a significant relationship between high self-esteem students whose teachers were rated as empathic and these students' achievement levels While this study produces interesting results it should be noted some research has shown that students high in self-esteem have been recorded as achieving highly regardless of instructional situation variables (e.g. Wattenberg & Clifford, 1972)

Classroom studies of the effect of teacher empathy on students go back some decades Diskin (1956) in a study replicated by Walter (1977), noted that teacher trainees who were high in measured empathy, had students who exhibited elevated levels of co-operative peer interaction and harmony Other early studies such as that of Dixon and Morse (1961), reported a positive relationship between a teacher's level of measured empathy and his/her rated competence More recently Cohen (1981), in a meta-analysis of students' ratings of teacher rapport (including empathy) in 28 studies, found a moderate positive relationship with achievement existed

Incorporating a general review of the literature Aspy (1975) reports that there exists strong evidence to support the claim that the students of empathic teachers are high achievers This appears to be so from elementary school (e.g. Feshbach & Feshbach, 1987, Mantro, 1971), through to second level (e.g. Scheuer, 1971, Aspy & Roebuck, 1977), and into third level (Chang et al., 1981, Perkins, 1971) Elementary school students taught by high-empathy teachers were shown to have gained 2.5 years in reading age achievement over a five month period, as against a 0.7 year gain by students of low-empathy teachers (Aspy & Hadlock, 1966) Stevens (1967) described the beneficial effects of an empathy based special education programme which raised 37 of the 43 of the participating students, from below average scores

at the scheme outset, to above average after eight months Coffman (1981) reported empathy as a critical teacher variable in the learning outcome of an interpersonal communications class The study points out that empathic behaviours by instructors facilitate student learning experiences in a positive way

Hopson and Scally (1981) refer to the enormous empathy-achievement study carried out by Aspy and Roebuck (1977) as "one of the most important pieces of educational research of the decade" (p 48) In Aspy and Roebucks'(1977) study titled, "Kids don't learn from people they don't like", they studied 600 teachers and 10,000 students The following are some of their findings

- (1) high-empathy teachers were shown to gain significantly higher levels of mathematics and reading achievement from their pupils

Students of high empathy teachers

- (2) miss fewer days from school
- (3) have more positive self-concepts
- (4) commit fewer acts of vandalism
- (5) exhibit fewer disruptive behaviours

Although not totally free from methodological criticism, these findings do imply that empathy is indeed a critical factor in the classroom. This evidence has been supported by other researchers (e.g. Waxman 1983, Tausch & Tausch, 1980). As the evidence for the positive influence of teacher empathy appears strong, it would be valuable to understand how this process evolves and manifests itself in an observable or measurable form in the classroom setting.

5.3 EMPATHY IN THE CLASSROOM - MANIFESTATIONS

If teacher empathy is, as some research indicates, such a critical classroom variable, then what are its behavioural manifestations? Aspy and Roebuck (1975) again tackled this question and found that high-empathy teachers (in contrast to teachers low in empathy) exhibit the following:

- (a) more student praise
- (b) more student encouragement
- (c) less student criticism
- (d) accepted students expression of feelings
- (e) elicit more student-initiated talk
- (f) fewer periods of confusion or silence
- (g) smiled more at their students

However, an attempt by Wisdom (1978) to replicate Aspy and Roebuck's (1975) findings only partially succeeded

What does appear important from the above findings is that while a teacher may empathise with the difficulties or problems of a student, this *internal empathy* is of little value unless it acted upon. Herein lies an important step from the theorising about the content and substance of empathy at an academic level, to the actual behavioural expression in a transactional mode at the applied level

Nelson-Jones (1982) when describing the behavioural communicants of empathy in the counselling situation listed several behaviours which may have parallels in the classroom situation. These included,

Effective communication of understanding

Clarity and freshness of expression

Easily comprehensible language

Good body language

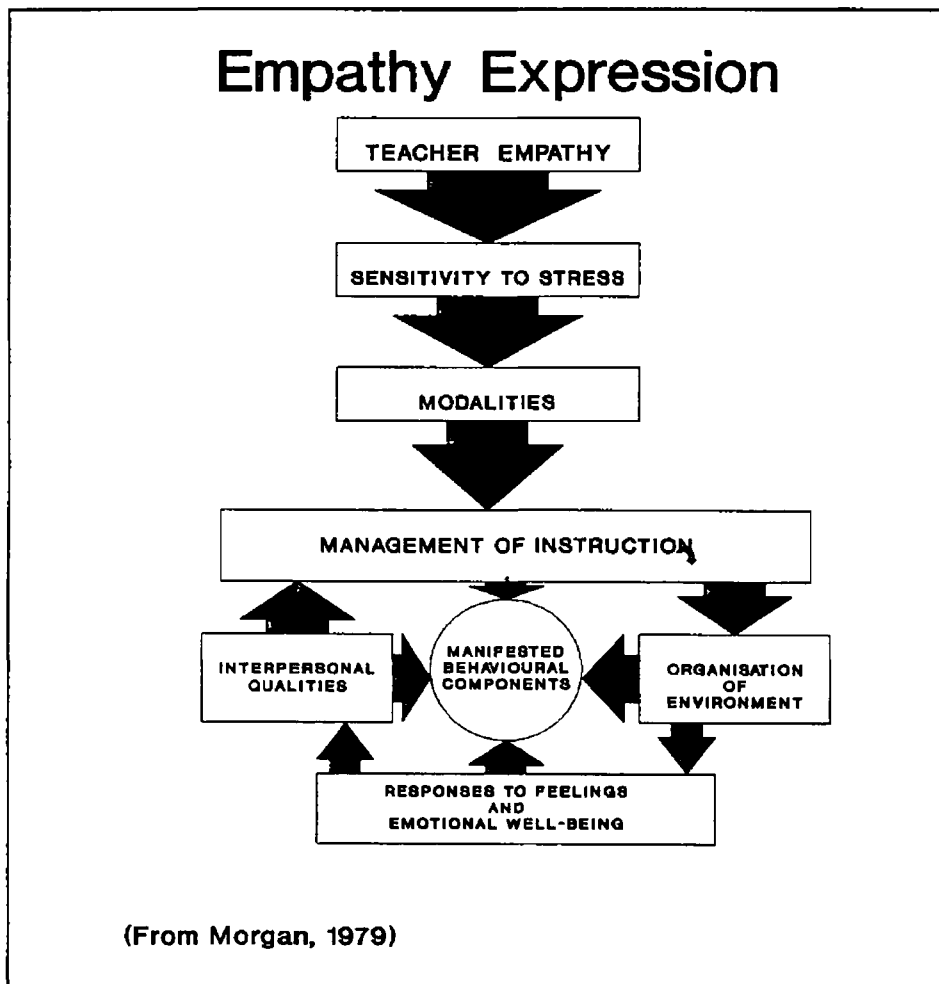
Refrain from being too judgemental

Refrain from talking too much

In recent years several theorists have attempted to coherently present models of how teacher empathy is manifested in the classroom. Perhaps the most useful is that hypothesised by Morgan (1979). This model

represents the channels through which teacher empathy is expressed in the classroom. In this respect it is a welcome step from traditional empathy research in that it actively strives to ascertain the behavioural indices and processes of an empathic teacher, functioning in the real world context of a classroom.

Figure 3. Teacher Empathic Process Model



The model (see Figure 3 above) gives a concrete idea of how an empathic teacher might transfer this disposition in the classroom situation to the pupils. Morgan further subdivides each of the four channels,

- Management of Instruction

- Organization of Environment

Response to Feeling & Emotional Well-Being

- Interpersonal Qualities

explaining in each a triad of ways the teacher facilitates the empathic process in the classroom situation

For example, she emphasises individual contact, recognition of student frustration and allowing each student the time they require to master a set task. Also important are overt displays of humour and affection. Morgan's model offers a practical template upon which empathy in the classroom can be viewed and understood.

A similar study conducted by Kieran (1979) which is described by Goldstien and Michaels (1985) in their review as "a ground breaking effort" (p 155), describes both **HOW** and **WHAT** the empathic teacher communicates. She identifies six Process Categories in which she proposes "how" the teacher communicates empathy using the following techniques

Verification of the pupils feelings as perceived by the teacher,

Reflection of those feelings back to the child,

Acceptance of what the child is feeling in an overt statement by the teacher,

Open **Validation** of the pupils feelings and a response which encourages the pupil to **Extend** thinking about his/her feelings or actions

Prescriptions for coping with feelings in the future and their resultant actions are also suggested

Kieran introduces Content Categories in an attempt to explain *What* the teacher communicates in the classroom that is perceived as being empathic by the pupil. These categories are labelled as follows

- 1 *Child's psychological or emotional states of being*
- 2 *Child's physical state of being*
- 3 *Child's involvement in an activity*
- 4 *Child's possessions or products of activities*
- 5 *Child's coping with emotions or feelings*

In each of the above categories Kieran elaborates on the actual statements that the teacher employs in the ongoing classroom interactions and activities. She interrelates these with the Process Categories giving

a model which delivers a dynamic view of empathic communication and interaction in the classroom environment Interestingly Kieran also highlights the importance of the focusing on the physical state of the child, a point which was introduced in the definition put forward by the present research as a more accurate representation of what empathy really entails, than previous definitions offered (see, p 92, Chapter 4)

Both Morgan's (1979) and Kieran's (1979) models bear a remarkable although perhaps not surprising similarity in their characterisation of how classroom empathy is communicated, to how its manifestation is recorded in the psychotherapeutic situation The common use of techniques such as verification, reflection, unconditional acceptance of feelings and emotions, highlight the "helping" nature of the empathic teacher Kieran (1979) refers to the teacher as "a facilitator" who as in the other helping professions, forms a instrumental helping relationship with another human being helping him/her to grow and actualize

It appears that the behavioural descriptor link between empathic teachers and psychotherapists is quite similar Thus, it may be valid to suggest that empathic teachers would be especially effective in interacting with pupils who have particular educational difficulties which may be manifestations of emotional/psychological disturbances Indeed some

writers and researchers have already indicated that this may be the case. Christopher Nolan, the gifted handicapped writer in his autobiography "Under the eye of the Clock", explains how his teachers developed his confidence by their constant empathic efforts to decipher his coded mute communication. He writes of his teachers that he was "constantly amazed at the almost telepathic degree of certainty with which they read his facial expressions, eye movements and body language" (1987, p 26).

Hukill and Hughes (1983) in an address delivered to the annual meeting of the American Educational Research Association titled "*Teachers for Tomorrow*" speak of empathy as an important personal characteristic in successful teaching of the future. Arguing the relevance of empathy in the education of emotionally disturbed Morgan (1983) compared two models employed, namely the humanistic/psychoeducational approach and the behavioural/learning model. Using a sample of 96 emotionally disturbed children she found that the humanistic approach elicited more helping behaviours, self-control and responsibility from the children. Overall she declares that empathic interaction must be developed in the classroom if emotionally disturbed children are to be motivated in the classroom and in life in general.

Further evidence for this prescriptive application of empathy in education is offered by Scheuer (1971) who observed a positive relation between teacher empathy levels and student academic gain in a population of 278 secondary school, minority group students, described as emotionally disturbed. Stoffer (1970) similarly reports a positive relationship between teacher empathy and student achievement, adding in this case that it was the shy withdrawn children who responded to a greater degree to the empathic teaching style. Research on the origins of fear of school and school phobia has also revealed that teacher empathy and warmth may be the critical teacher characteristics which allay pupil fear and prevent phobic reactions (Ojanen, 1980).

To conclude, this chapter has reviewed the position of empathy in the educational setting. Research would appear to indicate that empathy is indeed an important influence in the classroom milieu and its presence can have significant effects not just on the communication climate but also on student motivation and learning. The manifestation of teacher empathic functioning in the classroom indicates a heavy communicational aspect concurrent with that observed in psychotherapeutic settings. These behaviours highlight the personal validation of the students experiences, and consequently empowering the student to review the difficulties they

are facing and to review their personal schemata (or self-conceptions) in a more positive achievement oriented fashion

5.4 LITERATURE SUMMARY

The research proposal thus far has reviewed the difficulty facing research based in educational settings, taking into account the complexity of the institutions and the problems associated with evaluating the *correct* outcomes. In Chapter One, a review indicated that some theorists had identified certain objective variables which could be acknowledged as accounting for much of the variance in the learning that takes place in the classroom. In particular, the Theory of School Learning posited by Benjamin Bloom (1976) was considered as a vehicle in which it would be possible to review the specific learning mediators which appear to most influence school learning rates. These variables were identified as a student's cognitive learning history (cognitive entry characteristics) and their motivational orientation at the time of facing the task presented (affective entry characteristics).

In Chapter Two, it was indicated that Bloom's understanding of the components of cognitive entry characteristics was not as complete as perhaps it is understood to-day. The ensuing review looked closely at the cognitive factors that appear to influence mathematics attainment.

Specifically, it analysed measured Mathematical Aptitude and the actual cognitive processes a student employs when solving mathematics problems. Thus it was surmised that in mathematics the relevant cognitive entry characteristics could be characterised by the student's efficiency and proficient utilisation of mathematical problem-solving schemata. However, while this cognitive schematic processing was identified as a significant factor in mathematical task performance, it also became clear that these processes were not entirely devoid of affective input.

In Chapter Three, these affective mediators were reviewed under Bloom's heading of Affective Entry Characteristics. In essence, Bloom was referring to the impact motivational variables have on effective school learning. The review expressly studied Bernard Weiner's (1986) *An Attribution Theory of Motivation and Affect*, particularly the affective influence one's self-conception has on the approach to a learning situation. The structure of Self-concept was detailed and the influence of a past history of success or failure in mathematics was described in terms of a student's appreciation of the effort, ability, control, responsibility and so forth required in a performance situation. Chapter Three closed with the conclusion that an individual's self-concept, which was characterised as a leading indicator of one's affective entry characteristics, is in fact an alterable structure in certain circumstances.

It was suggested that one of the circumstances that such change in student self-concept may occur was with the diligent intervention of a teacher who had a highly developed ability to understand the anxiety, problems or needs of a student in difficulty in mathematics. This ability to be at one with the student's plight could be described as empathic responding on the part of the teacher. Chapter Four considered in detail the background, the definitions, the history and development, personality differences and associated behaviours, of Empathy

Chapter Five aimed to pull together the understanding gained about cognitive and affective entry characteristics and introduce the potentiality that teacher empathy may in the appropriate circumstances influence in a positive way a student's self-concept and consequentially perhaps cognitive entry characteristics also. The implication is that a teacher who manifests a high level of empathy can identify and relate readily to students when they are having problems learning mathematics (although the students need not necessarily be finding difficulty with learning for the teacher to empathise with them). This empathic relating leads to the teachers being able to understand from the students' perspective the difficulty they face and thus the appropriate action needed to alleviate this obstacle. This empathic behaviour should lead to an elevation in the level of student confidence and thus motivation in the subject. As seen in Chapter Two anxiety can play a significant role in the mediating of

specific problem-solving skills. Therefore, with this level of anxiety diminished by empathic teacher behaviour, increased level of cognitive functioning may also be possible. A detailed theoretical hypothesis obtained from this review will be outlined in full at the beginning of Chapter Six (Methodology).

CHAPTER SIX

6 0 RESEARCH HYPOTHESIS

This study thus far, has outlined aims to integrate the current literature on cognitive and affective factors influencing school-based learning, particularly in mathematics. This integration of the literature has indicated that a student's affective predisposition to a subject or task can have significant potency in their performance level. Some evidence has indicated that these affective (and indeed cognitive) factors are not invariant and can be modified with certain treatment interventions. The evidence reviewed indicated that the concept of effective teaching empathy could play a pivotal role in the positive conversion of affective factors (and thereby cognitive factors) which impact upon student mathematics task performance. These separate strands of the research literature together prompt the explicit research study objectives which can be outlined as follows

It is hypothesised that :

A: Teaching empathy will have a positive influence on the mathematics learning outcomes (as determined by an assessment test of a specific Sets & Venn Diagrams module covered) of first year of second level school students

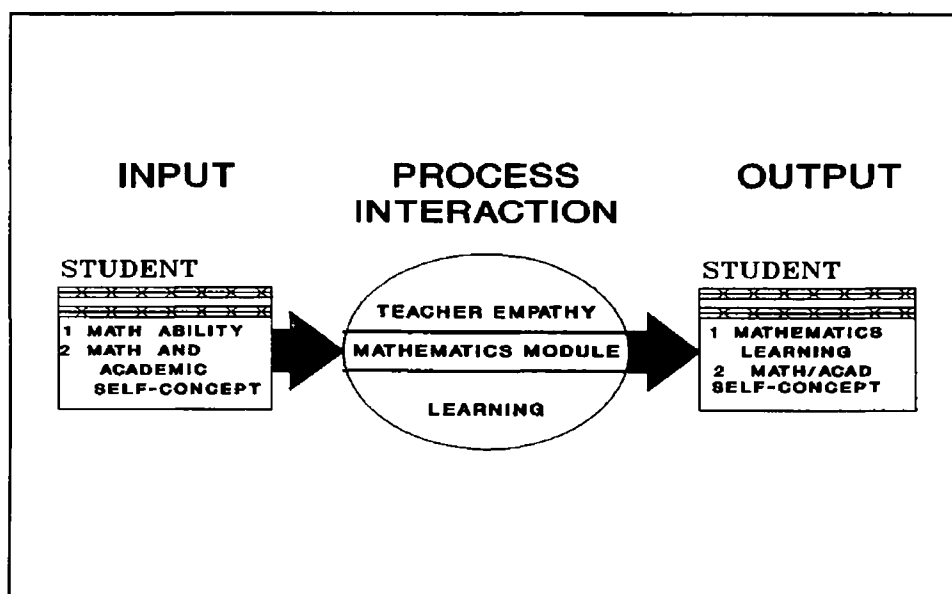
B: Teaching empathy will have a significant positive influence on the mathematics self-concepts and general school self-concepts of these student

The following is a description of the methodology employed in this research study including the sample population used, the tools used to measure the sundry variables seen as important in the study, the research execution and response rates. This methodology is divided into four separate sections to facilitate a progressive appreciation of the intricacy of the research proposition. These sections begin firstly with a general outline of the steps taken to investigate the validity of the stated hypothesis. The second section examines the experimental sample selection and sampling procedure. The third segment of this chapter examines the design and development of the various questionnaires and tests employed to measure the variables alluded to in the first section of this chapter. The final short section gives an overview of the administrative procedure undertaken in the implementation of the two phases of the research progression.

6 1 THE EXPERIMENTAL SETTING SUMMARISED

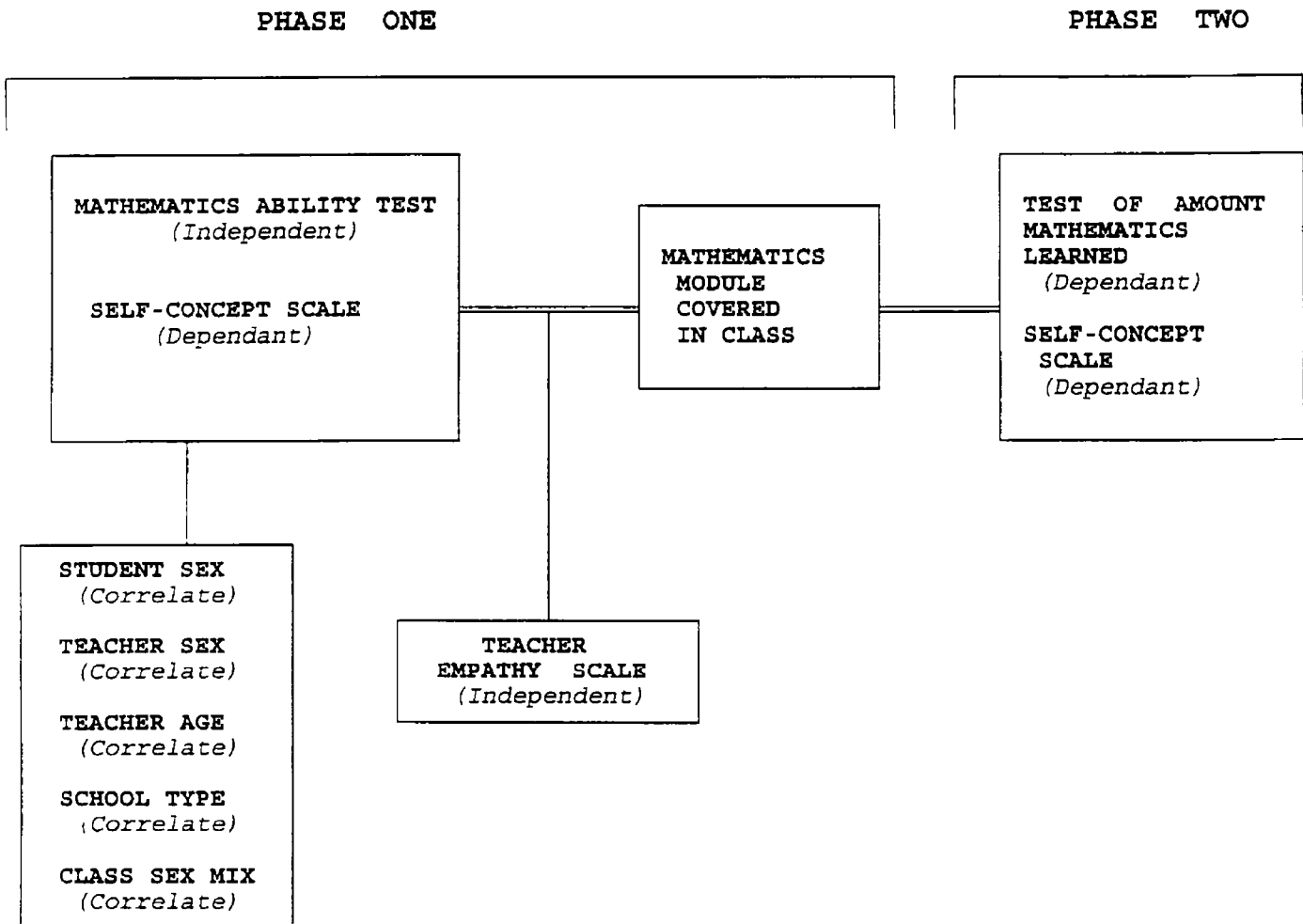
This study draws data from the real world educational setting in a two phase, input, process, outcome type model as could be seen from the shape of the literature described in the first five chapters. The setting is characterised graphically below in Figure 4. Although rudimentary in manner, this representation allows one view the research process as a three phased procedure, or similar to an Aptitude Treatment Interaction (ATI) study model as referred to in Chapter Two. Essentially this separates the educational process into three distinct (although not detached) steps, where measures of student variables are taken before they enter the learning situation, measures are taken of characteristics or treatments at work in the educational process and finally outcome variables are measured after the educational process has been completed.

Figure 4 ATI Process Conceptualisation



While this model demonstrates the progression of both data collection and the process of student learning, it does not cover the complexity of some of the variables accounted for. In an effort to summarise these intricacies, Figure 5, below outlines the nature of the variables measured in the present research and at which phase of the study they were appraised.

Figure 5 . Research Variables by Phases



This depiction better demonstrates the dependant aspect of some variables and the independence of others and at which phase of the research these combine. This template allows us review these variables and their measurement from a methodological perspective in the present chapter.

The diagrams indicates clearly that the data collection study was carried out as a two phased project. The first of these two phases was what ATI studies would identify as the Aptitude measurement phase. A selected school population was assembled for participation in the study (this population and their attributes will be presented in full in the next section). Using the ATI model, student Mathematics ability was measured in the first phase, as a relative temporal constant (a complete description of this test will be given in section three of this chapter). Along with mathematics ability student self-concept in the areas of mathematics and general academic motivation were also measured (the tests of student self-concept will be introduced and discussed in section three of this chapter). These measures of mathematics and general academic self-concept are perceived to be dependant in nature in their interaction with the independent measure of Teaching Empathy.

At this phase, participating teachers were also asked to accept the test of Teaching Empathy, and were asked to administer it to their students at some later stage, preferably two to three weeks subsequent to the

administering of the self-concept scales (the design and development of this Teaching Empathy test will be described in full in section three of this chapter)

Phase one was completed with the administration of these tests. Phase two did not commence until the learning task central to the study was completed. This learning task, the Sets and Venn Diagrams section of the New Junior Certificate mathematics course, generally covered by most schools in the first few months of students' first year in second level education (the module is described more fully in section three of this chapter). Once this module was completed, the schools were contacted again and phase two of the study was put into operation.

Phase two consisted of returning to the schools once the mathematics module was completed (roughly between a month and two months) and administering a *mathematics learned test*, based on the course covered. This multiple choice test (see section three of this chapter for fuller description) was also viewed as a dependant outcome upon which the independent teacher empathy score would have an influence. After the mathematics test was completed by students they were then asked to complete the two self-concept scales again to measure any increment in student self-concept regarding mathematics and general academic motivation.

Students entered replies or answers to all tests or scales on a special Answer Card provided (see Appendix A). As each student's replies were confidential on all tests they were allotted a number rather than have to write their names on their answer card. This Answer Sheet format held for all tests and questionnaire excepting the Mathematics ability test. To complete this students entered their answers in the space provided on the test sheet itself.

Teachers (population described in full in the next section) who were administering the tests were met individually and given a comprehensive briefing on test administration and procedure and an extensive booklet which outlined the step by step procedures was distributed (see Appendix B).

In addition to this the sex of the teachers and students involved in the study were closely matched as correlates in the study. Also recorded as correlates were the type of school the students and teachers were attached to and the particular syllabus each teacher followed. As there was a wide range in the age of the teachers participating in the study it was also decided that teacher age should also be measured as a correlate. The type of school is of particular importance in an Irish setting as research has indicated that different school types attract different student socio-economic background populations. Factors such as these can further have

an influence on student motivation and attainment. To deal with this fully Appendix C contains a section which describes the historical and educational links the different school types have on Irish educational organisation. Issues such as school ethos, school management structure, subject availability, student selection, single sex or co-educational make up are discussed in this appendix.

To summarise the methodological procedure, the following outline indicates the progression of the study and the procedural sequence of the data collection through several phases.

PHASE ONE Participating teachers were asked to administer the following:

- (a) The Mathematics Ability Test
- (b) The Self-Description Questionnaire

A few weeks later than the above:

- (c) The Student-Teacher Interaction Questionnaire was administered. The rationale behind this delay in administering the STIQ was that it would give students a chance to adapt to the new school environment before they assessed their teachers' interaction type.

PHASE TWO When, as described, the teachers had completed the Sets and Venn Diagrams module of the mathematics course they were asked

to initiate the second phase of the study This involved the administration of the following tests

- (a) The Test of Mathematics Learned during the experimental period
- (b) The Self-Description Questionnaire

When each school had completed the two phases of the study the completed packages were collected from the schools

The following sections will look more closely at the sample structure of this study, and the design of the various measurement instruments employed in the completion of the research

6 2 STUDENT SUBJECT SAMPLE

The sample subjects involved in this research were (387) students, all of whom were in their first year of study at Second level education The age range of these students lay inside a spread between 12 0 years and 13 8 years of age

The sex ratio breakdown of this student group was 206 female (53%) to 181 male (46%) In total sixteen separate class groups were involved in the study emanating from sixteen separate schools in the Greater Dublin area

As stated all students were at a common stage in their education, beginning their first year in second level education embarking on the new three year Junior Certificate course (commencing Sept 1990) Specifically all students were beginning for the first time the New Junior Certificate Mathematics course, which should follow a three year timetable to completion

It is important to record that students had just begun their first year in the second level education system, which is widely reported as a period of heightened anxiety for many students (see Marsh, Smith, Marsh & Owens, 1988) This period of heightened anxiety appears to imply that students would be very sensitive to characteristics of their new teachers and a teacher with positive levels of empathy may be especially constructive in aiding student integration The fact that students had just entered the second level school system, signified that these students had no prior teaching experience of their new teachers Thus they would have no preconceived attitudes toward these teachers resulting from previous experience Therefore any opinions they formed would be based on their experiences in the first few weeks of their educational experience with these new teachers This factor was considered helpful in that with no previous experience of their new teachers (particularly their mathematics teacher) the students' analysis of their teachers' empathic behaviour would be uncontaminated by prior euphoric or dysphoric

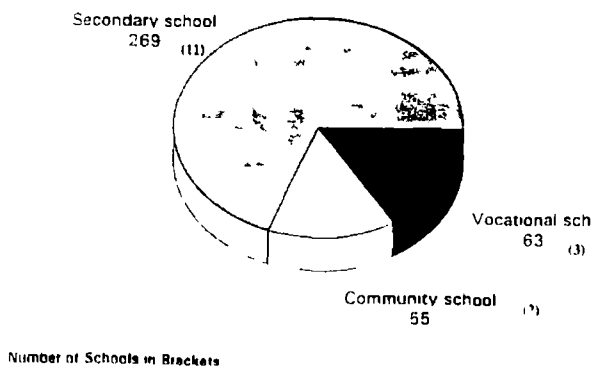
experiences which may have had little to do with any teacher empathic behaviour

The fact that students were just beginning in their new schools indicated that while they may have had preconceived attitudes towards mathematics in their old schools the new environment and new teachers would give them a chance to reappraise these opinions

6.3 SCHOOL SAMPLE AND TYPE

As stated 12 schools in the greater Dublin region participated in this study. While school and teacher participation was voluntary, effort was maintained at all times to have a representative sample of the school classification and distribution that exists in the greater Dublin region. To this end the school sample consists of eleven Secondary schools, two Community schools/colleges, and three Vocational schools (see Figure 6, below)

Figure 6 School Classification Breakdown



In an Irish context the representation of school type or classification in an educational research study can be of significant importance for historical reasons and for variations based on ethos, curriculum and student enrolment policies of these different school types. As these are distinctions which some researchers would view as having significant mediating effects on student achievement, it is necessary to understand and be cognisant of the background and trends of present day Irish school classification (see Appendix C for a detailed overview of the Irish school classification)

The student sex breakdown across the three school classifications was as follows

TABLE 1 STUDENT SEX BREAKDOWN BY SCHOOL TYPE

| SCHOOL TYPE | MALE | FEMALE | TOTAL | % OF TOTAL |
|-------------------|------|--------|-------|------------|
| SECONDARY | 111 | 157 | 269 | 69.5% |
| VOCATIONAL | 41 | 22 | 63 | 16.3% |
| COMMUNITY | 29 | 26 | 55 | 14.2% |
| TOTAL | 181 | 206 | 387 | 100% |
| % OF TOTAL | 47% | 53% | | 100% |

6.4 TEACHER SAMPLE

A total of 16 separate Teachers of Mathematics participated in this study. While there was a considerable range in the ages of the teachers (20 years to 45 years), the mean age was relatively young at 30.25 years. The sex breakdown ratio was rather more even with 7 male teachers and

9 females (44 % to 56%). As participation in the study was entirely voluntary it could be suggested that teachers who were confident of their ability and relations with their classes would volunteer before teachers who were less confident or saw themselves as less successful. To counter this possible mediator of data trends, specific strategies were developed to introduce teachers who were more anxious about participation to the study. The success of these strategies resulted in a more balanced teacher response sample. The following table overleaf (Table 2) gives a comprehensive summary of the teacher sample composition and their chronology.

TABLE 2. Individual Teacher Sample Assignations

| TEACHER Number | SEX | SCHOOL TYPE | CLASS SEX MIX | AGE in Years. |
|----------------|--------|-------------|---------------|---------------|
| 1 | Female | Secondary | Female | 20 - 25 |
| 2 | Female | Community | Mixed | 20 - 25 |
| 3 | Female | Secondary | Female | 26 - 30 |
| 4 | Male | Secondary | Male | 31 - 35 |
| 5 | Female | Community | Mixed | 41 - 45 |
| 6 | Female | Secondary | Female | 20 - 25 |
| 7 | Female | Secondary | Female | 20 - 25 |
| 8 | Female | Secondary | Female | 20 - 25 |
| 9 | Male | Secondary | Male | 26 - 30 |
| 10 | Male | Secondary | Male | 31 -35 |
| 11 | Male | Vocational | Male | 26 - 30 |
| 12 | Female | Secondary | Female | 36 - 40 |
| 13 | Male | Vocational | Mixed | 36 - 40 |
| 14 | Male | Vocational | Mixed | 41 - 45 |
| 15 | Male | Secondary | Male | 31 - 35 |
| 16 | Female | Secondary | Female | 31 - 35 |

6 5 INSTRUMENTS EMPLOYED

6 5.1 The Self-Description Questionnaire II (SDQ-II)

This instrument developed by Herbert Marsh is designed to measure, specifically, the self-concept of early adolescents (see, Marsh, 1990)

The instrument utilised was developed from an earlier version which was somewhat longer than the present form (see, Marsh, Parker, & Barnes, 1985) The present (1990) form was developed using the responses of 5,494 students (2,658 males and 2,836 females) from Sydney, Australia

The population age group was between the ages of 11 and 14 years The SDQ is designed to measure the multi-faceted, hierarchical model of self-concept proposed by Shavelson, *et al* , (1976) and treated in full in Chapter Three of this study

The full SDQ-II consists of 102 items, which assesses three areas of academic self-concept and seven areas of non-academic self-concept and general self-concept The scores from these 11 scales when aggregated yield the Total Self-Concept score The SDQ-II was devised specifically for use with young adolescents of an age corresponding to that of first year Irish second level entrants A list of the scales and their descriptors are outlined overleaf

Chapter Six - Methodology

The scales and descriptions are as follows

| SCALE | DESCRIPTOR |
|-------------------------|--|
| Physical Abilities | Skills and interest in sports and physical activities |
| Physical Appearance | Physical Attractiveness |
| Opposite Sex Relations | Interactions with peers of the opposite sex |
| Same Sex Relations | Interactions with peers of the same sex |
| Parent Relations | Interaction with parents |
| Honesty Trustworthiness | Trustfulness and dependability |
| Emotional Stability | Emotional well being and freedom from psychopathology |
| Mathematics | Ability enjoyment, and interest in mathematics and reasoning |
| Verbal | Ability enjoyment and interest in English and reading |
| General School | Ability enjoyment and interest in school work |
| General Self | Self worth self confidence self satisfaction |

Students are given a statement regarding one of the 11 scale dimensions,

e.g.

" I often need help in Mathematics"

They are asked to place a tick in a box under one of six possible answers

These are

False (1)

Mostly False (2)

More False Than True (3)

More True Than False (4)

Mostly True (5)

True (6)

Each reply carries a score, cited in brackets above, which are aggregated to give the Self-concept score. Thus for each of the scales Mathematical Self-concept and General School Self-concept the lowest possible score would be 10 and the highest possible score would be 60. (The SDQ II in full is listed in Appendix D1)

In the present study the two Scales of the SDQ II that were employed were the

(a) Mathematical Self-concept and

(b) General School Self-concept

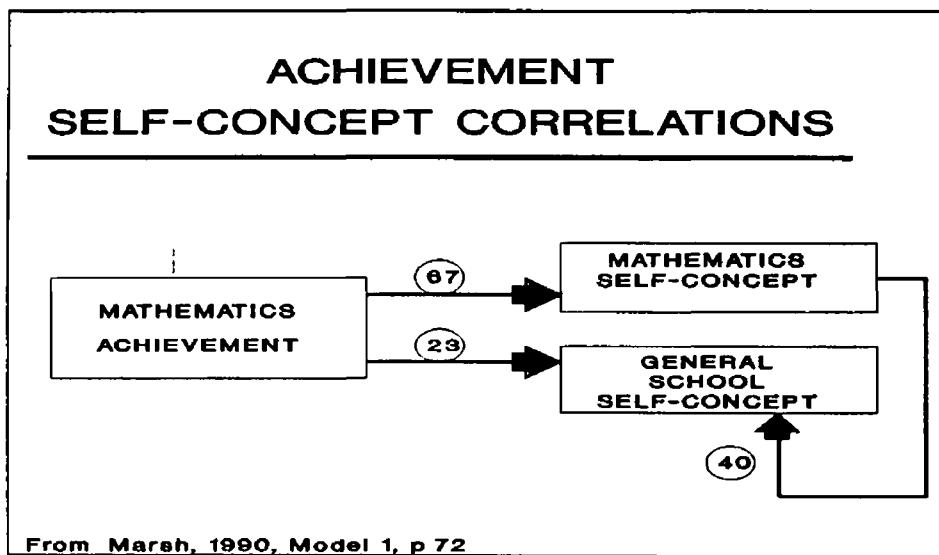
The justification for measuring just these two facets (see, Appendix D2) of Self-concept are as follows

(1) The Correlation between several independent facets of self-concept and Academic achievement are quite low, e.g. Physical Abilities and Maths achievement ($r = -0.08$). Thus many of these scales would be quite irrelevant to overall causative factors mediating academic achievement

(2) The time factor involved in the completion of the entire 102 item scale would be prohibitive in this study as it depended on the voluntary co-operation of teachers. Some reticence was expressed by teachers early in the study largely centred on concern regarding the amount of time the research would demand from the set amount of time they felt they had to complete the determined syllabus requirements.

(3) The correlation between General school achievement and Mathematics achievement and Mathematical and General Self-concept are the most marked of all the inter-correlations (see Figure 7).

Figure 7 SDQ II Dimension Intercorrelations



As the study is specifically interested in the influence of teacher Empathy particularly on Academic Self-concept and importantly Mathematical Self-concept, it was regarded that it would be sufficient to measure just these two scales alone of the Self-Description Questionnaire. The reliability and validity of such a measure are vitally important to the application of any conclusions drawn from these. The established criteria for the reliability and validity of the Self-Description Questionnaire are outlined in the following sections.

6.5.1.1 *Reliability of the SDQ*

The reliability of the SDQ is cited by Marsh (1990) as being firmly established by the research which highlights the internal consistency of the item responses of the instrument. Coefficient Alphas of the scales are positive with a median = .86. Specifically the Coefficient Alphas reported by Marsh for Mathematical Self-concept = .90 and for General School self-concept = .87. For the purposes of this study Coefficient Alphas were calculated for the **Irish population** surveyed and proved very similar to Marsh's findings. For the Irish population the Coefficient Alphas for Mathematical Self-Concept = .87 and for General School Self-Concept = .84.

Marsh expands to cite research which indicates that the intercorrelation between items within each scale are high, thus indicating that each

individual item is significantly correlated with other items designed to measure the same facet of self concept. This is demonstrated by the corrected item scale correlations which vary from .35 to .85, with a median of .61.

The second factor which contributes to the reliability of the SDQ-II is the reported (Marsh and Peart, 1988) internal consistency and stability over time, with short term stability coefficients recorded with a median = .79.

6.5.1.2 *Construct Validity*

Self-concept as a hypothetical or theoretical construct depends very much on construct validation research to verify the existence of the conceptualisation. Both Nunnally (1978) and Anastasi (1976) in their treatise on construct validity, highlight the importance of using several important and differential approaches in the validation process. These approaches include the use of methods such as Multitrait - multimethod analysis, Factor analysis and the relationship with other tests which measure similar accepted theoretical hypothesis. Intrinsic in this research approach is the fact that Self-concept is understood to be a multidimensional construct. The research studies employed to assess validity included within-network and between-network studies. The within-network studies explored the multidimensionality, and indicated the consistency and distinctiveness of the separate components. Factor

analytic studies (see, Marsh, 1990) revealed correlations of less than .20, demonstrating the distinctiveness of the SDQ II factors

6.5.1.3 *Sex Effects and the SDQ-II*

In a comprehensive review of research on Self-concept, Wylie (1979) summarised that while there appeared to be little evidence to suggest significant sex differences in overall Self-concept scores, this may belie sex differences that may exist in individual scale or component areas. There does appear for instance to be specific component sex differences in self-concept scores in areas such as more positive mathematics self-concept for boys in adolescence. This area has been comprehensively in Chapter Three (p 75/76)

Much of the research on sex differences in personality theory indicate sex differences are in evidence across certain facets of the individual at different developmental periods of an individual's life. Marsh has integrated such variances into the development of the SDQ II noting the consistency of stereotypic sex differences across the various scales. In this instance Marsh notes that accepted societal and empirically indicated sex differences exist across the data sets

- " (a) Boys have higher Physical Abilities, Physical Appearance, and Mathematics Self-concepts
- (b) there are no sex differences for the Parent Relations scale "

(c) girls tend to have higher Verbal Self-concept at the preadolescent \adolescent phase and higher General school Self-concept later in adolescence

As a result of these measured differences which are gender related, the SDQ-II has been developed with separate norm tables for males and females

6.5.2 The Student-Teacher Interaction Questionnaire

6.5.2.1 *Stages in Instrument Development*

As discussed in Chapters Four and Five the measurement of the concept of Empathy has been a contentious issue in recent psychological research. The affective-cognitive debate ruled much of the research into empathy measurement over the last few decades. With Davis' (1983) multidimensional construct, new movement in the measurement of empathy was initiated. However while Davis' Interpersonal Reactivity Index does measure cognitively and affectively a person's empathic bearing, it lacks specific application in the educational environment in which this study concentrates. An additional problem with many of the published tests of empathy available were the definitional differences that existed between them and the delineation of empathy characterised in this study (see, p 90, Chapter 5)

Due to this apparent lack of accurate indicators of teacher empathy in psychological literature, it was deemed necessary to develop in the educational setting an instrument which would effectively measure the concept

The evolution and development of the Student Teacher Interaction Questionnaire (STIQ) was a distinct four phased process

PHASE ONE The first phase was initiated with the objective of ascertaining, directly from the receivers of education (the students) their perceptions and experiences of a "Good Teachers Behaviour"

Specifically the aim was to elicit from students an account of the behaviours *they* perceived as good teacher behaviours in the classroom. In essence it was decided that no finer restraints would be exerted on students other than asking them to outline the behaviours they noticed a good teacher exhibiting. The definition of a good teacher was left to the individual discretion of the student respondent. The reasoning to this is firmly based in one of the maxims of Cognitive Functionalism, that every persons reality is a Perceived Reality and to define a perception such as Good Teacher Behaviours would be impeding a student's perception of their reality.

Procedurally phase one involved enlisting the co-operation of 12 Schools Guidance Counsellors in twelve second level schools. The schools involved came mainly from the Dublin City region, with a school from Co. Kildare and Co. Longford also employed. A total of 421 students took part in the exercise, 232 females and 189 males. The school classification types were:

6 Vocational schools

5 Secondary schools

1 Community College

Each Guidance Counsellor was tutored in the objective of the exercise and the importance of a standardised approach to the exercise. Procedurally the students were introduced to the fact that they were taking part in an educational research project which was aiming to isolate the behaviours which characterise good teachers. It was seen as important that the students understood the objective of the process and be relaxed while participating. Thus the use of School Guidance Counsellors, trained in counselling and facilitation techniques, was seen as a positive mediator in achieving this warm and acceptive atmosphere.

Each student was given a prepared sheet with the heading

"Write out in point form the things a Good Teacher does in your experience" This instruction was also verbally introduced by the

Guidance Counsellor as "writing down the things good teachers *do* in the classroom"

The students were allowed 15 minutes to complete the task. If students found it difficult to identify behaviours of good teachers, rather than not contribute, they were encouraged to identify the *Behaviours Bad Teachers* exhibited.

All student responses were anonymous and it was only necessary for students to identify their sex on their response sheets. Some of the participating Guidance Counsellors found the exercise initiated a progressive group discussion on teacher student interaction and understanding.

PHASE TWO This phase involved the collation of data received from the 421 students which involved nearly 2,600 identifiable behavioural descriptions. A frequency table of these behaviours revealed after categorisation a list of 108 popularly reported perceived behaviours. Of these 25 were reported 686 times. These 25 behaviours were identified as the most important to students. The behaviours of good teachers, reported with such frequency are (frequencies in brackets)

Listens to what students have to say [41]
Allows you ask questions [12]
Explains material clearly and thoroughly [75]
Takes a good humoured approach to the class [18]
Helps students according to their needs [12]
Treats all students equally [46]
Does not take his/her bad mood out on the class [12]
Does not embarrass a student in front of the class [13]
Communicates well [15]
Can have and take a joke in class [79]
Helps you with your work [16]
Treats students as adults\equals [39]
Talks with you individually [16]
Shows interest in student well-being [16]
Allows students speak freely about opinions [17]
Helps sort your problems without a fuss [29]
Makes sure everyone understands material [24]
Is open to go to for advice [11]
Makes you feel you can talk to him/her anytime [15]
Treats you with respect [27]
Gives a fair amount of homework [28]
Understands the needs of each student [34]
Can control a class without preaching [35]
Encourages you [12]
Makes their subject interesting and alive [43]

PHASE THREE The 25 behaviours mentioned were presented to 7 Educational Psychologists who reviewed the behaviours and identified those which were most empathically laden. This method follows the *Delphi* technique of qualitative data evaluation. The definition of empathy they were asked to employ was that outlined earlier (Chapter Four, p 90)

Procedurally the psychologists were asked to rate the empathic base of each of the 25 behaviours on a 1 to 9 scale (1 = Extremely Unimportant

empathic base to 9= Extremely Important empathic base) The rationale for employing such a wide spread 9 point rating scale was effort to distil an accurate and sensitive representation of the experts appraisal of the empathic content of each of the behaviours (see Appendix E) Additional comments or suggestions on descriptor form were also elicited from the psychologists at this stage

The ratings by the 7 independent psychologists were remarkably consistent From the 25 listed items they rated 15 as being highly empathy laden (inter-rater reliability > 88%) The majority of these 15 behaviours scored mean between 7 and 9 on the rating scale

The 15 behaviours selected were introduced into likert scale format with the polar cues spread from *Never Present* to *Always Present* This scale was piloted on a sample of 181 inner city Dublin students to ascertain the appropriateness of the style and language used Also of particular concern was the format of the instructions to students on the method of scale completion, and how students interpreted these From this survey three of the items were reviewed and changed slightly to make them more readily understandable There were also changes made to the explanatory introduction and instructions given to the students on Questionnaire completion procedure A series of student comments and opinions were

also recorded regarding the style of the scale and were integrated at a later stage into the administer's guide on procedure

The final draft of the Teacher Student Interaction Questionnaire (see Appendix F) still retained 15 items and was presented in a two page format

6 5 2 2 *Reliability of the STIQ*

The reliability of the STIQ was established on the internal consistency of the scales items Using the total sample described earlier the Cronbach Coefficient Alpha for the scale as a whole was .85

Further to this evidence of internal consistency intercorrelations among the responses to scales items These are outlined in Table 3 below

The item means and standard deviations as well as the corrected item-scale correlation which, demonstrates the correlation between an item and the sum of responses to other items in the same scale, are also presented

The corrected item-scale correlations range from .35 to .66 (disregarding item 6 for the moment as it will be discussed later) with a median of .51

These statistics support the internal consistency of the STIQ, indicating that each item is significantly and substantially correlated with the other items in the scale designed to measure teaching empathy

Table 3 Item Statistics of the STIQ

| ITEM | MEAN (SD) | ALPHA IF ITEM DELETED | CORRECTED ITEM TOTAL CORR | CORRELATION AMONG ITEMS | | | | | | | | | | | | | | |
|------|--------------|-----------------------------|------------------------------------|-------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 1 | 3.2 (1.2) | 85 | 44 | | .52 | .21 | .24 | .23 | 06- | .14 | .34 | .15 | .29 | .22 | .35 | .32 | .32 | .36 |
| 2 | 3.3 (1.3) | 84 | 56 | .52 | | .31 | .39 | .33 | .05 | .20 | .33 | .18 | .40 | .28 | .40 | .41 | .36 | .41 |
| 3 | 3.6 (1.4) | 85 | 47 | .21 | .31 | | .27 | .32 | .09 | .20 | .15 | .25 | .29 | .28 | .26 | .30 | .20 | .28 |
| 4 | 3.9 (1.2) | 84 | 51 | .24 | .39 | .17 | | .41 | .13 | .23 | .39 | .31 | .33 | .33 | .31 | .43 | .37 | .39 |
| 5 | 3.7 (1.3) | 83 | 65 | .23 | .33 | .32 | .41 | | .02 | .27 | .39 | .27 | .49 | .59 | .46 | .48 | .51 | .44 |
| 6 | 2.7 (1.5) | 88 | 1 | .02 | .05 | .10 | .13 | .02 | | .21 | .11 | .25 | .04 | .05 | .05 | .12 | 06- | .11 |
| 7 | 4.2 (1.1) | 85 | 35 | .14 | .20 | .20 | .23 | .27 | .21 | | .28 | .25 | .1 | .30 | .27 | .33 | .22 | .39 |
| 8 | 3.3 (1.3) | 84 | 55 | .34 | .33 | .15 | .39 | .39 | .11 | .28 | | .30 | .39 | .33 | .33 | .49 | .52 | .30 |
| 9 | 4.1 (1.2) | 85 | 41 | .15 | .18 | .25 | .31 | .27 | .25 | .25 | .30 | | .24 | .31 | .32 | .32 | .39 | .34 |
| 10 | 3.0 (1.3) | 84 | 57 | .19 | .40 | .29 | .33 | .49 | .04 | .1 | .39 | .24 | | .42 | .46 | .41 | .46 | .36 |
| 11 | 3.7 (1.3) | 84 | 62 | .1 | .28 | .28 | .33 | .59 | .05 | .30 | .33 | .31 | .42 | | .51 | .49 | .46 | .55 |
| 12 | 3.6 (1.2) | 84 | 62 | .35 | .40 | .26 | .31 | .46 | .05 | .27 | .34 | .32 | .46 | .51 | | .51 | .41 | .45 |
| 13 | 3.6 (1.4) | 83 | 66 | .32 | .41 | .30 | .43 | .48 | .12 | .33 | .49 | .32 | .41 | .49 | .51 | | .51 | .44 |
| 14 | 3.3 (1.4) | 84 | 63 | .37 | .36 | .0 | .37 | .51 | 06- | .12 | .51 | .39 | .46 | .46 | .41 | .52 | | .33 |
| 15 | 4.4 (1.0) | 84 | 54 | .6 | .31 | .18 | .29 | .44 | .11 | .39 | .30 | .34 | .26 | .55 | .45 | .44 | .33 | |

(- AFTER THE CORRELATION IMPLIES A NEGATIVE CORRELATION)

6.5.2.3 Validity of the STIQ

Construct validity for the STIQ was approached using one of the approaches suggested by Anastasi (1976), namely factor analysis

While on its own this approach does not assure validation, it does however give an insight into the factor structure of the teacher empathy measure and thus deliver insight into what exactly is being measured

While factor analysis is only one of the many varieties of method of investigating a construct's validity, methods such as relations with other tests was deemed inappropriate as other tests of empathy did not review the construct in an educational setting (e.g. the Thematic Apperception Test TAT). Indeed many of the tests reviewed focused on the prosocial aspect of empathy. Also problematic with relating the STIQ with other tests of empathy was the variance in definitions used by the authors of the other tests. Some were so either affectively based (e.g. Mehrabian & Epstein, 1972) or cognitively based (e.g. Dymond's Scale for the measurement of Empathic Ability, 1949) that they did not appear to measure the same construct the present study is reviewing (see definition p 90, Chapter Four).

Factor Analysis looked at the within network form of the STIQ. It was speculated originally that the operational behaviours of an empathic teacher would include some of the following characteristics:

Exceptional Communication skills

Exceptional Ability to Transfer the Subject matter being taught

An Exceptional Sensitivity to Individual Student well-being

With these characteristics in mind a factor analysis was conducted on the scale using the subject pool of 387 described earlier in this chapter.

Chapter Six - Methodology

The analysis used iterated communality estimates, and Kaiser Normalisation with an oblique rotation

The Factor Structure Matrix is displayed in Table 4, below and gives an insight into the emergent factor structure of the STIQ

Table 4 Factor Analysis for the STIQ

| STIQ ITEMS | FACTOR 1 | FACTOR 2 | FACTOR 3 |
|--|----------|----------|----------|
| 1 WILL TALK TO ME INDIVIDUALLY | 241 | 032 | 774 |
| 2 ENCOURAGES ME | 404 | 031 | 783 |
| 3 CAN CONTROL A CLASS WITHOUT DIFFICULTY | 485 | 114 | - 341 |
| 4 TREATS ME WITH RESPECT | 464 | - 298 | - 567 |
| 5 COMMUNICATES WELL | 798 | 076 | 413 |
| 6 DOES NOT EMBARRASS A STUDENT IN FRONT OF THE CLASS | 039 | 802 | 036 |
| 7 ALLOWS ME TO ASK QUESTIONS | 438 | 561 | 167 |
| 8 MAKES IT EASY FOR ME TO TALK THEM ANYTIME | 457 | - 337 | 642 |
| 9 TREATS ALL STUDENTS EQUALLY | 462 | - 535 | - 291 |
| 10 MAKES THE SUBJECT INTERESTING AND ALIVE | 602 | 104 | 583 |
| 11 EXPLAINS MATERIAL CLEARLY AND FULLY | 825 | 185 | 307 |
| 12 UNDERSTANDS THE NEEDS OF EACH STUDENT | 686 | 159 | 507 |
| 13 HELPS ME SORT OUT MY PROBLEMS AND DIFFICULTIES | 670 | 315 | - 586 |
| 14 IS OPEN TO GO TO FOR ADVICE | 619 | 233 | - 594 |
| 15 MAKES SURE EVERYONE UNDERSTANDS THE MATERIAL | 687 | - 372 | 281 |

As can be seen from Table 4 the STIQ the coefficients in Factor 1 for items 3, 5, 10, 11, 12, 13, 14, 15, are quite high indicating a solid loading on this factor (this was also the case in the factor pattern matrix indicating the regression coefficient) with coefficients within the range 49 to 83. When the items were analysed closely for common base, it was clear that most of these items referred to particularly supportive teaching style, involving clear communication and clarity and verification of student comprehension of material taught. From this it was decided to label Factor 1 "*Supportive Teaching Style*".

STIQ Items 1, 2, 4, and 8 loaded highly on a separate factor, with coefficients ranging from 64 to 78. An analysis of these items indicated a clear personal, individual interest and communication set of behaviours by the teachers. It was decided to label this factor, Factor 2, "*Personal Focus of Teacher*".

The third factor identified included STIQ Items 6, 7, and 9. The analysis of these items failed to offer any immediate commonality. The analysis was tempered by the knowledge that item 6, *My teacher does not embarrass me in front of the class* when isolated proved to be a maverick item. This became clear as, mentioned earlier when evaluating the internal consistency of the STIQ, as this item had a very low corrected item-total correlation score. This implied that the correlation between the

item and the sum of responses to other items in the scale was insignificant. Thus the item is not correlated with the other items in the scale designed to measure teacher empathy. An analysis of the raw data responses for item 6 showed the lowest mean of any item in the scale. This implied that many of the teachers evaluated did in fact embarrass students in front of the class. A possible solution to this anomaly was that students were confused by the negative aspect of the item and treated it as a positive statement in their answering format. The consequence of this anomaly is that item 6 is not a reliable scale item and thus Factor 3 was deemed to be too circumstantial to include independently as a factor variable.

An intercorrelation between Factor1 and Factor2 was $r=0.66$, which while significant is decidedly smaller than the Coefficient Alpha estimate of reliability $=0.85$. This indicates some degree of independence between the factors.

6.5.3 Mathematics Ability Test

In Chapter Two, the relevance of a measure of mathematics ability as an indicator of cognitive learning history for undertaking future mathematics learning. Thus an appropriate measure of mathematics ability was deemed important in this study. While there exists an array of relevant indicators of mathematics ability, many are quite involved and can take

up to forty minutes for students to complete. With the time restrictions imposed on this study due to its voluntary nature such tests were not practical. The test chosen is the City of Dublin Vocational Education Committees (CDVEC) "Mathematics Test", developed Paul Hyland of the CDVEC Psychological Service. The test was developed specifically for use with first year entrant students, with an objective of ascertaining the level of mathematics concept acquisition and knowledge pertaining to their primary school experience. The test has been used for nearly a decade in the City of Dublin VEC area, with each prospective entrant completing the test. It has found to be a temporally stable and reliable indicator of basic mathematical competency of student primary level mathematical ability. The test format is similar to Fuch's (1987) Curriculum Based Measurement Test. It also mirrors elements used in the International Assessment of Mathematics and Science Project (See Lapointe et al, 1989)

The test assess ten specific areas of mathematics competence

| | | |
|------------------|-------------|-------------------------------|
| Addition | Subtraction | Multiplication |
| Division | Symbols | Application of above problems |
| Units of Measure | Fractions | Decimals |
| Problem Solving | | |

The test is a written reply format test, the only test in this study to be non-multiple choice. There is a blank space provided at the bottom of each page of the test to facilitate student rough work and calculations. A

time restriction of 10 minutes is allowed for the completion of the test (see Appendix G, for full copy of the test)

6 5 4 Mathematics Module Assessment

As stated earlier the mathematic course of the new junior certificate is constructed intently with a choice of three separate syllabi for participating students. The rationale for this decision was tied to the problems experienced in the traditional separate Intermediate Certificate and " Group Certificate" (officially referred to as the Day Vocational Certificate) courses. The new junior certificate is established on a common core or foundation of mathematical concepts from which emanate three syllabi of differing difficulty and complexity.

Syllabus C (also referred to as Foundation level) is derived from the Day Vocational Certificate (Group Certificate) in a broad sense, in that it is aimed at the students who traditionally would have pursued this course. Typically these have been described as weaker students or students of below average ability. Consequently while the curricular content of the newly devised syllabus C is similar to the fundamentals of both syllabus A and B, it is presented in a more lively and innovative manner. To achieve this curriculum content is presented in a form which relates as much as possible to the students own environment and

experience To date 16% of students taking the new junior certificate have followed syllabus C

Syllabus B (Ordinary level) covers the middle ground in the traditional Intermediate Certificate syllabus, with an expansion in the degree of difficulty and complexity relative to the Foundation level The proportion of junior certificate students taking this is in the region of 50%, making it by far the most preferred syllabus undertaken by schools and students Importantly from the perspective of this study, it has been noted that many schools begin nearly all first year classes with syllabus B, there after assigning students to Syllabus A or C if their ability requirements appears not to be met by syllabus B

The Syllabus C (Higher level) option in the new junior certificate course is somewhat equivalent to its predecessor higher level (honours) mathematics of the Intermediate certificate However Syllabus A is more global in its appeal than the original higher level intermediate certificate course and nearly 33% of students taking the junior certificate opt for the Higher level syllabus

In terms of content of the separate syllabi, all three follow a basic core with similar topics being realised, but at differing levels of complexity and sophistication This fact is highlighted in the similarity of assessment

of the different syllabi where corresponding topics are examined but in quite a different format for each syllabus

In the present research, the schools taking part contained classes that studied mathematics in all three separate syllabi. This logically implies that the specific mathematics module investigated in this research, while covering the same basic mathematical concepts, differed in its presentation and the level or depth into which the areas were entered depending on the syllabus covered. Necessarily, teaching methods employed may differ slightly depending on the syllabus covered, but all teachers participating in the research would be qualified to teach any of the three syllabi.

Taking cognisance of the fact that separate cohorts of the student population involved in this study would intend to follow separate syllabi, the assessment strategy utilised needed to be sequentially based, accounting for the differential treatment in format employed by each of the syllabi.

To embrace this circumstance, the assessment test developed for the Sets/Venn Diagram module completed by students is designed in a three-tiered sequence (section one, two and three). The design of the test was carried out in close consultation with three full-time and experienced

teachers of mathematics and overseen by an expert in the area of mathematics curriculum development and assessment. There were several pilot trials of the test in classroom settings to ascertain student attitudes, response rates, time factors, and difficulty levels. Valuable information was gathered from these trials and integrated into the final draft.

Section One deals with fundamental symbol recognition, essential terminology used in all levels of basic set theory. There are eight questions each of which asks for then recognition of the correct symbol for a set theory concept, e.g.

"The correct symbol for the element of set is "

| | | | | |
|-------|--------|--------|------|---|
| A | B | C | D | E |
| \in | \cap | $\{\}$ | A' | U |

This section would be common content to all three syllabi and in pilot trials was completed by the vast majority of students in less than seven minutes.

Assessment Section Two also contains eight questions which look at basic applications of the symbols tested in section one. This section again is common to all three syllabi, although the last few questions may be beyond what some teachers would cover with Foundation level

students In pilot trials most ordinary level syllabus students completed this section in about twelve minutes

Assessment Section Three contains four problem type questions It was decided to introduce this form of question for two reasons

(1) The problem type questions are similar in construct to questions produced in the Foundation level syllabus However the difficulty level is advanced in relation to the content of the Foundation level syllabus and is more related to the level experienced in the Ordinary and Higher level syllabi However it was established in experimental trials, that many of the advanced members of the Foundation level classes could cope with the questions

(2) Due to the fact that the questions are asked in a "longhand" fashion there was no use of the symbols commonly used in the first two assessment sections Consequently the amount of time needed to translate the problems into set theory syntax had to be taken into account In pilot trials it was confirmed that introducing eight such questions proved both too time consuming and tedious for the students involved This latter point was of particular concern as it was envisaged that students would complete this test and the Self-Description Questionnaire at the one sitting On further investigation it was deduced that the optimum number

of questions to be asked, while not over stretching time allowed or student attention levels, was four

As stated, the questions are presented in longhand form, ascending in difficulty from the first to the fourth, in the common multiple choice format (See Appendix H)

6 6 THE LEARNING TASK

As stated previously the Learning task completed by students participating in this study was the introductory Sets and Venn Diagrams mathematics module of the junior certificate course. This tends to be the first course attempted by teachers with their new entrants. The reasons for this choice are many, firstly it is not, generally, an area of mathematics that is covered in the primary school curriculum. Therefore teachers like to introduce the students to what they may feel is a new exciting concept in mathematics. In a sense every student is starting from a common basis. Secondly the fact that much of the module is graphic in representation, teachers feel that this will stimulate student interest.

Of particular use to this study is the fact that the students have not covered the area before, and therefore all students should theoretically be starting from a common base, which should highlight the influence of the teacher's classroom interactions.

As outlined in section 6.6.4 on the assessment test, there exists a choice of three set syllabi (A, B and C) for first year students. The differences are explained in the above section.

Necessarily there exist differences in the amount of time teachers spent covering the module. This would be dependant on personal teaching style, class size, whether the class group was mixed ability or streamed. However despite this most teachers had covered the course in a little over a month.

With the methodological procedure outlined and phases of data collection explained, Chapter Seven will deal with the analysis of the data received, and the statistical treatments utilised to test the hypotheses proposed.

CHAPTER SEVEN

7.0 RESULTS

7.1 STATISTICAL TREATMENT EMPLOYED

The purpose of the present study was to investigate the influence perceived Teaching Empathy would have on (a) student learning rates in a defined mathematics module, and on (b) student General Academic and Mathematics Self-Concept. The influence of the independent variable (Teaching Empathy) on the dependent variables (Mathematics Learned, and changes in the two self-concept scores) was assessed using parametric statistical methods. The direction of the statistical evaluation can be discriminated systematically from a review of the initial mean scores outlined in Tables 5 and 6. All overall statistics quoted refer to the population $N=387$.

Table 5 looks at the mean scores for all 16 teachers on the independent measure of the STIQ (Teaching Empathy). It also shows the standard deviations of the total population and of each individual teacher. The total empathy score range for each teacher would have been between a minimum of 14 and a maximum of 70. Also included are the mean and standard deviation breakdowns of the two strong composite factors identified in Chapter Six as the major components of teacher empathic behaviour as measured by the STIQ (i.e. *Supportive Teaching Style and Personal Focus of Teacher*). The possible range for Factor1 would have been scores between 8 and 40 and for Factor2 between 4 and 20.

Table 5. Teaching Empathy and Factor Mean Scores

| TEACHER NUMBER | MEAN | SD | Factor1 <i>Supportive Teaching Style</i> | SD | Factor2 <i>Personal Focus of Teacher</i> | SD |
|-------------------------|-------------|-------------|---|------------|---|------------|
| TOTAL POPULATION | 50.9 | 11.0 | 28.9 | 7.2 | 13.6 | 3.6 |
| TEACHER 1 | 53.5 | 7.0 | 31.5 | 5.1 | 13.5 | 2.2 |
| TEACHER 2 | 53.6 | 13.0 | 30.8 | 7.4 | 14.3 | 4.8 |
| TEACHER 3 | 64.2 | 5.7 | 35.7 | 4.7 | 18.8 | 1.4 |
| TEACHER 4 | 53.2 | 8.0 | 32.3 | 4.5 | 12.7 | 3.3 |
| TEACHER 5 | 51.4 | 6.7 | 30.1 | 4.7 | 12.2 | 2.6 |
| TEACHER 6 | 57.8 | 7.3 | 34.1 | 3.9 | 14.6 | 2.7 |
| TEACHER 7 | 35.1 | 9.2 | 18.6 | 6.1 | 9.1 | 2.7 |
| TEACHER 8 | 43.3 | 12.7 | 22.7 | 7.1 | 12.4 | 4.2 |
| TEACHER 9 | 54.4 | 4.6 | 31.6 | 3.4 | 15.3 | 1.9 |
| TEACHER 10 | 49.7 | 12.2 | 27.5 | 7.7 | 13.8 | 3.7 |
| TEACHER 11 | 54.4 | 2.9 | 32.0 | 2.0 | 14.8 | 1.9 |
| TEACHER 12 | 40.1 | 7.3 | 20.8 | 5.5 | 11.4 | 2.4 |
| TEACHER 13 | 54.7 | 7.6 | 32.8 | 4.4 | 13.3 | 3.5 |
| TEACHER 14 | 56.8 | 7.2 | 33.1 | 4.0 | 15.3 | 2.8 |
| TEACHER 15 | 42.5 | 7.9 | 22.8 | 5.1 | 12.0 | 2.8 |
| TEACHER 16 | 46.1 | 7.0 | 25.2 | 4.8 | 13.5 | 2.2 |

The second table shown below (Table 6) presents mean score data for the dependant variable measures in the study. The table shows the scores of the Self-concept questionnaires (for both the Mathematics and General School Self-Concept) both before treatment and after treatment. Also outlined are the Mathematics Learned assessment scores, taken after the module was completed and the baseline measure of mathematics ability scores, taken before the students undertook the course.

Table 6 Mean Scores of Dependant Variables (*mathematics ability incl*)

| TEACHER POPULATION | SELF-CONCEPT BEFORE | | SELF-CONCEPT AFTER | | Maths Learned Assessed | Maths Ability |
|--------------------|---------------------|----------------|--------------------|----------------|------------------------|---------------|
| | Mathematics | General School | Mathematics | General School | | |
| OVERALL POPULATION | 44.8 (10.9) | 46.9 (8.5) | 41.2 (10.9) | 47.6 (7.7) | 12.9 (2.8) | 22.2 (3.8) |
| TEACHER 1 | 37.1 (10.2) | 45.3 (8.1) | 34.1 (13.3) | 44.3 (11.4) | 10.0 (3.5) | 21.2 (5.5) |
| TEACHER 2 | 36.1 (11.8) | 47.2 (9.3) | 34.7 (11.9) | 43.2 (8.4) | 12.0 (4.2) | 19.7 (2.9) |
| TEACHER 3 | 39.7 (14.2) | 47.5 (7.8) | 42.6 (13.3) | 48.3 (8.2) | 13.7 (1.9) | 21.5 (3.5) |
| TEACHER 4 | 38.2 (8.9) | 46.9 (7.0) | 41.2 (8.1) | 48.9 (5.5) | 12.5 (2.3) | 22.4 (3.4) |
| TEACHER 5 | 39.9 (10.2) | 47.6 (6.5) | 40.3 (11.2) | 44.6 (8.9) | 13.0 (2.6) | 23.3 (5.6) |
| TEACHER 6 | 50.3 (6.5) | 51.3 (6.7) | 48.9 (6.9) | 50.1 (6.8) | 14.9 (2.3) | 22.9 (4.1) |
| TEACHER 7 | 41.4 (11.6) | 46.0 (10.4) | 36.1 (11.7) | 44.9 (9.8) | 14.1 (3.5) | 23.8 (3.8) |
| TEACHER 8 | 40.9 (11.4) | 47.7 (7.1) | 39.2 (10.9) | 49.0 (6.6) | 14.3 (2.3) | 23.5 (3.4) |
| TEACHER 9 | 46.2 (6.7) | 50.8 (4.6) | 47.5 (4.9) | 51.5 (4.9) | 12.3 (1.9) | 23.0 (3.8) |
| TEACHER 10 | 43.3 (9.1) | 49.0 (6.4) | 43.5 (9.0) | 49.1 (6.6) | 12.0 (2.9) | 22.6 (3.2) |
| TEACHER 11 | 32.1 (9.7) | 31.0 (9.3) | 44.2 (4.9) | 46.4 (4.6) | 13.5 (1.8) | 21.2 (2.5) |
| TEACHER 12 | 41.4 (11.5) | 46.2 (10.5) | 36.4 (11.7) | 46.1 (7.4) | 13.8 (3.4) | 22.9 (3.6) |
| TEACHER 13 | 39.2 (8.4) | 45.5 (6.8) | 42.3 (8.9) | 48.3 (6.2) | 12.4 (2.0) | 21.8 (3.4) |
| TEACHER 14 | 43.7 (8.6) | 50.1 (7.7) | 44.5 (8.0) | 48.4 (8.5) | 12.5 (1.9) | 21.5 (2.7) |
| TEACHER 15 | 41.2 (12.3) | 48.9 (5.1) | 43.6 (10.9) | 50.1 (5.7) | 12.6 (2.3) | 21.9 (3.7) |
| TEACHER 16 | 39.4 (10.9) | 44.0 (9.9) | 35.7 (12.9) | 46.3 (9.5) | 12.9 (2.6) | 21.0 (3.4) |

STANDARD DEVIATIONS IN BRACKETS

As the hypothesis submitted that Teaching Empathy would have a positive effect on amount of Mathematics Learned and on a students Mathematics and General School Self-Concept, it is appropriate to examine these scores collectively at this point to appraise in a general sense, if effect were operating. In Table 7 below, these data are outlined. Specifically it should be noted that the scores for Mathematics and General School Self-Concept in this table, are expressed as change scores. That is the mean incremental change or difference in scores between *the before*

Chapter Seven - Results

treatment and after treatment measure, is presented. It is interesting to note that some classes display a positive shift while some have a negative adjustment in their scores after the module has been taught indicating that self-concept was not static.

Table 7 Comparison of Empathy and Dependant Variable Means

| TEACHER NUMBER | TEACHING EMPATHY MEANS | Factor1 <i>Supportive Teaching Style</i> | Factor2 <i>Personal Focus of Teacher</i> | Difference in Mathematics Self-Concept score after Treatment | Difference in General School Self-Concept after Treatment | Mathematics Learned Assessed |
|-------------------------|------------------------|---|---|--|---|------------------------------|
| TOTAL POPULATION | 50.9 (11.0) | 28.9 (7.2) | 13.6 (3.6) | + 34 (7.5) | + 68 (6.9) | 12.9 (2.8) |
| TEACHER 1 | 53.5 (7.0) | 31.5 (5.1) | 13.5 (2.2) | 2.9 (12.6) | -1.0 (6.9) | 10.0 (3.5) |
| TEACHER 2 | 53.6 (13.0) | 30.8 (7.4) | 14.3 (4.8) | 1.4 (7.6) | 3.9 (8.9) | 12.0 (4.2) |
| TEACHER 3 | 64.2 (5.7) | 35.7 (4.7) | 18.8 (1.4) | +2.9 (2.7) | + 79 (2.5) | 13.7 (1.9) |
| TEACHER 4 | 53.2 (8.0) | 32.3 (4.5) | 12.7 (3.3) | +3.0 (3.1) | +2.0 (3.6) | 12.5 (2.3) |
| TEACHER 5 | 51.4 (6.8) | 30.1 (4.7) | 12.2 (2.6) | + 46 (6.9) | 3.0 (6.5) | 13.0 (2.6) |
| TEACHER 6 | 57.8 (7.3) | 34.1 (3.9) | 14.6 (2.7) | 1.42 (7.3) | 1.1 (6.4) | 14.9 (2.3) |
| TEACHER 7 | 35.1 (9.2) | 18.6 (6.1) | 9.1 (2.7) | 5.3 (7.9) | -1.1 (8.6) | 14.1 (3.5) |
| TEACHER 8 | 43.3 (12.7) | 22.7 (7.1) | 12.4 (4.2) | 1.6 (6.2) | +1.3 (5.3) | 14.3 (2.3) |
| TEACHER 9 | 54.4 (4.6) | 31.6 (3.4) | 15.3 (1.9) | +1.3 (5.3) | + 64 (2.9) | 12.3 (1.9) |
| TEACHER 10 | 49.7 (12.3) | 27.5 (7.7) | 13.8 (3.7) | + 21 (5.9) | + 07 (2.0) | 12.0 (2.9) |
| TEACHER 11 | 54.4 (2.9) | 32.0 (2.0) | 14.8 (1.9) | +12.1 (8.1) | +15.4 (9.2) | 13.5 (1.8) |
| TEACHER 12 | 40.1 (7.3) | 20.8 (5.5) | 11.4 (2.4) | 5.0 (9.2) | 11 (8.0) | 13.8 (3.4) |
| TEACHER 13 | 54.7 (7.6) | 32.8 (4.4) | 13.3 (3.5) | +3.0 (5.7) | +2.8 (3.6) | 12.4 (2.0) |
| TEACHER 14 | 56.8 (7.2) | 33.1 (4.0) | 15.3 (2.8) | + 82 (7.1) | 1.6 (5.4) | 12.5 (1.9) |
| TEACHER 15 | 42.5 (7.9) | 22.8 (5.1) | 12.0 (2.8) | +2.4 (5.5) | +1.2 (3.9) | 12.6 (2.3) |
| TEACHER 16 | 46.1 (7.0) | 25.2 (4.8) | 13.5 (2.2) | 3.8 (5.3) | +2.4 (7.4) | 12.9 (2.6) |

NOTE: Standard Deviations in Brackets

As the hypothesis would hold that this shift may be due to empathic teaching, this table gives the first global indication as to whether teachers of varying levels of empathy may have had a functional effect on their students' self-concept attributions. The Mathematics Learned assessed mean scores fall within a possible range of 0 to 20.

While Table 7 above demonstrates some of the variance about the mean in Teaching Empathy by teachers, it is difficult to distil whether or not there exists a relationship between a teacher's measured empathy score and their students' performance in the Mathematics Learned assessment and their *change* Self-Concept scores. To quantify if such a relationship exists, Correlations measured by Pearson Correlation Coefficient were executed. Table 8, below outlines the status of these relationships and their significance.

Table 8. Correlations of Teaching Empathy & Factors with Dependant Variables

| N=387 | Maths. Learned | Maths. Self-Con. Pre-Treatment | Maths. Self-Con. Post-Treatment | Gen. Sch. Self-Con Pre-Treatment | Gen. Sch Self-Con Post-Treat. |
|------------------------------------|----------------|--------------------------------|---------------------------------|----------------------------------|-------------------------------|
| Teaching Empathy | .116* | .147* | .253** | .077 | .052 |
| Factor1: Supportive Teaching Style | .056 | .146* | .255** | .052 | .029 |
| Factor2: Personal Focus of Teacher | .164** | .137* | .229** | .104* | .106* |

(* = $p < .05$, ** = $p < .001$)

In Table 8 above it can be noted that the difference or change scores in self-concept scores quoted in earlier results, are not used in the correlation matrix. The use of change scores (difference between time one and time two scores) in statistical quantification has been an area charged with difficulty for psychological and social science research for some time (see, Cronbach & Furby, 1970, Glasnapp, 1984, O Connor, 1972). Johns (1981) warns that the use of difference scores can introduce problems of "unreliability, systematic correlation with their components, and spurious correlation with other variables" (p 443). Cohen & Cohen (1983) detail that change score analysis "is an area fraught with booby traps where intuitive "doing what comes naturally" is almost certain to lead one astray" (p 413). Thus the spurious nature of change or difference scores, leads in essence to the invalidation of much of the inferences that tend to be made from these data (Berger-Gross, 1982). The solution to this difficulty is suggested by Cronbach and Furby (1970) and others (e.g. Cohen & Cohen, 1983, p 415) involving the use of both **pre-** and **post-** test scores in a hierarchical Multiple Regression Analysis formula, where the post-score is entered as a dependent variable and the pre-score as a co-variate. The appropriateness of this solution will be expanded upon later in the present chapter.

Despite this problem with change scores the results reported in Table 8 indicate that a positive significant relationship existed between Teaching Empathy scores and Mathematics Learned assessed

Thus there is a positive link, in a general overview, between higher order empathy scores and positive mathematics outcome scores. While the correlations between Teaching Empathy and the pre-treatment and post-treatment self-concept scores are indicated, the evaluation of relationships with these is difficult to infer. Thus it is more advisable to use the regression solution outlined above to analyse relationships and any consequential effects Teaching Empathy may be having on student self-concept outcome scores.

It should also be noted here that the difference between both sets of pre- and post-treatment self-concept scores is not statistically significant. A paired samples student t-test indicated that the difference between pre-treatment and post-treatment scores in General School Self-Concept give $t = -1.94$, not significant. Similarly for Mathematics Self-Concept pre- and post-treatment difference proved to be not significant ($t = -0.90$, NS).

The correlation between this study's second independent variable, baseline mathematics ability, and the dependent outcomes (see Table 9 below)

indicate a strong relationship between Mathematics Ability and student learning outcomes

Table 9 Correlation of Baseline Mathematics Ability with Dependant Variables

| N= 387 | Maths Learned | Maths Self-Concept Pre-Treatment | Maths Self Concept Post Treatment | General School Self Concept Pre-Treatment | General School Self Concept Post-Treatment |
|---------------------|---------------|----------------------------------|-----------------------------------|---|--|
| Mathematics Ability | 232 | 333 | 345 | 282 | 314 |
| Significance | p = 0001 | p = 0001 | p = 0001 | p = 0001 | p = 0001 |

The significant correlation between Mathematics Ability and Mathematics Learned, indicates a strong reciprocal relationship between the level of student Mathematics Ability score and their level of attainment in the Mathematics Learned assessment test. Again we are faced with the problem of being unable to correlate the independent variable in this case (Mathematics Ability) with the change in self-concept scores although the before and after scores are displayed to give a general indication of relatedness.

In respect of the specific goals of this research, this section has given a clear indication that Teaching Empathy and student baseline Mathematics Ability are significantly positively related to the amount of mathematics learned by students as assessed by the Mathematics Learned assessment ($r = 116$, $p < 05$, and $r = 232$, $p < 0001$ respectively). However as

explained we cannot as yet infer whether similar relationships exist between these two independent variables and the self-concept outcomes

The next section will introduce the Multiple Regression Analyses described above, to resolve whether there exists a relationship between Teaching Empathy/Mathematics Ability and the Mathematics Learned outcomes, the self-concept outcome scores and also whether this relationship can be identified as inductive. Another advantage of the multiple regression process is that it allows one to tease out some of the differential effects of these variables (e.g. Teaching Empathy) while controlling for the effects of others (e.g. Mathematics Ability)

There are several requirements for a multiple regression to be an effective statistical technique and the present independent variable data (Teaching Empathy and Mathematics Ability) fulfils these, including the fact that both measures provide interval data, are relatively normally distributed and they do not correlate with each other (Teaching Empathy with Mathematics Ability $r = -0.061$ NS)

At this stage it is worth restating the hypothesis that the regression analysis proposes to investigate in full "*That Teaching Empathy will have a positive influence on Mathematics learning outcomes*"

The first regression performed investigated the effect of Mathematics Ability and Teaching Empathy on Mathematics Learned assessed and

whether these variables were independent of each other or not. To establish this, a two step (stepwise) regression was employed, analysing the effect of mathematics ability alone in the first step, withholding Teaching Empathy from the equation, and then following with Teaching Empathy included. As mathematics assessment score is not a change score, the hierarchical regression method outlined earlier is not necessary with this data. Also included are the separate regressions of the two main factors of Teaching Empathy, *Supportive Teaching Style* and *Personal Focus of Teacher* against mathematics learned assessed. The results displayed below in Table 10 indicate the significance of the B score in the final column.

Table 10 Regression Analyses of independent variables and mathematics learned assessed

| INDEPENDENT VARIABLES | MATHEMATICS LEARNED ASSESSED | | | |
|--|------------------------------|------|------|--------------|
| | B | Beta | SE B | Significance |
| Teaching Empathy | 0332 | 1309 | 0125 | 0082 |
| Factor1 <i>Supportive Teaching Style</i> | 0389 | 1004 | 0253 | 1293 NS |
| Factor2 <i>Personal Focus of Teacher</i> | 1969 | 2554 | 0504 | 0001 |
| Mathematics Ability | 1772 | 2399 | 0364 | 00001 |

These results indicate that while the level of student Mathematics Ability has a significant effect on mathematics learned assessed scores, Teaching Empathy also has a significant effect. When the regression technique

investigated the effect of the two factors of Teaching Empathy on mathematics learned, it indicated that in fact only one of the factors, *Personal Focus of Teacher* (Factor2) was having a significant interaction. *Supportive Teaching Style* was not recorded as having a significant interactive effect. Thus it can be stated that as Teaching Empathy did have a positive interactive effect on Mathematics Learned assessed, the first Null Hypothesis is rejected.

The second hypothesis proposed that "*Teaching Empathy will have a significant positive influence on Mathematics Self-Concept and General School Self-Concept outcome scores*"

The specific statistical treatment employed to test these hypotheses were multiple regression analyses applying the *hierarchical* regression, referred to earlier, of mathematics ability, Teaching Empathy (and its' two factors) on students' Mathematics Self-Concept and General School Self-Concept ratings. These regressions will be introduced individually for each self-concept measure, beginning with Mathematics Self-Concept scores.

The first block in this regression, following Cohen & Cohen's (1983) outline, lets the post treatment score = Y , and the pre-treatment score equal the research factor we want to relate to the change. Using the

formula for the significance of F^* (see, Koutsoyiannis, 1977) it is possible to evaluate the significance of F^* against F

$$F^* = \frac{R^2_2 - R^2_1}{R^2_2 (N - k)}$$

For the first regression cited below in Table 11, $F^* \approx 20.26$, indicating that $F^* > F_{(05)}$. This implies the acceptance of equation two (that including Teaching Empathy and Student Mathematics Ability) over equation one (which contains only pretest scores as a predictor of post-test scores)

Table 11 below, presents the results of this hierarchical regression, again indicating the presence or absence of significant effects by Teaching Empathy, (including, *Personal Focus of Teacher* and *Supportive Teaching Style*) and Mathematics Ability on Mathematics Self-Concept scores, and displaying the level of these significances in the final column

Table 11 Regression analyses of independent variables on mathematics self-concept

| INDEPENDENT VARIABLES | MATHEMATICS SELF-CONCEPT | | | |
|--|--------------------------|------|------|--------------|
| | B | Beta | SE B | Significance |
| Teaching Empathy | 1551 | 1569 | 0318 | 00001 |
| Factor1 <i>Supportive Teaching Style</i> | 1637 | 1083 | 0639 | 0108 |
| Factor2 <i>Personal Focus of Teacher</i> | 2221 | 0739 | 1276 | 0826 NS |
| Mathematics Ability | 3466 | 1205 | 0970 | 0004 |

These results indicate that Teaching Empathy as measured in this study did have a significant effect on student Mathematics Self-Concept post-treatment scores. However, regressing the two component factors of Teaching Empathy revealed that Factor1, *Supportive Teaching Style*, is the only one of the component factors which attributes a significant effect. It is clear also that a student's measured level of Mathematical Ability exerts a significant effect on student post-treatment self-concept scores.

Therefore, at this point, the first section of the second Null Hypothesis can be rejected, as it is clear that Teaching Empathy does have a positive influence on student Mathematics Self-Concept outcome scores.

The third set of multiple regression analyses (again hierarchical) examined the effect, if any, of the independent variables on the dependent student General School Self-Concept scores. The treatment technique in this case

is parallel to that outlined in the previous regression evaluation. The significance of F^* was measured as follows:

$$F^* \approx 14.543, \text{ therefore } F^* > F_{(0.05)}$$

Table 12 Regression analyses of Independent variables on student general school self-concept outcomes

| INDEPENDENT VARIABLES | GENERAL SCHOOL SELF-CONCEPT | | | |
|--|-----------------------------|------|------|--------------|
| | B | Beta | SE B | Significance |
| Teaching Empathy | 0098 | 0139 | 0270 | 7175 NS |
| Factor1 <i>Supportive Teaching Style</i> | 0644 | 0600 | 0548 | 2404 NS |
| Factor2 <i>Personal Focus of Teacher</i> | 2088 | 0981 | 1100 | 0584 NS |
| Mathematics Ability | 2927 | 1434 | 0817 | 0004 |

These analyses indicate that while students' Mathematics Ability has significant effect on student General School Self-Concept post-treatment score, Teaching Empathy does not appear to have had a significant influence on student General School Self-Concept score. This lack of effect by Teaching Empathy holds true for both of its component factors also.

To summarise thus far, the stated conclusions thus far indicate that Teaching Empathy does have a significant effect on student mathematics learning as assessed in this study by the Mathematics Learned assessment.

What is also captivating in this result is that of the component factors of Teaching Empathy, *only* Factor1 (*Personal Focus of Teacher*), was recorded as having a significant effect on student mathematics learning. The measure of baseline Mathematics Ability taken at the beginning of the present study also had a strong predictive quality in terms of achievement in the Mathematics Learned assessment.

On the issue of Mathematics Self-Concept scores, both of the independent variables measured in this study (Teaching Empathy and student Mathematics Ability) were recorded as producing a significant effect. However, only one factor component of Teaching Empathy, *Supportive Teaching Style*, has a significant influence on students' Mathematics Self-Concept outcomes.

For General School Self-Concept a significant effect was recorded for students Mathematics Ability, but Teaching Empathy (and its component factors) appeared to have no significant influence.

While in a general sense the hypothesis is maintained, with Teaching Empathy positively influencing two of the three measured dependant outcomes, it must be recognised that these results are global in that they do not account for any potential effect that the independent correlates such

as student sex, teacher sex, school type and so forth, may have on the outcome variables

7.2 CORRELATE EFFECTS

This section of this chapter will introduce these correlates or categorical variables, into the quantitative evaluation of the data of this study. While it might appear simplistic to introduce each correlate individually and investigate its influence, this may obfuscate any general amalgamous associations that may have evolved. Therefore where possible, correlate effects if significant, are displayed collectively. The correlates identified as being worth consideration were in this study were as follows: Student Sex, Teacher Sex, Teacher Age, School Sex, School Classification Type, and Mathematics Syllabus covered by the teacher. While these breakdowns of the overall population were carefully measured, no particular effects were predicted or outlined in the central hypothesis of this study.

Of the correlates measured the mathematics syllabus breakdown transpired to be redundant, as all teachers surveyed covered syllabus B of the junior certificate course. This has tended to evolve as standard practice in many schools in their first year of the junior certificate, after which some teachers reevaluate the ability of the class to progress at this level. Those who feel syllabus B is too challenging for their students adopt syllabus C,

Chapter Seven - Results

and those who feel their students could work at a more advanced level elevate to syllabus A in the second year

The objective of this section is to determine whether the categorical variables outlined above play a part in influencing the results of the main predicted moderator variables described in the first section of this chapter

The first phase of correlate variable investigation are involves the inspection of the main independent and independent variable mean scores by the correlates These mean scores are listed below in Table 13

Table 13 Independent and Dependent Variable Means by Correlates

| CORRELATES | TEACHING EMPATHY | MATHS ABILITY | GENERAL SCHOOL SELF CONCEPT PRE TREATMENT | GENERAL SCHOOL SELF CONCEPT POST TREATMENT | MATHS SELF CONCEPT PRE TREATMENT | MATHS SELF-CONCEPT POST TREATMENT | MATHS LEARNED ASSESSED |
|----------------------|------------------|---------------|---|--|----------------------------------|-----------------------------------|------------------------|
| STUDENT SEX Male | 50 86 | 22 06 | 47 42 | 48 43 | 40 59 | 42 41 | 12 18 |
| Female | 50 94 | 22 26 | 46 58 | 46 97 | 41 00 | 40 04 | 13 61 |
| TEACHER SEX Male | 51 91 | 22 13 | 46 79 | 49 12 | 40 91 | 43 73 | 12 50 |
| Female | 50 02 | 22 19 | 47 09 | 46 41 | 40 67 | 38 98 | 13 32 |
| TEACHER AGE IN YEARS | | | | | | | |
| 20 - 25 | 48 63 | 22 23 | 47 49 | 46 52 | 41 33 | 38 94 | 13 26 |
| 26 - 30 | 58 37 | 21 93 | 44 63 | 48 87 | 40 00 | 44 59 | 13 21 |
| 31 - 35 | 48 14 | 22 04 | 47 37 | 48 73 | 40 56 | 41 26 | 12 48 |
| 36 - 40 | 48 21 | 22 30 | 45 81 | 47 35 | 40 21 | 39 67 | 13 02 |
| 41 - 45 | 53 74 | 22 50 | 48 66 | 46 26 | 41 56 | 42 18 | 12 82 |
| SCHOOL SEX Male | 49 97 | 22 46 | 48 85 | 49 85 | 42 05 | 43 82 | 12 35 |
| Female | 49 17 | 22 43 | 47 01 | 47 28 | 41 59 | 39 48 | 13 59 |
| Mixed | 53 99 | 21 53 | 45 13 | 46 01 | 38 48 | 40 76 | 12 65 |
| SCHOOL TYPE | | | | | | | |
| Secondary | 49 50 | 22 44 | 47 77 | 48 34 | 41 79 | 41 28 | 13 08 |
| Vocational | 55 32 | 21 54 | 43 18 | 47 84 | 38 89 | 43 57 | 12 76 |
| Community | 52 47 | 21 53 | 47 36 | 43 91 | 38 02 | 37 55 | 12 53 |

Table 13 above indicates the average variable scores broken down by the correlates measured in this study. While these give some insight into the differential profile that separate correlates order with the variable scores, there is no indication of the influence or impact any of these correlates' interaction may be having on dependent scores. However, before investigating the interaction of the various correlates and the dependent outcomes, it is worth reviewing some of the correlations that exist between some of the Independent and Dependent variables. Of particular note are the differential correlations by student sex and variables such as Mathematics Ability and Teaching Empathy (see Table 14 below).

Table 14 Student Sex Correlations, Teaching Empathy
(& Factors) by Mathematics Ability and Mathematics
Learned

| N=387 | FEMALE | | MALE | |
|-----------------------------------|---------------|---------------------|---------------------|---------------------|
| | Maths Ability | Mathematics Learned | Mathematics Ability | Mathematics Learned |
| Teaching Empathy | 14* | 056 NS | 064 NS | 42** |
| Factor1 Supportive Teaching Style | 12* | 066 NS | 070 NS | 32** |
| Factor2 Personal Focus of Teacher | 19* | 049 NS | 017 NS | 44** |

(* = $p < 05$ ** = $p < 001$)

These results are of interest as they clearly indicate that the relationship between the way females of varying Mathematical Ability score Teaching Empathy and its component factors quite differently to their male

counterparts Also, it is evident that the manner in which males score their teachers on Teaching Empathy is related to their Mathematics Learned outcomes, while no such relationship is indicated for female students While these relationships are interesting (and will be discussed further in Chapter Eight) they do not indicate a causative interaction Further detailed analysis is required to illuminate this aspect of the data

To measure the effects of the correlates on the dependent variables, a series of regression analyses were performed As with the first section of this chapter, the initial multiple regression is a stepwise regression which investigates the effects of the series of correlates on Mathematics Learned assessed Included in the regression are the two main independent variables, Teaching Empathy and Mathematics Ability

Table 15 Regression analyses of correlates (& Ind Vars) on Dependent Mathematics Learned Outcomes

| CORRELATES | MATHEMATICS LEARNED ASSESSED | | | |
|---------------------|------------------------------|-------|------|--------------|
| | B | BETA | SE B | SIGNIFICANCE |
| TEACHING EMPATHY | 0337 | 1326 | 0125 | 0074 |
| MATHEMATICS ABILITY | 1711 | 2319 | 0356 | 00001 |
| STUDENT SEX | 1 707 | 3048 | 4989 | 0007 |
| TEACHER SEX | 3377 | 0601 | 4529 | 4564 NS |
| TEACHER AGE | 0016 | 7 774 | 1170 | 9891 NS |
| SCHOOL SEX | 0977 | 0269 | 3697 | 7916 NS |
| SCHOOL TYPE | 0112 | 0029 | 3907 | 9771 NS |

This data confirms the significant effect of both Teaching Empathy and student Mathematics Ability on Mathematics Learned even with the inclusion of five correlates in the equation. However, it also indicates that student sex also has a significant effect on Mathematics Learned. The investigation of this Beta value demonstrated that the significant sex effect was due to male students scoring more positively relative to their female counterparts. None of the other correlates measured in this study (teacher sex, teacher age, school sex, and school type) indicated any significant effect on the amount of mathematics learned.

To study the effects of the correlate on Mathematics Self-Concept, the hierarchical multiple regression as described earlier was employed. Again, the F^* equation is accepted over F , with $F^* \approx 49.419$, thus $F^* > F_{(0.05)}$. In Table 16 overleaf, the hierarchical regression of the correlates measured in this study are regressed against the major dependent variables.

This data again shows that student baseline Mathematics Ability and Teaching Empathy produce significant effects on Mathematics Self-Concept scores post-treatment. However, the introduction of the series of correlates measured has indicated that sex of teacher is also having a significant influence on student Mathematics Self-Concept measured at the end of the mathematics module covered.

Table 16 Regression analyses of correlates (& Ind Vars) on Mathematics Self-Concept outcomes

| CORRELATES | MATHEMATICS SELF-CONCEPT | | | |
|---------------------|--------------------------|------|--------|--------------|
| | B | BETA | SE B | SIGNIFICANCE |
| TEACHING EMPATHY | 1201 | 1216 | 0312 | 0001 |
| MATHEMATICS ABILITY | 3600 | 1253 | 0921 | 0001 |
| STUDENT SEX | 1 139 | 0522 | 1 2196 | 3511 NS |
| TEACHER SEX | 6 118 | 2796 | 1 1085 | 00001 |
| TEACHER AGE | - 4778 | 0594 | 2864 | 0960 NS |
| SCHOOL SEX | 6215 | 0439 | 9045 | 4924 NS |
| SCHOOL TYPE | 5488 | 0368 | 9563 | 5664 NS |

Evaluation of the Beta score in this situation, assigns this significance to the positive effect male teachers are having on student Mathematics Self-Concept, compared with their female counterparts. None of the other correlates measured in this study appeared to produce a significant influence on the dependent outcomes measured.

The final hierarchical multiple regression, regressed the measured correlates (and the independent variables) with general school self-concept outcome scores. Again in this situation the test of the significance of the F^* equation proved to be significant $F^* \approx 73.27$ therefore $F^* > F_{(0.05)}$.

The regression results are displayed in Table 17 below, with the significance of the Beta scores outlined in the final column.

Table 17 Regression analyses of correlates (& Ind Vars) on General School Self-Concept Outcomes

| IND VARIABLES & CORRELATES | GENERAL SCHOOL SELF-CONCEPT | | | |
|----------------------------------|-----------------------------|------|--------|--------------|
| | B | BETA | SE B | SIGNIFICANCE |
| TEACHING EMPATHY | 0077 | 0111 | 0266 | 7704 NS |
| MATHEMATICS ABILITY | 2732 | 1339 | 0779 | 0005 |
| STUDENT SEX | 4786 | 0309 | 1 0513 | 6492 NS |
| TEACHER SEX | 4 5229 | 2913 | 9633 | 00001 |
| TEACHER AGE | - 4824 | 0845 | 2474 | 052 NS |
| SCHOOL SEX | 2 0912 | 2084 | 7890 | 0084 |
| SCHOOL TYPE | 2 2827 | 2155 | 8238 | 0059 |

The regression results cited in Table 17, above continue to support the association made in the first section of this chapter which indicated that student mathematical ability was having a strong influence on student General School Self-Concept outcome scores, while Teacher Empathy was not having a similar effect. The regressing of the correlates on these outcome scores indicates that some of these may also be having a significant bearing on student General School Self-Concept post-treatment. In particular it is noted that teacher sex is having a particular influence on these scores. Further evaluation of these Beta scores indicate that male teachers are presenting a positive influence on student general self-concept outcome scores as against their female counterparts. The significance of the classification type of school attended by students is an interesting result with the effect appearing to be most positive for vocational schools.

and slightly positive for secondary schools, above community schools/colleges. Perhaps tied to this finding is the third significant indicator which signified the effect of school sex on the dependent outcomes. In this instance it appeared that the positive effect was recorded in all male schools and mixed schools at the expense of female schools.

These results will be evaluated and discussed in full in Chapter Eight.

CHAPTER EIGHT

8 0 DISCUSSION

A review of the results established in Chapter Seven allows us enter the final portion of this study with a clearer understanding of the interactive effects of the various measured independent variables (Teaching Empathy and Mathematics Ability) on the dependent student outcomes (Mathematics Learned, Mathematics Self-Concept and General School Self-Concept) In addition to these evaluations, the influence of the various correlates measured in the study (e g Teacher Sex, Student Sex, *etc* ,) are also presented and appraised

The chapter begins with a summary description of the principal results outlined in Chapter Seven The succeeding sections evaluate and discuss these results in sequence Following these evaluations the conclusions are discussed and a model proposed to elucidate the mteractive process that took place The chapter concludes with review of the findings in terms of the ramifications for future research

8 1 SUMMARY OF RESULTS

8 1 1 Mathematics Learned Assessed

It is apparent from the correlational analysis and the stepwise multiple regression analysis cited in Chapter Seven, that both Teaching Empathy and student Mathematics Ability are not alone related to student outcome scores in Mathematics Learned, but they actually influenced significantly

the amount of Mathematics Learning taking place in the mathematics module covered ($t=2.66$, $p < .05$ and $t=4.87$, $p < .0001$, respectively)

The differential effect of the two component factors of Teaching Empathy indicated some unanticipated results. Factor2 (*Personal Focus of Teacher*) was revealed to be exerting a significant influence on Mathematics Learned outcomes ($t=3.85$, $p < .001$), whereas Factor1 (*Supportive Teaching Style*) was not recorded as having a significant effect. Further to these results, regression of the study's correlates on Mathematics Learned outcomes, indicated that Student Sex was also a significant influencing factor. Interestingly, this emerged as a positive increment for female students over their male counterparts ($t=-5.2$, $p < .001$). As stated in Chapter Seven there was no significant difference between male and female scores on Factor2 of Teaching Empathy (*Personal Focus of Teacher*).

8.1.2 Mathematics Self-Concept Outcomes

The hierarchical multiple regression analyses revealed that both Teaching Empathy and student Mathematics Ability exerted positive and significant effect on student Mathematics Self-Concept Outcome scores ($t=4.88$, $p < .0001$, and $t=3.57$, $p < .001$, respectively). On this occasion only one component factor of Teaching Empathy (Factor1 *Supportive Teaching Style*) was identified in analysis as exerting a significant effect ($t=2.56$,

$p < .05$) Of the correlates measured, only one, Teacher Sex recorded a significant effect ($t = -5.5, p < .001$) A review of this particular result indicated a positive increment for male teachers above their female counterparts

8.1.3 General School Self-Concept Outcomes

For the final affective outcome analysed, the independent measure of student Mathematics Ability, presented a significant effect on General School Self-Concept outcomes ($t = 3.5, p < .001$) Teaching Empathy showed no such significant effect, nor did any of its component factors Several of the correlates measured indicated a significant effect for this outcome Teacher Sex, School Sex and School Type were all recorded as exerting significant influence on General School Self-Concept outcomes The interpretation of these results indicated that male teachers influenced a more positive increment in student General School Self-Concept than did their female counterparts The School Sex result, indicated a positive increment for all male and mixed schools with little deviation over time for the all female schools in scores on General School Self-Concept School Type indicated a positive increment for both secondary and vocational schools and a negative increment for community schools

Table 18 below summarises the findings of all the multiple regression analyses carried out in this study, indicating the *t* values and their significance for each of the variables measured

Table 18 Summary of Multiple Regression Analyses findings

| Variables and Correlates | Mathematics Learned | Mathematics Self-Concept | General School Self-Concept |
|---|---------------------|--------------------------|-----------------------------|
| Teaching Empathy | <i>t</i> =2.66 * | <i>t</i> =4.88 ** | NS |
| Teaching Empathy Factor1 (<i>Supportive Teaching Style</i>) | NS | <i>t</i> =2.56 * | NS |
| Teaching Empathy Factor2 (<i>Personal Focus of Teacher</i>) | <i>t</i> =3.85 ** | NS | NS |
| Mathematics Ability | <i>t</i> =4.87 ** | <i>t</i> =3.57 ** | <i>t</i> =3.51 ** |
| <i>Student Sex</i> | <i>t</i> = 5.2 ** | NS | NS |
| <i>Teacher Sex</i> | NS | <i>t</i> = 5.5 ** | <i>t</i> =-4.7 ** |
| <i>School Sex</i> | NS | NS | <i>t</i> =2.65 * |
| <i>School Type</i> | NS | NS | <i>t</i> =-2.8 * |

*=Significant at the .05 level

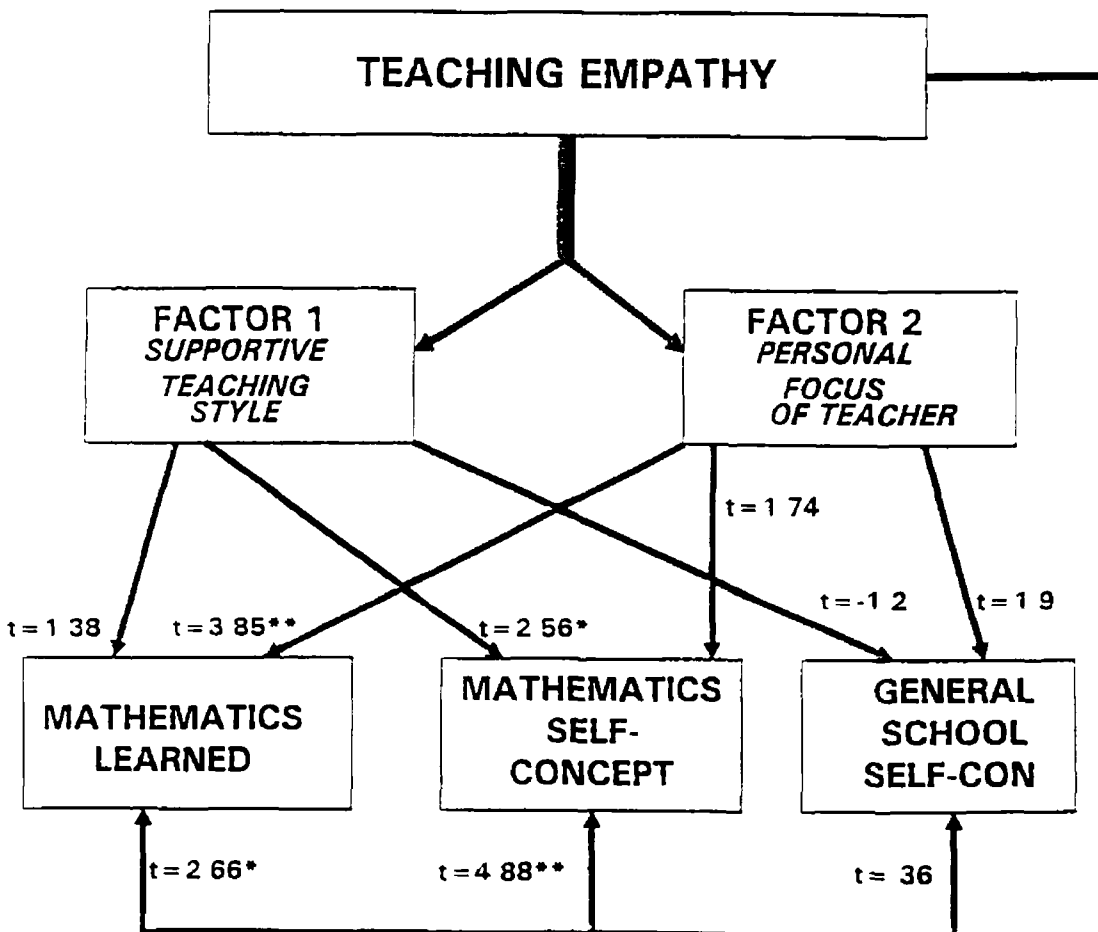
**=Significant at the .001 level

Returning to the central hypothesis of this study, it is clear that the first Null hypothesis can be rejected, as it is apparent that Teaching Empathy does have a positive influence on student Mathematics Learning in the mathematics module examined in the research. The second aspect of the Null hypothesis can be rejected in part as it appears that Teaching Empathy does in fact influence student Mathematics Self-Concept outcomes, although it does not indicate that Teaching Empathy, in any way, effects student General School Self-Concept

8.2 OUTCOMES APPRAISED

Figure 8, displayed below, demonstrates in a graphic mode the extent and process of the significant relationships between the independent variable of Teaching Empathy (and its two component factors) and the dependent outcomes of Mathematics Learned, Mathematics Self-Concept and General School Self-Concept

Figure 8 *The effect of Teaching Empathy on Dependent Outcomes*



* = $p < .05$
 ** = $p < .001$

In order to evaluate further the results summarised above, particularly the significant influence of Teaching Empathy on Mathematics Learned and Mathematics Self-Concept, it is appropriate firstly to view how the two factor components of Teaching Empathy differentially influence both of these outcomes. It is important to recall that there was no significant difference between any correlate groups on their baseline measure of Mathematics Ability. That is to say that there was no measured difference in this study's population among correlate groupings such as student sex, teacher sex, school type (implying social class) on the measure of Mathematics Ability. It is also noteworthy that a student's level of measured mathematical ability is not correlated with the overall level of measured Teaching Empathy recorded by that student. Thus for the student population as a whole, the baseline level of Mathematical Ability did not relate to the way they scored overall Teaching Empathy. However, it may be recalled that Factor2 of Teaching Empathy (*Personal Focus of Teacher*), was significantly *negatively* correlated with Mathematics Ability ($r = -0.096, p < .05$), although this is a very modest correlation. This latter finding has implications which will be discussed later in the evaluation of both the Mathematics Learned and Mathematics Self-Concept outcomes, especially with regard to interactive differences by gender, manifest in the results.

8 2 1 Mathematics Learned Outcomes Appraised

The primary results indicated, as stated, that Teaching Empathy is positively related to, and influences students' Mathematics Learned outcomes. Thus it appears that teacher behaviours that are seen as both cognitively empathic (i.e. *Supportive Teaching Style*) and affectively empathic (i.e. *Personal Focus of Teacher*) influenced in a positive way student learning in the Sets and Venn Diagrams module of their mathematics course. This conclusion ties with the findings of Borko and Livingston (1989) who speak of an effective teacher's role as involving the intricate blending of social and complex cognitive skills to match the needs, interests and abilities of the learners. They speak of the teacher's use of *improvisation* in the face of differential levels of student interest and comprehension of information presented in class. This mirrors Carpenter, Fennema, Peterson, Chiang and Loef's (1989) conclusions in a study that looked at using knowledge of children's mathematical thinking for classroom teaching. Here the necessity for teachers to gain an understanding of students' thinking was highlighted in the facilitation of student growth in understanding and problem-solving. This *empathic* understanding by teachers of the individual affective and cognitive dispositions of students regarding the mathematical material presented, necessarily involves the attenuation of the traditional authoritarian perception of the teacher as the sole source of information (see, Wood, Cobb & Yackel, 1991).

The most interesting and surprising secondary result regarding Mathematics Learned outcomes, emerged when the effect of the two component factors of overall Teaching Empathy were evaluated separately. The analysis related that only Factor2, identified as *Personal Focus of Teacher*, had a significant effect on the Mathematics Learned outcomes of students. Closer examination of this factor is necessary to appraise the interaction that took place and interpret the causal dynamic. The *Personal Focus of Teacher* factor contains the following items:

My teacher will talk to me individually

My teacher encourages me

My teacher treats me with respect

My teacher makes it easy for me to talk with them at anytime

These items clearly refer to personal focusing of teacher attention on student well-being. In essence they seem to refer to behaviours that verify the affective well-being of the student for the teacher. On the surface it is apparent that these behaviours do not specifically refer directly to any cognitive acquisition of declarative knowledge related to the direct instruction of mathematics. On the contrary, the behaviours could naturally be assumed to be linked to the personal, affective or motivational aspects of a classroom learning experience. Thus the question to be resolved, is how or why these aspects of a teacher's

classroom behaviour influence positively and incrementally the students' learning of mathematics

As an aid to understanding this unanticipated result it is helpful to look at the interaction of the other component factor of Teaching Empathy, which is *not* significantly related to Mathematics Learned outcomes. The main component factor of Teaching Empathy, Factor1 (*Supportive Teaching Style*), contains items such as,

Makes subject interesting and alive

Makes sure everyone understands the material

Explains material clearly and fully

Communicates well

On review, these items would appear to involve and describe the sequential delivery of declarative knowledge relating to the mathematics module being taught. Surprisingly, this factor did **not** influence student scores in the Mathematics Learned assessment test. Thus it would appear that for the population surveyed in this study, the personalised intervention and attention of the teacher (Factor2) has significantly influenced the cognitive acquisition of mathematical structures and processes associated with positive scores in the Mathematics Learned assessed outcome, while supportive and methodical teaching style (Factor1) did not.

How then can this unanticipated result be interpreted in terms of the existing research available? As outlined in Chapter Three, many researchers (e.g. Dweck, 1986, Nicholls, 1984, Stipek & Hoffman, 1980, Tomic, 1989) have identified the importance of understanding and mediating the affective or motivational disposition of the learner in the learning situation as it can have significant consequences on influencing achievement rates. However these researchers have seen this personal mediating process, such as the *Personal Focus of Teacher* factor outlines, as having primary value in facilitating elevation of *student motivation* and thus task effort levels. The present study would clearly contradict these findings, as results indicate that the personal intervention and empathic focus of a teacher is of central importance in the *direct* learning of declarative mathematical information, and contrary to previous research, it is not achieving this result by the mediation of student motivation levels.

This interpretation is supported by the rejection of the premise that the personalised behaviours contained in the *Personal Focus of Teacher* factor should influence how a student feels about mathematics (mathematics self-concept) and thus generate increased effort in mathematics learning. Existing research, outlined in Chapter Three, would indicate that such personalised teacher encouragement, as that contained in *Personal Focus of Teacher* behaviours, would positively influence student motivational

attributions, effort levels and thus subject-specific self-conceptions (see, Ames and Archer, 1988, Anderson & Jennings, 1980, DeCharms, 1976, Page, 1958) However the results of the present study clearly confound these data and clearly show that there is no significant effect recorded for the influence of *Personal Focus of Teacher* on student Mathematics Self-Concept ($t=1.74$, NS)

Therefore to summarise, *Personal Focus of Teacher* does have a significant positive effect on Mathematics Learned, but this positive influence does not emanate from an elevation of students' mathematics self-conceptions

Such an unanticipated and confounding result merits further review in an effort to understand the generative process that took place. It is reasonable to maintain that the *Personal Focus of Teacher* component of Teaching Empathy, appealed to the personal control aspect of a student's learning experience (Schunk, 1986, Wood, Cobb & Yackel, 1991). A teacher who does focus personally with students in the classroom while teaching, is in essence handing a degree of personal regulation to the students in question, over the pace and level at which the mathematical material is being delivered. Researchers such as Carpenter, Fennema, Peterson, Chiang and Loef (1989) and Putnam (1987) have indicated the importance of *facilitating* student learning by using personalised and

individually tailored encouragement in an effort to transfer learning control to the student

Such learner control, although a contentious and complex area, is generally recognised as having positive learning consequences for students (see, Carrier & Williams, 1988, Clark, 1982, Hannafin, 1984, Gorrell & Trentham, 1992)

It is also evident that this personalised contact and interaction between the teacher and student results in more time being spent by the teacher communicating individually with the student. Thus the pace of the learning is, in a manner, being determined by the students, conditional on their individual needs. These needs obviously refer to the cognitive readiness of the students to assimilate and encode the declarative information relating to the mathematics subject matter being covered (see, Fuchs, Fuchs, Hamlett & Stecker, 1991)

Thus far, we recognise that *Personal Focus of Teacher* behaviours represent the effort by teacher to pattern instruction as a facilitative process incorporating the understanding of student thinking and affect. The consequences of this approach involves the transference of at least an element of control or responsibility to the student for the learning taking place

Is there any evidence to indicate exactly how such personalised empathic focus specifically interacted with student learning of mathematical information in this study? It will be recalled that in Chapter Two, the processes of approaching a mathematics problem were outlined and reviewed in the light of current cognitive task analytic research. Investigators such as Mayer (1985) related in their research the progression of steps or stages involved in mathematical task analysis (*Translation → Integration → Solution Planning → Solution Execution*), and it may be these components of mathematical reasoning that the *Personal Focus of Teacher* factor of Teaching Empathy is influencing. According to an extensive longitudinal study carried out by Turner et al , (1990) in Northern Ireland, the most prominent error identified in the mathematical task analysis of early secondary school students was the failure to translate accurately the problems they were facing. Carrier and Williams (1988) point out that the meaningfulness of the information presented to students in the learning situation is important as this is what influences a student's attempts to relate (i.e. translate or encode) new concepts to prior knowledge. Conceivably, it could be that the extra time and personal attention involved in the *Personal Focus of Teacher* components of Teaching Empathy may allow students gain a more complete accommodation of the representation to translation of the material they are encountering.

Researchers such as Carpenter et al , (1989) and Clark (1982) speak of the importance of facilitating the students' development of their own encoding strategies in the construction of their knowledge sets Wood et al , (1991) highlighted the importance of releasing students from the role of passive recipient in the mathematics classroom Describing the benefits of a student-centered interactive approach to teaching mathematics, they emphasise the value of the development of an understanding of the underlying conceptual operations that underscore student thinking This is attained by encouraging students to be actively engaged in the translation and construction of their own knowledge construction by a process of personal interaction with the teacher including open communication, negotiation and encouragement on the part of the mathematics teacher

This personalised student-centered interaction on the part of the mathematics teacher changes the overall accent or goal of the instructional experience from one of producing a learner that has passively learnt rules and knowledge that emphasise performance based achievement, to an individualised, process learning goal Carol Dweck's (1986) work on the importance of a tasks *goal orientation* may lead to a clearer understanding of the process taking place in the classroom with *Personal Focus of Teacher* behaviours She (also, Ames & Archer, 1988, Nicholls, 1984, Stodolsky, Salk & Glaessner, 1991) stresses the importance of

understanding how children construe and interpret events in a learning situation in terms of their own perceptions of their competence. Two classes of goals are identified

(1) *Learning Goals*; where emphasis is on increase in individual competence or mastery through effort, redirecting student concentration from their ability conceptions

(2) *Performance Goals*, where the goal is essentially assessed by favourable judgements of their competence or avoidance of negative judgements, based on their ability levels

The adoption of either of these two goals are characterised by different behaviour patterns by the student. As *performance goals* are centered on student's concern about their ability level, when faced with potentially threatening and challenging tasks many students tend to exhibit defensive avoidance or even withdrawal from the situation (Ames, 1984b, Elliot and Dweck, 1988). With *Learning Goals*, because of the choice aspect inherent in the process and the focus on incremental progress, the student approach is characterised by effort (Bandura & Schunk, 1981)

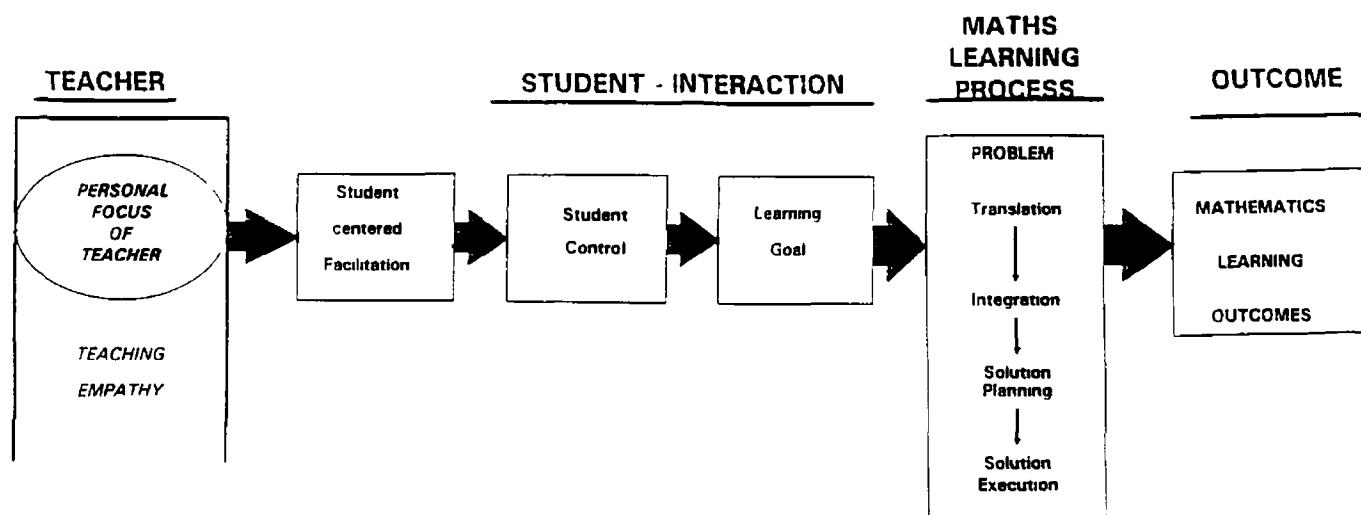
It is conceivable that in the present study the goal being set by teachers exhibiting *Personal Focus of Teacher* behaviours is a *Learning* type goal as against a *Performance* goal. This would be characterised by the

diagnosing of student ability/interest levels by the teacher through personal interaction, but with the instructional focus centring on student effort. This would involve the encouragement of student exploration and initiative without fear of judgement of their competence.

It should be recalled that the Sets & Venn Diagrams module which this study investigated involved the delivery of concepts which the majority of the students would not have encountered in their primary school education. As such students who might identify themselves as high achievers in the past, need not necessarily transfer such an attribute to high confidence in ability to face a new challenge (Licht & Dweck, 1984). Thus it may be that, under such conditions, *Personal Focus of Teacher* behaviours such as individual attention and encouragement integrate with student task analysis steps such as problem translation and integration discussed earlier.

The proposed process of the influence of Personal Focus of Teacher behaviours outlined above is graphically represented in Figure 9 below, outlining the suggested sequential steps, developed above, that lead to the positive interactive effect.

Figure 9 *The Process influence of Personal Focus of Teacher on Mathematics Learning Outcomes*



8 2 1.1 Gender and Mathematics Learned outcomes

A further interesting secondary result regarding Mathematics Learned outcomes in the present study, was the fact that Female students outscored their male counterparts in the assessment test ($t=-5.2, p < .001$). This result is of particular interest in the light of the evidence which relates that there was no significant difference between male and female students in their baseline mathematics ability scores ($t=-.52, NS$). The result is also at variance with the typical gender differences in mathematics achievement found at this age (e.g. Maccoby & Jacklin, 1974, Parsons Meece, Adler & Kaczala, 1982, Stipek & Hoffman, 1980, Wise, 1985).

In an effort to explain this phenomenon, any differences in the manner in which males and females scored Teaching Empathy and particularly the Personal Focus of Teacher factor were analysed. The results indicated no

significant difference between the manner in which male and female students scored these concepts. However, there did appear to be a difference in the relationship between baseline mathematics ability scores and the manner in which males and females scored Teaching Empathy and its two factors. For female students, there exists a negative correlation between baseline mathematics ability and overall Teaching Empathy ($r = -.14, p < .05$) and similarly for Factor2, *Personal Focus of Teacher* ($r = -.19, p < .05$) and Factor1, *Supportive Teaching Style* ($r = -.12, p < .05$). While these negative correlations are moderate, they are statistically significant. The resultant indications are that female students of lower mathematical ability scored teachers higher in levels of overall Teaching Empathy and its two component factors (*Personal Focus of Teacher* and *Supportive Teaching Style*), and higher mathematics ability females scored teachers lower on Teaching Empathy. It is still worth noting that female student mathematics ability is significantly positively correlated with Mathematics Learned outcomes ($r = .34, p < .001$). Meanwhile, there is no evidence of a significant correlation, either positive or negative, between male students' scoring of Teaching Empathy and their mathematics ability scores.

This gender difference is curious, as it indicates a differential pattern of scoring Teaching Empathy in terms of a student's mathematics ability between male and female students. A possible explanation for this

differential trend may follow the research on gender differences in the way students perceive mathematics. Pedro, Wolleat, Fennema & DeVaney-Becker (1981) reported gender differences which clearly identified females as being more anxious regarding mathematics than male students at high school level. Female students were also more likely to attribute failure in mathematics to internal and stable factors such as ability and success to external factors (also see, Dweck, 1986). It is also held that females at this stage of puberty have less confidence than do males (Fennema, 1983, Randall, 1987, Licht & Dweck, 1983) and this influences the ease at which they engage in public interaction in the classroom. Randall (1987) suggests that this lack of confidence lead to a preference to speak and interact with their teacher privately (*Personal Focus of Teacher*). A third area of research which may help explain the main gender difference results might be the data that describes the primary school (elementary school in the U S) environment as "feminine", which is described as creating a disadvantage for male students (Brophy & Good, 1974, Stake & Katz, 1982). If these findings are valid, it would appear to imply that the high number of female teachers in primary school and the feminine atmosphere existent therein, lead to problems for female students when they transfer to the more patriarchal and differentiated climate of the secondary school.

Taking the substance of these three areas of research the emergent deduction appears to be that at 12/13 years of age, female students are less confident than their male counterparts, making public classroom interaction more difficult. The female students in the present study had recently transferred from the "feminine environment" of the primary school, to the more diverse and robust environment of the secondary school system, which can have an unsettling effect (Simmons, Rosenberg, & Rosenberg, 1973). Added to these data, female students at this stage of schooling appear to be more anxious about mathematics than their male counterparts. Therefore it would appear to follow that the warm personalised interaction of an empathic teacher, would be perceived as an important support to female students at this stage of their schooling, especially to students with lower mathematics ability levels. The present study would appear to indicate that male students do not face the same levels of apprehension or anxiety at this stage of their schooling, in terms of their scoring of Teaching Empathy and their baseline mathematics ability scores.

8.2.2 Mathematics Self-Concept Outcomes Appraised

Turning to the second major result of this study, that Teaching Empathy had a significant effect on student Mathematics Self-Concept outcomes ($t=4.88, p < .001$). It appeared that the cognitive and affective identification of the mathematics teachers with students in the present

study had a positive influence on how students felt toward mathematics at the end of the course taught. While a student's mathematics ability is also a predictor of this outcome it is interesting to note that the influence of Teaching Empathy is statistically stronger. To evaluate in more detail the probable process of empathic influence on the Mathematics Self-Concept, it is worth analysing the impact of each of the component factors of Teaching Empathy.

Surprisingly, the analysis returned that of the two factors of Teaching Empathy, only Factor1, Supportive Teaching Style had a singular significant influence on student Mathematics Self-Concept outcomes. The items which make up this factor it will be recalled include the following:

Makes subject interesting and alive

Makes sure everyone understands the material

Understands the needs of each student

Helps me sort out problems and difficulties

Explains the material clearly and fully

These items appear to refer explicitly to clear and effective teaching behaviours related to the imparting of facts and processes in the understanding of Sets and Venn Diagrams theory and practice. As alluded to earlier, relevant research would seem to imply that such clear and methodical teaching behaviours as these would be expected to foster

greater declarative learning more so than dictate the motivational orientation of the learner (see, Mosley, 1986, Pressley, 1986, Palmscar & Brown, 1987) However the results of the present study indicate that such is not the case with the current population How then can this be explained?

It is accepted that as children enter adolescence, mathematics becomes one of the school subjects that students record as being difficult and anxiety inducing (see, Stodolsky, Salk & Glassner, 1991) Hoyles (1982) reported that fourteen year old students recorded that bad mathematics experiences were characterised by more negative feelings (e.g. shame, inadequacy, anxiety) than was failure in other subjects Students surveyed at this age also indicate that mathematics is not a subject that they could learn without the help of a teacher, as opposed to subjects such as social studies or history, which they felt they could learn without teacher aid The comment was that mathematics needed to be explained before one could understand it (see, Stodolosky et al , 1991, p 110)

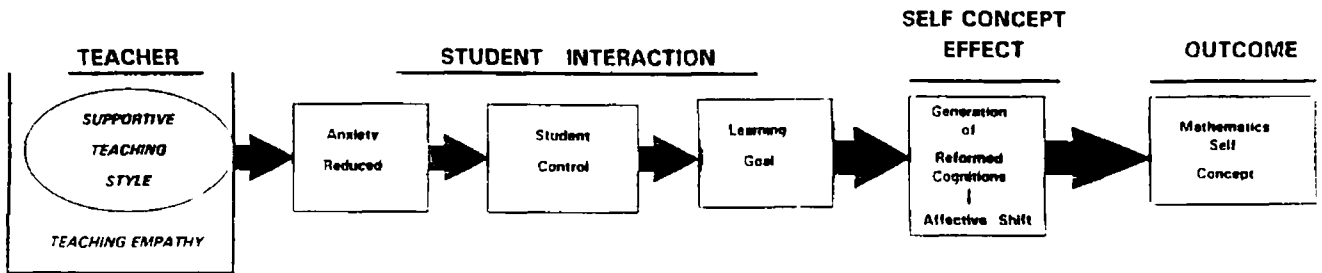
Thus, if one accepts the view that many students maintain a pessimistic attitude to mathematical subject matter due to some negative learning experiences, or the novel (thus challenging or threatening, see, Licht & Dweck, 1984) nature of the Sets and Venn Diagrams module, it seems reasonable to advance that teachers that offer clear and supportive

teaching behaviours will have a positive influence on student perceptions of the matter being taught. Clearly such lucidity of teaching style and material presentation, as presented by the item behaviours outlined in the Supportive Teaching Style factor, would help ameliorate any anxieties that students may have about the mathematics concepts covered. It should be stressed that this does not involve the teaching of material that is easily understood by students, at the expense of complex concepts, rather it involves the methodical teaching of all relevant concepts to all students, engendering intellectual growth and confidence. Teaching Empathy behaviours such as *makes the subject interesting and alive* and *makes sure everyone understands the material*, may be likely to adapt student motivational patterns, addressing the underlying motivational anxieties that might exist, replacing them with a thorough understanding of the subject matter being covered. Leven (1992) speaks of the importance of generating reformed cognitions which, when stripped of the existing affective anxiety, can result in a refreshed affective orientation.

Again the process that may be at work here is the *Supportive Teaching Style* leading to a reduction of student anxiety regarding the material to be learnt. This step would again involve the student taking a degree of control of the learning taking place as discussed earlier. This empowerment of the student would again imply the emphasis being on a *Learning Goal* as against a *Performance Goal*, where the threat to

personal self-conception of ability is not an issue, rather the premium is on effort. This process of Supportive Teaching Style intervention thus appears to lead to positive Mathematics Self-Concept outcomes. The process is described graphically in Figure 10 below.

Figure 10 *The process influence of Supportive Teaching Style on Mathematics Self-Concept outcomes*



8.2.2.1 Gender effect on Mathematics Self-Concept outcomes

A secondary result that emanated from the analysis of the Mathematics Self-Concept outcomes, and not initially implicated in the experimental objective of this study, was the finding that Teacher Sex was statistically related to Mathematics Self-Concept scores. The regression analysis outlined in Chapter Seven, demonstrated that Teacher Sex was significantly positively related to student Mathematics Self-Concept outcomes. In particular it indicated that Male Teachers influenced a more

positive rise in their student Mathematics Self-Concept outcome scores, than their female colleagues ($t=-5.52, p < .0001$)

Further analysis indicated that this result was true regardless of the sex of their students, the gender mix of their class (i.e. male, female or mixed) or the school classification type. Looking at Teacher Sex differences in Teaching Empathy, it appeared that while no significant difference existed in scores of overall Teaching Empathy, there did exist a statistically significant difference on scores of *Supportive Teaching Style* ($t=2.78, p < .05$), with male teachers scoring significantly better.

Much of the evidence on sex differences in empathy indicates trends contrary to this occurrence, with females scoring higher on scales of empathic ability than males (see, Lennon & Eisenberg, 1987). However, as stated, there was no gender difference recorded in this study on the overall measure of Teaching Empathy. Why male teachers receive higher scores on the more cognitive *Supportive Teaching Style*, is difficult to explain as no further relevant information was accumulated in the progress of the study, which might facilitate the interpretation of this occurrence. However, research by Etaugh and Good (1975) did indicate that male teachers may provide a more positive classroom atmosphere, especially for male students. Whatever the explanation, it did appear in the present study that students (regardless of sex) scored male teachers

higher on items such as *explaining material clearly and fully, makes sure everyone understands the material and makes subject interesting and alive*, and these had a positive consequence on students' Mathematics Self-Concept outcomes

The two correlates that influenced outcomes outlined thus far are interesting in that both Female students outscoring their male counterpart in the Mathematics Learned assessment and male teachers scoring higher on Factor1 of Teaching Empathy and positively influencing student Mathematics Self-Concept outcomes, are contrary to expected results and existing evidence in these areas

The final dependent outcome treated in the present study was the influence of Teaching Empathy on General School Self-Concept outcomes. Results indicated that Teaching Empathy (and its' two component factors) had no effect on student outcomes in this area ($t= 362$, NS). On reflection this result is understandable in many ways when one realises that only one of the students' many teachers, their mathematics teacher, was evaluated in this study. Thus the effect of one teacher's interactions with a student, even if highly supportive and empathic, would be unlikely to influence greatly a student's overall conception of the schooling experience. It is interesting to note however that students' Mathematics Ability is positively related to their General

School Self-Concept outcome scores ($t=3.58, p < .001$) It would therefore appear that a student's underlying aptitude in mathematics (which tends to be highly correlated with overall IQ) does positively effect the degree of a student's self-conception of the overall schooling experience

Several correlates measured in the present study emerged as having a significant influence on students' General School Self-Conceptions. These were Teacher Sex, School Sex and School Type. The Teacher Sex result implied a positive increment for students of male teachers over their female counterpart. However the validity of the interpretation of this result is spurious, for the reasons already outlined suggesting that the influence of the one teacher surveyed in each school could hardly be expected to create or influence greatly a student's General School Self-Conception. The School Type result indicated a positive increment for students in Vocational Schools, a positive increment for students in Secondary Schools (although not quite as large as that of vocational schools) and a negative change for students in Community Schools/Colleges. While on the surface these results appear interesting and indeed controversial, it should be remembered that the study's school population size is quite small, represented by three Vocational Schools, eleven Secondary Schools and two Community Schools/Colleges. Regarding the School Sex result, there was a positive increment in

General School Self-Concept for all male schools and mixed schools (i.e. Vocational and Community Schools) and no change for all female schools. Again the results are interesting but with the size of the School Sex population being relatively small and being restricted by the data that was collected for what was essentially a study of the influence of Teaching Empathy on Mathematics Learning outcomes, the full and concise interpretation these results are seen as beyond the scope of the present study.

8.3 CONCLUSIONS

Teaching Empathy has been shown in the present study to be positively related to the cognitively-based, Mathematics Learned outcomes and to the affectively-based, Mathematics Self-Concept outcomes of first year second level school children, studying the Sets and Venn Diagrams module of mathematics at their respective schools. Subsequent analysis indicated that (a) the *Personal Focus of Teacher* component of Teaching Empathy specifically influenced Mathematics Learned outcomes and (b) the *Supportive Teaching Style* component of Teaching Empathy had a causal influence on student Mathematics Self-Concept outcomes.

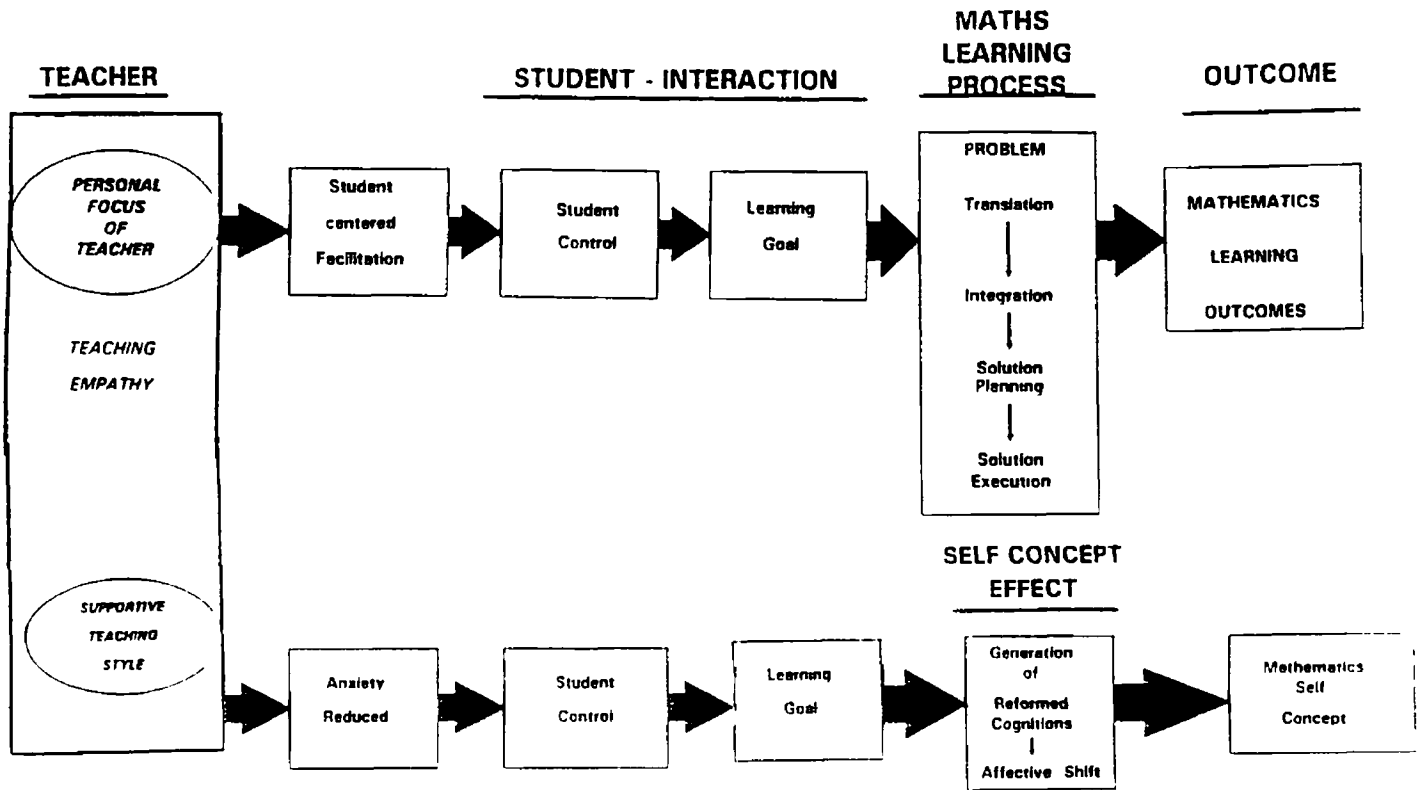
The *Personal Focus of Teacher* component of Teaching Empathy appears to have influenced student Mathematics learning by initiating a process

which imparted to students an element of control over the learning situation through facilitative interaction. This student control of learning led to an empowerment, which can change the goals of the instructional situation from Performance based ability directed goals to effort grounded Learning goals. This release leads to increased proficiency in task-analysis activities such as information translation, integration and encoding. This appeared to be specially true for female students who scored significantly better than their male counterparts in Mathematics Learned assessed

The *Supportive Teaching Style* component of Teaching Empathy appeared to influence student self-concept outcomes by mediating student anxiety relating to the novel material they were covering, ensuring that all students understood the matter being covered and found the subject interesting and alive. Male teachers appeared to score significantly better than their female colleagues at generating positive student mathematics self-concept outcomes, regardless of the sex of the students they taught. Figure 11 below displays in graphic form the process that is suggested to have taken place with the population in the present research

Figure 11 *The process of Teaching Empathy influence on student*

Cognitive and Affective outcomes in Mathematics Learning



The implications of the results of this research study are diverse. It is clear that Teaching Empathy is at very least a bi-dimensional concept, the first dimension (*Supportive Teaching Style*) indicating a cognitively oriented series of behaviours that reflect teachers' efforts to empathise with the cognitive functioning of their students. The second dimension of Teaching Empathy identified (*Personal Focus of Teacher*) appears to involve a personalised connection between teacher and student which indicates a more effective affiliation with student well-being.

These conclusions would concur with the conceptualisations of researchers such as Davis (1983) and Carey, et al , (1988) who view empathy as encompassing both cognitive and affective reactions. The physical aspect of empathy proposed in the definition cited in Chapter Four (p 90), does not appear to have been relevant in this study.

Perhaps the most exciting results in this study are that the affective, *Personal Focus of Teacher*, component of Teaching Empathy was significantly related to student Mathematics Learning, indicating that the clear presentation of declarative information alone is not sufficient for efficacious learning in mathematics in the conditions outlined in this study. A teacher's personalised equity with, and encouragement of students, is what mediates students' actual learning of the material being presented.

Meanwhile, the *Supportive Teaching Style* factor of Teaching Empathy, which involves clarity of presentation and explanation of mathematics material being taught, influences not the amount learned, but students' affective disposition toward the subject. This process, it is suggested, is achieved by the lowering of student anxiety regarding the subject matter (which in this study involved novel subject content) which in effect helped students alter their confidence level regarding their ability to cope.

These findings if applied to the wider educational setting could have major implications for educational instruction. While many researchers already quoted highlight the importance of personalised teacher interaction for the mediation of student motivation attributions, few have recognised its importance in the mediation of actual declarative learning. If this interpretation is legitimate, then the training of empathic communication (e.g. Milnes & Bertcher, 1980), especially the affective personal interaction aspects, in teacher education would appear to be of significant importance. To date, the importance of such personal communicative skills are under-represented in teacher training, certainly in Ireland, with greater emphasis being put on the transference of subject based information in a managed and structured fashion.

While this has shown the importance of empathy in the learning and self-concept outcomes in mathematics, further research is needed to clarify the dynamics of these interactions. Of primary importance would be to ascertain whether Teaching Empathy is independent over time. This study took Teaching Empathy to be enduring and invariant (as concluded by researchers such as Aspy, 1975, Feshbach & Feshbach, 1987). However it would be worthwhile in further studies in this area to investigate the independence of empathy over time, as if it proved to be variant, it might imply significant consequences in terms of its relationship with student attributions and self-conceptions. That is to say

that students' changing levels of mathematics and school self-concepts may well mediate their perception of their teachers' level of empathy over time

The individual interaction of the Personal Focus of Teacher component of Teacher Empathy, needs closer observation to evaluate in more detail the process of student learning (i.e. problem translation/integration *etc.*), that it influences and precisely how it does so. Likewise the Supportive Teaching Style component would benefit from further research which would impart a greater understanding of the interaction of these behaviours with the motivational attribution dimensions of students of various abilities

While Teacher Sex appeared to have significant influence on both Mathematics and General Self-Concept outcomes of this research, the breath of the study was not wide enough to deliver a fully satisfactory explanation as to why male teachers outscored their female colleagues in terms of engendering a positive shift in student Self-Concept

Also of concern is the fact that the present study sourced data on Teaching Empathy (independent) and Mathematics Learning and Self-Concept outcomes (dependent) from students alone. Therefore the research may suffer from what Goldstein and Michaels (1985) refer to as

measurement circularity, where only one section of the population furnish all the data employed in the research

Further research should also consider the evaluation of teacher self-perceptions of their empathic ability and perhaps use a form of *gap score analysis* (see, Boulding, Karla, Staelin & Zeithaml, 1993) where the teachers' self perceptions scores are taken from student perceptions of the teacher's empathy levels to render a more utilitarian measure of Teaching Empathy

To conclude, the present research has emphasised the importance of Teaching Empathy in the teaching of first year (second level schooling) mathematics education, both in terms of the amount of Mathematics Learned and student Mathematics Self-Concept. While the study may have illuminated some interesting mediating effects of empathic behaviours in the classroom setting, further explorative research is needed to understand the significant dynamic that takes place between Teaching Empathy behaviour interactions and student levels of attainment on both cognitive and affective mathematics learning goals

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APPENDICES

APPENDIX A

TEST ANSWER SHEET

Use a HB pencil only for completing this answer sheet. Be sure each mark is dark and completely fills the intended space. Completely cross out errors or stray marks.

| SURNAME | | | | | | | | | | FIRST NAME | | | | | | | | | | | |
|---------|---|---|---|---|---|---|---|---|---|------------|---|---|---|---|---|---|---|---|---|---|---|
| A | A | A | A | A | A | A | A | A | A | A | A | A | A | A | A | A | A | A | A | A | |
| B | B | B | B | B | B | B | B | B | B | B | B | B | B | B | B | B | B | B | B | B | |
| C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | |
| D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | |
| E | E | E | E | E | E | E | E | E | E | E | E | E | E | E | E | E | E | E | E | E | |
| F | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F | |
| G | G | G | G | G | G | G | G | G | G | G | G | G | G | G | G | G | G | G | G | G | |
| H | H | H | H | H | H | H | H | H | H | H | H | H | H | H | H | H | H | H | H | H | |
| I | I | I | I | I | I | I | I | I | I | I | I | I | I | I | I | I | I | I | I | I | |
| J | J | J | J | J | J | J | J | J | J | J | J | J | J | J | J | J | J | J | J | J | |
| K | K | K | K | K | K | K | K | K | K | K | K | K | K | K | K | K | K | K | K | K | |
| L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | |
| M | M | M | M | M | M | M | M | M | M | M | M | M | M | M | M | M | M | M | M | M | |
| N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | |
| O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | |
| P | P | P | P | P | P | P | P | P | P | P | P | P | P | P | P | P | P | P | P | P | |
| Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | |
| R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | |
| S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | |
| T | T | T | T | T | T | T | T | T | T | T | T | T | T | T | T | T | T | T | T | T | |
| U | U | U | U | U | U | U | U | U | U | U | U | U | U | U | U | U | U | U | U | U | |
| V | V | V | V | V | V | V | V | V | V | V | V | V | V | V | V | V | V | V | V | V | V |
| W | W | W | W | W | W | W | W | W | W | W | W | W | W | W | W | W | W | W | W | W | W |
| X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z |

| DATE OF BIRTH | | |
|---------------|-------|------|
| DAY | MONTH | YEAR |
| Jan | | |
| Feb | | |
| Mar | | |
| Apr | | |
| May | | |
| Jun | | |
| Jul | | |
| Aug | | |
| Sep | | |
| Oct | | |
| Nov | | |
| Dec | | |

| ID NUMBER | | | | | | | | | |
|-----------|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 8 | 2 | | | | | | |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |
| 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 |

SEX

MALE

FEMALE

| CLASS | |
|-------|----|
| P | 4 |
| S | 3 |
| S | 5 |
| PP | 1 |
| | 2 |
| | 3 |
| | 4 |
| | 5 |
| | 6 |
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| | 50 |

Start with number 1 for each new section.
 If a section has fewer than 50 questions, leave the extra spaces blank.
 If a question has fewer than 5 options, leave the extra spaces blank.

| SECTION 1 | |
|-----------|-------------|
| 1 | A B C D E F |
| 2 | A B C D E F |
| 3 | A B C D E F |
| 4 | A B C D E F |
| 5 | A B C D E F |
| 6 | A B C D E F |
| 7 | A B C D E F |
| 8 | A B C D E F |
| 9 | A B C D E F |
| 10 | A B C D E F |
| 11 | A B C D E F |
| 12 | A B C D E F |
| 13 | A B C D E F |
| 14 | A B C D E F |
| 15 | A B C D E F |
| 16 | A B C D E F |
| 17 | A B C D E F |
| 18 | A B C D E F |
| 19 | A B C D E F |
| 20 | A B C D E F |
| 21 | A B C D E F |
| 22 | A B C D E F |
| 23 | A B C D E F |
| 24 | A B C D E F |
| 25 | A B C D E F |

| SECTION 2 | |
|-----------|-------------|
| 1. | A B C D E F |
| 2. | A B C D E F |
| 3. | A B C D E F |
| 4. | A B C D E F |
| 5. | A B C D E F |
| 6. | A B C D E F |
| 7. | A B C D E F |
| 8. | A B C D E F |
| 9. | A B C D E F |
| 10. | A B C D E F |
| 11. | A B C D E F |
| 12. | A B C D E F |
| 13. | A B C D E F |
| 14. | A B C D E F |
| 15. | A B C D E F |
| 16. | A B C D E F |
| 17. | A B C D E F |
| 18. | A B C D E F |
| 19. | A B C D E F |
| 20. | A B C D E F |

USE

CLASS

LEAVEN

EDUCATIONAL RESEARCH CENTRE, St. PATRICK'S COLLEGE, DUBLIN 9

UTILITY FORM - 02

Side 2

Use a HB pencil only for completing this answer sheet. Be sure each mark is dark and completely fills the intended space. Completely erase any errors or stray marks.

Start with number 1 for each new section. If a section has fewer than 50 questions, leave the extra answer spaces blank. If a question has fewer than five options, leave the extra spaces blank.

| SECTION 3 | SECTION 4 | SECTION 5 | SECTION 6 |
|-----------------|--------------|--------------|--------------|
| 1. A B C D E F | 1 A B C D E | 1 A B C D E | 1 A B C D E |
| 0 0 0 0 0 0 | 2 A B C D E | 2 A B C D E | 2 A B C D E |
| 2. A B C D E F | 3 A B C D E | 3 A B C D E | 3 A B C D E |
| 0 0 0 0 0 0 | 4 A B C D E | 4 A B C D E | 4 A B C D E |
| 3. A B C D E F | 5 A B C D E | 5 A B C D E | 5 A B C D E |
| 0 0 0 0 0 0 | 6 A B C D E | 6 A B C D E | 6 A B C D E |
| 4. A B C D E F | 7 A B C D E | 7 A B C D E | 7 A B C D E |
| 0 0 0 0 0 0 | 8 A B C D E | 8 A B C D E | 8 A B C D E |
| 5. A B C D E F | 9 A B C D E | 9 A B C D E | 9 A B C D E |
| 0 0 0 0 0 0 | 10 A B C D E | 10 A B C D E | 10 A B C D E |
| 6. A B C D E F | 11 A B C D E | 11 A B C D E | 11 A B C D E |
| 0 0 0 0 0 0 | 12 A B C D E | 12 A B C D E | 12 A B C D E |
| 7. A B C D E F | 13 A B C D E | 13 A B C D E | 13 A B C D E |
| 0 0 0 0 0 0 | 14 A B C D E | 14 A B C D E | 14 A B C D E |
| 8. A B C D E F | 15 A B C D E | 15 A B C D E | 15 A B C D E |
| 0 0 0 0 0 0 | 16 A B C D E | 16 A B C D E | 16 A B C D E |
| 9. A B C D E F | 17 A B C D E | 17 A B C D E | 17 A B C D E |
| 0 0 0 0 0 0 | 18 A B C D E | 18 A B C D E | 18 A B C D E |
| 10. A B C D E F | 19 A B C D E | 19 A B C D E | 19 A B C D E |
| 0 0 0 0 0 0 | 20 A B C D E | 20 A B C D E | 20 A B C D E |
| 11. A B C D E F | 21 A B C D E | 21 A B C D E | 21 A B C D E |
| 0 0 0 0 0 0 | 22 A B C D E | 22 A B C D E | 22 A B C D E |
| 12. A B C D E F | 23 A B C D E | 23 A B C D E | 23 A B C D E |
| 0 0 0 0 0 0 | 24 A B C D E | 24 A B C D E | 24 A B C D E |
| 13. A B C D E F | 25 A B C D E | 25 A B C D E | 25 A B C D E |
| 0 0 0 0 0 0 | 26 A B C D E | 26 A B C D E | 26 A B C D E |
| 14. A B C D E F | 27 A B C D E | 27 A B C D E | 27 A B C D E |
| 0 0 0 0 0 0 | 28 A B C D E | 28 A B C D E | 28 A B C D E |
| 15. A B C D E F | 29 A B C D E | 29 A B C D E | 29 A B C D E |
| 0 0 0 0 0 0 | 30 A B C D E | 30 A B C D E | 30 A B C D E |
| 16. A B C D E F | 31 A B C D E | 31 A B C D E | 31 A B C D E |
| 0 0 0 0 0 0 | 32 A B C D E | 32 A B C D E | 32 A B C D E |
| 17. A B C D E F | 33 A B C D E | 33 A B C D E | 33 A B C D E |
| 0 0 0 0 0 0 | 34 A B C D E | 34 A B C D E | 34 A B C D E |
| 18. A B C D E F | 35 A B C D E | 35 A B C D E | 35 A B C D E |
| 0 0 0 0 0 0 | 36 A B C D E | 36 A B C D E | 36 A B C D E |
| 19. A B C D E F | 37 A B C D E | 37 A B C D E | 37 A B C D E |
| 0 0 0 0 0 0 | 38 A B C D E | 38 A B C D E | 38 A B C D E |
| 20. A B C D E F | 39 A B C D E | 39 A B C D E | 39 A B C D E |
| 0 0 0 0 0 0 | 40 A B C D E | 40 A B C D E | 40 A B C D E |
| | 41 A B C D E | 41 A B C D E | 41 A B C D E |
| | 42 A B C D E | 42 A B C D E | 42 A B C D E |
| | 43 A B C D E | 43 A B C D E | 43 A B C D E |
| | 44 A B C D E | 44 A B C D E | 44 A B C D E |
| | 45 A B C D E | 45 A B C D E | 45 A B C D E |
| | 46 A B C D E | 46 A B C D E | 46 A B C D E |
| | 47 A B C D E | 47 A B C D E | 47 A B C D E |
| | 48 A B C D E | 48 A B C D E | 48 A B C D E |
| | 49 A B C D E | 49 A B C D E | 49 A B C D E |
| | 50 A B C D E | 50 A B C D E | 50 A B C D E |

ORGANISER'S GUIDE

The following is a list of details aimed at both standardising and simplifying the test administration for the teacher involved in the research project

- 1 Test package is collected from Finian Buckley or the Student Teacher assigned in your school
- 2 The appropriate first year classes should be selected
- 3 A check should be made that a sufficient number of test packages are on hand to cope with the number of students in these classes
- 4 Questionnaire administration to class(es)
- 5 Questionnaires/Answer sheets collected from students
- 6 Questionnaire answer sheets coded as outlined for that class
- 7 Return Questionnaires to Finian Buckley

STANDARDISED QUESTIONNAIRE ADMINISTRATION INSTRUCTIONS/TALK

For the purpose of this scientific research project it is most important that the following instructions be complied with precisely when presenting the questionnaire to the students

- 1 If necessary, introduce yourself to the students

- 2 Ask students for their co-operation with this research project, emphasising that it is not a test, and thus they should not be anxious. The aim of the research is to establish why some students are more successful at Mathematics than others

- 3 Assure students of confidentiality and anonymity

- 4 Explain the Questionnaire/ Answer sheet format
Each student should have,
 - a) A copy of the Teacher Student Interaction Questionnaire
 - b) A copy of the Self-Description Questionnaire

 - c) A Blue Answer Sheet (Utility Form)

4 Outline the method of completing the Answer sheet, in particular the following.

- * No mark should be put on the Questionnaires
- * Taking the Answer Sheet, Students should first write their name along the top of the form above the area marked Surname and First name They need not use the complex letter grid to fill in their name, just writing it down will suffice
- * Next step is to fill in their date of birth in the space provided Again it is not necessary to fill in the grid, just writing it long-hand in the space provided will suffice
- * The next item to be filled in is their Sex, by filling in either the male or female box provided

***** / *****

- * The first Questionnaire to be completed is the Teacher Student Interaction Questionnaire, The replies to which should inserted in Section 1 of the Answer Sheet provided
- * Taking item one as an example "My Teacher will talk to me individually", the student decides which answer, A to E, they feel is appropriate from their experience In replying to all items in this Questionnaire students should refer to their present Mathematics teacher
- * Having decided which answer best describes their experience they go to Section 1 of the answer sheet and shade in the appropriate box next to item one in that section

* Students should be informed that if by accident, they fill in the wrong box, then they should put an X through that box and shade in the box they feel is appropriate

* When students have completed the Teacher Student Interaction Questionnaire they may progress immediately to the next Questionnaire which is the Self-Description Questionnaire

The same answering procedure applies to this questionnaire and replies should be entered in Section Two of the answer sheet

* When all students have completed the questionnaires, they should place the completed questionnaires in a box/table/pile at the end of the room when the teacher instructs them to do so

* Students should be thanked for their attention and co-operation

* The answer sheets should be checked to insure that the correct class and school code is clearly marked on each one

APPENDIX C

CLASSIFICATION BACKGROUND OF IRISH EDUCATION

The Irish School Classification

In the Irish second level educational system there are a variety of school classification types. These typically originate from the management structure which the school is organised about. It is perhaps clearest to use the rudimentary classification employed by Breen (1984 & 1986) in his investigations on student performance and education and employment trends. The triadic classification he employs (see also, Murphy, 1980), which was adopted by this study, allots schools to the following categories

- 1 Secondary Schools
- 2 Vocational Schools
- 3 Community/Comprehensive Schools/Colleges

Secondary Schools These are characterised traditionally as private voluntary schools (single sex), run in the main by the religious orders. While they receive government grants and most do not charge fees, a small number do charge termly rates. In this study of the nine secondary schools participating two were fee paying schools.

While Secondary schools historically provided mainly an academic education (Breen, 1986), this trend is beginning to change slowly with the introduction of the New Junior Certificate and the arrival of the

mandatory transition year studies. However few would argue that the educational ethos of the secondary school is still linked strongly to the academic pedagogy of university entrance. It is especially important to note that secondary schools, being effectively private in nature, can reserve the right to accept or reject a student for entrance as they so wish. This is traditionally done on the basis of an entrance test result, with only those reaching a certain achievement level being accepted. However, with the present demographic profile indicating a drop in the school going population, such schools are becoming less selective in the recruiting of students. Realising this, it is still relevant to note reports such as that by Marks, Cox and Pomian-Szrednicki (1983) which dealt with achievement standards in English schools, and indicated that selective schools appear to have significant enhancing effect on student performance. While the degree of variance attributable to such factors is extremely difficult to measure, its presence must be recognised as a possible influence on scholastic attainment.

Vocational Schools. These schools are administered by local vocational education committees and are effectively state financed. Vocational education committees are in a sense a sub-section of the local city or county council with their membership being mostly composed of the elected members of these councils.

When the modern vocational school system was instituted after the Vocational Education (Amendment) Act 1970, one of the primary objectives was the provision of technical education to a wider population. This technical subject specialisation is still in evidence to-day, although there is a growing emphasis on the Leaving Certificate in recent times. At present the vocational schools have perhaps the widest choice of subjects available to students in the Irish educational system.

Vocational schools being state run, are consequently obligated to accept all presenting students regardless of intellectual level (unless psychological evaluation suggest alternative education would be more advantageous). Such a restriction on selection of entrants may have an overall depreciating influence on the subsequent scholastic performance of students (see Marks et al , 1983).

Community/Comprehensive Schools/Colleges: Although taken in this study as one classified type, there are in fact three separate and distinct school structures in this category. These are Community Schools, Community Colleges, and Comprehensive Schools.

All three school types share a common factor, they all offer a comprehensive choice of subjects, both academic and technical, to the attending students. All three of these schools types have management

boards with some VEC representation and varying degrees of religious and parental involvement

In common with vocational schools, these school types are also obligated to accept students in their catchment area, regardless of academic ability

For a more comprehensive review of the background and development historically and politically of the categories of school forms in Ireland see Coolahan (1981)

While it can be argued that school type can have an influence on student learning because of curricular variations or ethos differences, researchers must be aware that different school types recruit students from divergent class and socio-economic backgrounds. This has historically been the case in Ireland and the manifestations of the varieties are important to understand

Socio-Economic Background of Students

Perhaps one of the most fiercely contested debates in the sociology of education in recent decades has been the issue of school effectiveness. Primarily the debate centred around the debate as to whether student school attainment or performance is mediated more significantly by in-school factors than background or social/contextual factors

The initial controversy in this dialectic was activated by Coleman *et al*, 1966, in a large scale study conducted in the United States. Their contentious findings indicated that "schools bring little to bear on a child's achievement that is independent of his background and general social context" (Coleman *et al*, 1966, p 325). The Plowden Report (1967) in England concurred with this evaluation, as it also asserted the importance of independent student characteristics and the home environment, in the levels of school attainment.

In the decades since then many studies have questioned the importance of out-of-school factors and have indeed indicated that the schooling process is somewhat more important than the early studies concluded (see, Madaus, Airasian and Kellaghan, 1980, Rosenshine, 1971). While the conclusions vary as to the extent of the significance of out-of-school factors, it would be careless not to attempt to identify and take heed of such variables as Social Class Background (SCB) of students which have shown to have significant effects on school attainment (see, Craft, Raynor, and Cohen 1980). Other evidence suggests for example that entrants to the Vocational school sector are generally of perceived lower ability than those of the secondary school cohort (Greaney, 1973, Hannan and Breen *et al*, 1983).

The explanations offered for these apparent class/SEB differentials have been varied, but one common theme is that voiced by Lane (1972). His

evaluation of the situation led him to surmise that Working class and Middle class members, possess differing world models and therefore have radically different views on the possibilities of personal social ascent. Thus it was surmised that the importance of educational attainment is viewed differentially by the two separate SEB groups.

Realistically however the statement that social class background influences scholastic attainment belies the fact that such a classification is in fact an umbrella for a variety of related factors. Examples of these would include, bad housing, inadequate care, lack of parental support (see, Taylor, 1980).

For the purposes of this study the SEB of the students is estimated globally based on the school type as cited by Hannan, Breen, Murray, Watson, Hardimann and Higgins (1983). In Table A, below the differential composition rates of Irish schools in 1983 can be seen to reflect the distribution of students according to social class.

Breen (1986) highlights that Vocational schools appear to have a concentration of students from the working-class or small farming backgrounds. Conversely, the Secondary schools display a much higher representation of middle class children in their constitution.

Table A The percentage composition of the three school types according to SEB - 1983

| SEB Background of Students | SECONDARY SCHOOLS | | VOCATIONAL SCHOOLS | | COMM. SCHOOLS | |
|----------------------------------|----------------------|-----|-----------------------|-----|------------------|-----|
| | F | M | F | M | F | M |
| | % | % | % | % | % | % |
| Uppr. Middle | 18 | 32 | 8 | 9 | 13 | 15 |
| Lower Middle | 38 | 40 | 22 | 28 | 31 | 33 |
| Upr. Working | 26 | 18 | 31 | 32 | 31 | 27 |
| Lwr. Working | 19 | 11 | 39 | 31 | 26 | 26 |
| Total % | 100 | 100 | 100 | 100 | 100 | 100 |

SOURCE HANNAN AND BREEN ET AL , 1983, P 90

The student breakdown for the Community/Comprehensive schools appears to be to a lesser extent disproportionately made up of a working class cohort and shows an under-representation of the middle-class cohort typified by the secondary school system

Based on this, accepted formula (albeit generalised) the estimated SEB breakdown of students involved in the present study would be similar to that represented by Hannan & Breen et al , (1983) in Table A above

To summarise, it is important to appreciate when reviewing the Irish education system that certain historical factors have influenced school classification. While it is true to say that these *historical* influences are now waning in importance, there are still vestiges present which can influence school ethos and student selection policies. What is also apparent is the proclivity of students of differing social class backgrounds to select different school varieties. While this trend is also reducing with the amalgamation of the traditional single-sex religious schools and the increase in the numbers of Community school/colleges, the bias must be recognised when viewing results of school-based research.

[The research cited in this appendix is referenced in the main Reference section]

APPENDIX D1

THE SELF-DESCRIPTION QUESTIONNAIRE II

| | | False | Mostly False | More False Than True | More True Than False | Mostly True | True |
|-------|---|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|------|
| 61 | English is one of my best subjects | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 61 |
| 62 | I am a nervous person | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 62 |
| 63 | My parents understand me | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 63 |
| 64 | I am stupid at most school subjects | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 64 |
| 65 | I have good friends who are members of my own sex | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 65 |
| 66 | I have lots of friends of the opposite sex | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 66 |
| 67 | I get good marks in mathematics | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 67 |
| <hr/> | | | | | | | |
| 68 | I am ugly | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 68 |
| 69 | I can do things as well as most people | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 69 |
| 70 | I sometimes cheat | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 70 |
| 71 | I can run a long way without stopping | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 71 |
| 72 | I hate reading | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 72 |
| 73 | I often feel confused and mixed up | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 73 |
| 74 | I do not like my parents very much | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 74 |
| <hr/> | | | | | | | |
| 75 | I do well in tests in most school subjects | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 75 |
| 76 | Most boys try to avoid me | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 76 |
| 77 | Most girls try to avoid me | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 77 |
| 78 | I never want to take another mathematics course | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 78 |
| 79 | I have a good looking body | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 79 |
| 80 | I feel that my life is not very useful | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 80 |
| 81 | When I make a promise I keep it | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 81 |

| | | False | Mostly False | More False Than True | More True Than False | Mostly True | True | | |
|-------|--|-------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|-----|
| 2 | I hate things like sports gym, and dance | 82 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 82 |
| 3 | I get good marks in English | 83 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 83 |
| 4 | I get upset easily | 84 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 84 |
| 5 | My parents really love me a lot | 85 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 85 |
| 6 | I have trouble with most school subjects | 86 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 86 |
| 7 | I make friends easily with members of my own sex | 87 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 87 |
| 8 | I get a lot of attention from members of the opposite sex | 88 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 88 |
| <hr/> | | | | | | | | | |
| 9 | I have always done well in mathematics | 89 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 89 |
| 10 | If I really try I can do almost anything I want to do | 90 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 90 |
| 11 | I often tell lies | 91 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 91 |
| 12 | I have trouble expressing myself when I try to write something | 92 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 92 |
| 13 | I am a calm person | 93 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 93 |
| 14 | I'm good at most school subjects | 94 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 94 |
| 15 | I have few friends of the same sex as myself | 95 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 95 |
| <hr/> | | | | | | | | | |
| 16 | I hate mathematics | 96 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 96 |
| 17 | Overall I'm a failure | 97 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 97 |
| 18 | People can really count on me to do the right thing | 98 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 98 |
| 19 | I learn things quickly in English classes | 99 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 99 |
| 20 | I worry about a lot of things | 100 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 100 |
| 21 | Most school subjects are just too hard for me | 101 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 101 |
| 22 | I enjoy spending time with my friends of the same sex | 102 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 102 |

APPENDIX D2

THE DIMENSIONS OF THE SDQ-II EMPLOYED

SELF DESCRIPTION QUESTIONNAIRE

Please select the statement that is nearest to your view
Shade in the space under the letter which corresponds to
your view on Section 2 of your answer sheet

1 Mathematics is one of my best subjects

| | | | | | |
|----------|-----------------|-------------------------------|-------------------------------|----------------|----------|
| A | B | C | D | E | F |
| False | Mostly False | More False Than True | More True Than False | Mostly True | True |

2 People come to me for help in most school subjects

| | | | | | |
|----------|-----------------|-------------------------------|-------------------------------|----------------|----------|
| A | B | C | D | E | F |
| False | Mostly False | More False Than True | More True Than False | Mostly True | True |

3 I often need help in mathematics

| | | | | | |
|----------|-----------------|-------------------------------|-------------------------------|----------------|----------|
| A | B | C | D | E | F |
| False | Mostly False | More False Than True | More True Than False | Mostly True | True |

4 I'm too stupid at school to get into a university

| | | | | | |
|----------|-----------------|-------------------------------|-------------------------------|----------------|----------|
| A | B | C | D | E | F |
| False | Mostly False | More False Than True | More True Than False | Mostly True | True |

5 I look forward to mathematics classes

| | | | | | |
|-------|-----------------|-------------------------------|-------------------------------|----------------|------|
| A | B | C | D | E | F |
| False | Mostly False | More False Than True | More True Than False | Mostly True | True |

6 If I work really hard I could be one of the best students in my school year

| | | | | | |
|-------|-----------------|-------------------------------|-------------------------------|----------------|------|
| A | B | C | D | E | F |
| False | Mostly False | More False Than True | More True Than False | Mostly True | True |

7 I have trouble understanding anything with mathematics in it

| | | | | | |
|-------|-----------------|-------------------------------|-------------------------------|----------------|------|
| A | B | C | D | E | F |
| False | Mostly False | More False Than True | More True Than False | Mostly True | True |

8 I get bad marks in most school subjects

| | | | | | |
|-------|-----------------|-------------------------------|-------------------------------|----------------|------|
| A | B | C | D | E | F |
| False | Mostly False | More False Than True | More True Than False | Mostly True | True |

9 I enjoy studying for mathematics

| | | | | | |
|-------|-----------------|-------------------------------|-------------------------------|----------------|------|
| A | B | C | D | E | F |
| False | Mostly False | More False Than True | More True Than False | Mostly True | True |

10 I learn things quickly in most school subjects

| | | | | | |
|-------------------|-----------------------------|---|---|----------------------------|------------------|
| A False | B Mostly False | C More False Than True | D More True Than False | E Mostly True | F True |
|-------------------|-----------------------------|---|---|----------------------------|------------------|

11 I do badly in tests of mathematics

| | | | | | |
|-------------------|-----------------------------|---|---|----------------------------|------------------|
| A False | B Mostly False | C More False Than True | D More True Than False | E Mostly True | F True |
|-------------------|-----------------------------|---|---|----------------------------|------------------|

12 I am stupid at most school subjects

| | | | | | |
|-------------------|-----------------------------|---|---|----------------------------|------------------|
| A False | B Mostly False | C More False Than True | D More True Than False | E Mostly True | F True |
|-------------------|-----------------------------|---|---|----------------------------|------------------|

13 I get good marks in mathematics

| | | | | | |
|-------------------|-----------------------------|---|---|----------------------------|------------------|
| A False | B Mostly False | C More False Than True | D More True Than False | E Mostly True | F True |
|-------------------|-----------------------------|---|---|----------------------------|------------------|

14 I do well in tests in most school subjects

| | | | | | |
|-------------------|-----------------------------|---|---|----------------------------|------------------|
| A False | B Mostly False | C More False Than True | D More True Than False | E Mostly True | F True |
|-------------------|-----------------------------|---|---|----------------------------|------------------|

15 I never want to take another mathematics course

| | | | | | |
|-------|-----------------|-------------------------------|-------------------------------|----------------|------|
| A | B | C | D | E | F |
| False | Mostly False | More False Than True | More True Than False | Mostly True | True |

16 I have trouble with most school subjects

| | | | | | |
|-------|-----------------|-------------------------------|-------------------------------|----------------|------|
| A | B | C | D | E | F |
| False | Mostly False | More False Than True | More True Than False | Mostly True | True |

17 I have always done well in mathematics

| | | | | | |
|-------|-----------------|-------------------------------|-------------------------------|----------------|------|
| A | B | C | D | E | F |
| False | Mostly False | More False Than True | More True Than False | Mostly True | True |

18 I'm good at most school subjects

| | | | | | |
|-------|-----------------|-------------------------------|-------------------------------|----------------|------|
| A | B | C | D | E | F |
| False | Mostly False | More False Than True | More True Than False | Mostly True | True |

19 I hate mathematics

| | | | | | |
|-------|-----------------|-------------------------------|-------------------------------|----------------|------|
| A | B | C | D | E | F |
| False | Mostly False | More False Than True | More True Than False | Mostly True | True |

20 Most school subjects are just too hard for me

| | | | | | |
|-------|-----------------|-------------------------------|-------------------------------|----------------|------|
| A | B | C | D | E | F |
| False | Mostly False | More False Than True | More True Than False | Mostly True | True |

APPENDIX E

TEACHER EMPATHIC BEHAVIOUR SCALE AS
ASSESSED BY EXPERTS

APPENDIX F

THE STUDENT-TEACHER INTERACTION QUESTIONNAIRE

TEACHER STUDENT INTERACTION QUESTIONNAIRE

In this Questionnaire you will find 15 Behaviours listed
You are asked to indicate your experience of these by choosing
an option ranging from " NEVER " to " ALWAYS "
Having selected your option please mark your choice on the answer
sheet Section 1 by shading the letter corresponding to your choice

MY TEACHER:

1 Will talk to me individually

| | | | | |
|----------|--------------|--------------|------------|----------|
| A | B | C | D | E |
| Never | Infrequently | Occasionally | Frequently | Always |

2 Encourages me

| | | | | |
|----------|--------------|--------------|------------|----------|
| A | B | C | D | E |
| Never | Infrequently | Occasionally | Frequently | Always |

3 Can control a class without difficulty

| | | | | |
|----------|--------------|--------------|------------|----------|
| A | B | C | D | E |
| Never | Infrequently | Occasionally | Frequently | Always |

4 Treats me with respect

| | | | | |
|----------|--------------|--------------|------------|----------|
| A | B | C | D | E |
| Never | Infrequently | Occasionally | Frequently | Always |

5 Communicates well

| | | | | |
|----------|--------------|--------------|------------|----------|
| A | B | C | D | E |
| Never | Infrequently | Occasionally | Frequently | Always |

6 Does not embarrass a student in front of the class

| | | | | |
|----------|--------------|--------------|------------|----------|
| A | B | C | D | E |
| Never | Infrequently | Occasionally | Frequently | Always |

7 Allows me to ask questions

| | | | | |
|----------|--------------|--------------|------------|----------|
| A | B | C | D | E |
| Never | Infrequently | Occasionally | Frequently | Always |

8 Makes it easy for me to talk with them anytime

| | | | | |
|----------|--------------|--------------|------------|----------|
| A | B | C | D | E |
| Never | Infrequently | Occasionally | Frequently | Always |

9 Treats all students equally

| | | | | |
|----------|--------------|--------------|------------|----------|
| A | B | C | D | E |
| Never | Infrequently | Occasionally | Frequently | Always |

10 Makes the subject matter interesting and alive

| | | | | |
|----------|--------------|--------------|------------|----------|
| A | B | C | D | E |
| Never | Infrequently | Occasionally | Frequently | Always |

11 Explains material clearly and fully

| | | | | |
|----------|--------------|--------------|------------|----------|
| A | B | C | D | E |
| Never | Infrequently | Occasionally | Frequently | Always |

12 Understands the needs of each student

| | | | | |
|----------|--------------|--------------|------------|----------|
| A | B | C | D | E |
| Never | Infrequently | Occasionally | Frequently | Always |

13 Helps me sort out my problems and difficulties

| | | | | |
|----------|--------------|--------------|------------|----------|
| A | B | C | D | E |
| Never | Infrequently | Occasionally | Frequently | Always |

14 Is open to go to for advice

| | | | | |
|----------|--------------|--------------|------------|----------|
| A | B | C | D | E |
| Never | Infrequently | Occasionally | Frequently | Always |

15 Makes sure everyone understands the material

| | | | | |
|----------|--------------|--------------|------------|----------|
| A | B | C | D | E |
| Never | Infrequently | Occasionally | Frequently | Always |

APPENDIX G

THE MATHEMATICS ABILITY TEST

YOU HAVE 10 MINUTES FOR THIS TEST
READY GO!

MATHEMATICS TEST

NAME _____
SCHOOL _____
AGE _____

| ADDITION | | SUBTRACTION | | MULTIPLICATION | | DIVISION | | SYMBOLS |
|-----------|--|-----------------|---|-----------------|---|----------------|---|---|
| 1 Add (+) | $\begin{array}{r} 34 \\ 22 \\ \hline 18 \\ \hline \end{array}$ | 4. Subtract (—) | $\begin{array}{r} 26 \\ 13 \\ \hline \end{array}$ | 7 Multiply (x) | $\begin{array}{r} 84 \\ \times 7 \\ \hline \end{array}$ | 10. Divide (+) | $\begin{array}{r} 9 \overline{) 63} \\ \hline \end{array}$ | 13. $38 + 29 = \underline{\hspace{2cm}}$ |
| 2 Add (+) | $\begin{array}{r} 27 \\ 362 \\ \hline 114 \\ \hline \end{array}$ | 5 Subtract (—) | $\begin{array}{r} 618 \\ 121 \\ \hline \end{array}$ | 8 Multiply (x) | $\begin{array}{r} 1216 \\ \times 6 \\ \hline \end{array}$ | 11. Divide (+) | $\begin{array}{r} 7 \overline{) 910} \\ \hline \end{array}$ | 14. $17 + 28 + 19 = \underline{\hspace{2cm}}$ |
| 3 Add (+) | $\begin{array}{r} 312 \\ 27 \\ \hline 101 \\ \hline \end{array}$ | 6. Subtract (—) | $\begin{array}{r} 316 \\ 127 \\ \hline \end{array}$ | 9. Multiply (x) | $\begin{array}{r} 719 \\ \times 14 \\ \hline \end{array}$ | 12. Divide (+) | $\begin{array}{r} 8 \overline{) 672} \\ \hline \end{array}$ | 15. $318 - 49 = \underline{\hspace{2cm}}$ |

| | | | | |
|-----------------|-------|-------|-------|-------|
| Office Use Only | | | | |
| Total | Total | Total | Total | Total |

APPENDIX H

THE MATHEMATICS MODULE ASSESSMENT TEST

ASSESSMENT SECTION ONE

1 The correct symbol for "a Subset of" is

| | | | | |
|-------|--------|---------|---|-----------|
| A | B | C | D | E |
| \in | \cap | $\{ \}$ | A | \subset |

2 The correct symbol for the "Complement of a Set" is

| | | | | |
|---|-------|----|--------|--------------|
| A | B | C | D | E |
| U | \in | A' | \cap | \checkmark |

3 The correct symbol for the "element of a set" is

| | | | | |
|-------|----|--------|---|---|
| A | B | C | D | E |
| \in | A' | \cap | X | U |

4 The correct symbol for "not an element of the Set" is

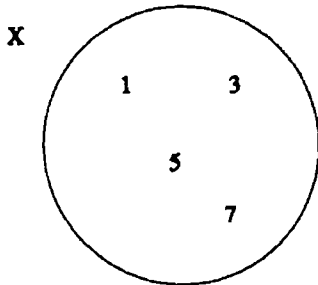
| | | | | |
|---|-----------|-------|----------|----------|
| A | B | C | D | E |
| X | \subset | \in | \notin | Σ |

5 The correct symbol for "not a Subset of" is

| | | | | |
|---------------|----------|----|--------|---------|
| A | B | C | D | E |
| $\not\subset$ | \notin | A' | \cap | $\{ \}$ |

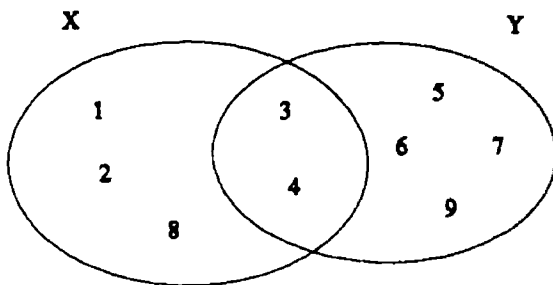
ASSESSMENT SECTION TWO

1 Which of the statements A to E is correct for the Venn Diagram shown



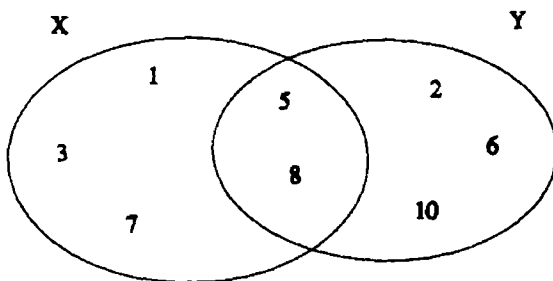
- A $X = \{1, 2, 3, 5, 7\}$
- B $X = \{\text{All odd numbers } \leq 10\}$
- C $3 \in X$
- D $4 \in X$
- E $X \in \{1, 3, 5, 7\}$

2 Which of the statements A to E is correct for the Venn Diagrams shown



- A $X \cup Y = \{3, 4\}$
- B $X \cap Y = \{3, 4\}$
- C $X \subset Y = \{1, 2, 3, 4, 8\}$
- D $X = Y = \{3, 4\}$
- E $Y \in X = \{3, 4\}$

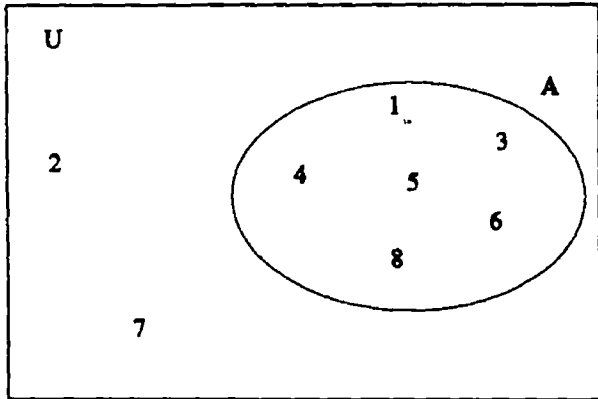
3 Which of the statements A to E is correct for the Venn Diagrams shown



- A $X \cup Y = \{1, 2, 3, 5, 6, 7, 8, 10\}$
- B $X \cap Y = \{5\}$
- C $X = \{\text{all odd numbers } \leq 10\}$
- D $X \subset Y = \{1, 2, 3, 5, 6, 7, 8, 10\}$
- E $X \cup Y = \{5, 8\}$

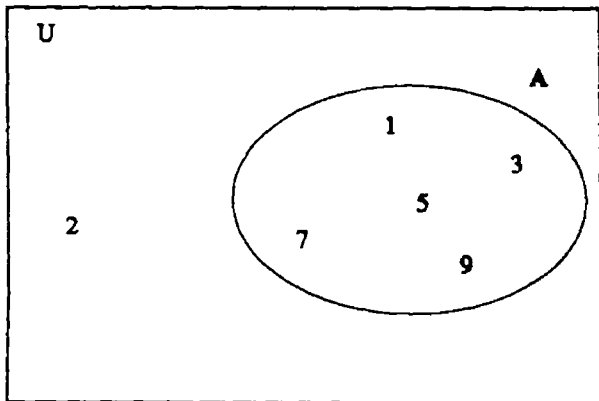
ASSESSMENT SECTION TWO continued

4 Which of the statements A to E is correct for the "Complement of A"



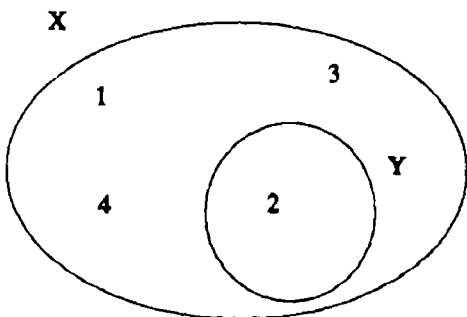
- A $A' = \{1, 3, 4, 5, 6, 8\}$
- B $A' = \{1, 2, 3, 4, 5, 6, 7, 8\}$
- C $U = \{2, 7\}$
- D $A' = \{1, 2, 7\}$
- E $A' = \{2, 7\}$

5 Which of the statements A to E is correct for the Venn Diagram shown



- A $A = \{1, 2, 3, 5, 7, 9\}$
- B $A' = \{1, 3, 5, 7, 9\}$
- C $2 \notin A$
- D $2 \in A$
- E $9 \notin 9$

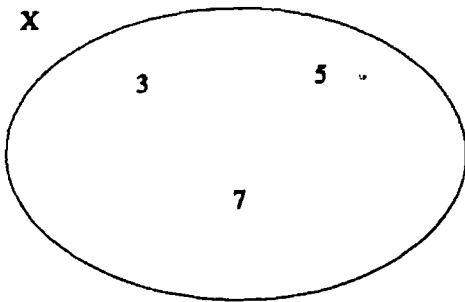
6 Which of the statements A to E is correct for the Venn Diagram shown



- A $Y \subset X$
- B $Y \not\subset X$
- C $X \cap Y = \{2, 3\}$
- D $X \cup Y = \{3\}$
- E $Y = \{1, 2, 3, 4\}$

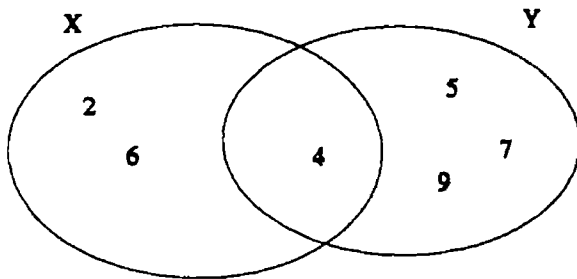
ASSESSMENT SECTION TWO continued

- 7 Which of the statements A to E is correct for the Venn Diagram shown



- A $X = \{\text{all odd numbers} \leq 10\}$
- B $1 \in X$
- C $\{ \} \subset X$
- D $\{3, 5, 7\} \subset \{3, 5, 7\}$
- E $X = \{12\}$

- 8 Which of the statements A to E is correct for the Venn Diagram shown



- A $X \cap Y = \{2, 4, 6\}$
- B $X \cup Y = \{4\}$
- C $X \subset Y$
- D $2 \notin X$
- E $\{ \} \notin Y$

ASSESSMENT SECTION THREE

- 1 Using Venn Diagrams to solve the problem below, which of the statements A to E is the correct answer?

Problem " There are 50 teenagers in a Youth Club all of whom play at least one of the two games offered 22 play Table Tennis (T) overall however 10 of these play Table Tennis and Basketball How many play Basketball (B) only?

| A | B | C | D | E |
|----|----|---|----|----|
| 22 | 28 | 2 | 38 | 32 |

- 2 Using Venn Diagrams to solve the problem below, which of the statements A to E is the correct answer ?

Problem Of the 116 passengers who boarded an aircraft in Paris bound for Dublin, all of them spoke at least one of the three languages, French (F), English (E), or German (G)
75 spoke French, 70 spoke English, 39 spoke German
20 passengers spoke French and German but not English
35 spoke French and English but not German
7 spoke German and English but not French
3 passengers spoke all Three languages

Solve How many passengers overall spoke French or German?
(i e what is $F \cup G$?)

| A | B | C | D | E |
|----|----|----|----|-----|
| 71 | 91 | 20 | 23 | 114 |

ASSESSMENT SECTION THREE continued.

- 3 Referring to the problem outlined in Question 2 above, using Venn Diagrams find the correct answer A to E for the following problem

Solve *How many passengers overall spoke French or English?*
(i.e. what is $F \cup E$?)

| A | B | C | D | E |
|-----|----|----|-----|----|
| 107 | 35 | 38 | 145 | 33 |

- 4 Using Venn Diagrams to solve the following problem, what is $Z \cap S \cap N$?

Problem

50 first year students were asked whether they watched any or all of the TV programmes, Zig & Zag (Z), The Simpsons (S) and Neighbours (N)

4 said they watched Zig & Zag only

6 said they watched The Simpsons only

5 said they watched Neighbours only

8 said they watched Zig & Zag and The Simpsons but not Neighbours

7 said they watched Zig & Zag and Neighbours but not The Simpsons

4 said they watched The Simpsons and Neighbours but not Zig & Zag

3 said they watched none of these TV programmes

How many watched all Three programmes (i.e. $Z \cap S \cap N$)?

| A | B | C | D | E |
|----|----|----|----|---|
| 19 | 37 | 13 | 16 | 3 |