UNIVERSITY OF ALBERTA

A STUDY OF THE MEANINGS OF EXCELLENCE IN SCHOOL MATHEMATICS FOR SECONDARY MATHEMATICS TEACHERS AND STUDENTS

BY

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled "A Study of the Meanings of Excellence in School Mathematics for Secondary Mathematics Teachers and Students" submitted by Douglas Roy Franks in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

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DEDICATION

This work is dedicated to the following very special people:

Roy and Jess Franks

Sandra Franks

Aaron and Jennifer Franks

ABSTRACT

Excellence in education generally is dominated by the "technical" perspective and the standard of "mental proficiency," according to Prakash & Waks (1985), and is thus conceived too narrowly. Research suggests that this perspective also prevails in many mathematics classrooms (Romberg & Carpenter, 1986). The educational excellence debate frequently occurs at the institutional level. What personal notions of excellence appear to hold within the classroom? In what ways do beliefs about mathematics education - for example, its nature and purpose - and classroom experiences in mathematics shape students' and teachers' views on excellence?

In the present research, the nature of excellence in a suburban Canadian secondary school mathematics setting is explored in an interpretive study of the personal perceptions and experiences of senior academic mathematics teachers and students. Classroom observation, individual "qualitative" interviews, a group interview and document review were data gathering methods.

Perspectives on personal excellence, "excellence in education," and excellence in school mathematics were reviewed. Issues which grounded the interpretation included personal excellence as "becoming" and the potential for excellence, excellence as technical goodness and as instrumental goodness (e.g., excellence in professional fields such as teaching), excellence of mind, the "stigma of excellence," <u>arete</u>, excellence of character, excellence and compliance, the notion of "loved work," and the place of "community."

School context was analyzed with a model of conceptions of education as technical, rational, personal, and social. The context was predominantly "technical." Programmatic excellence interpreted as overall student academic achievement prevailed. To extend the potential for individual student excellence within this context, three major categories: student excellent-in-mathematics, excellent-as-such, and excellent-as-human being, were informally constructed by school members, especially teachers.

Tension is inherent in the nature of excellence. Tensions which support some forms of excellence and which limit or deny other forms are considered. It is suggested that school system structures which

especially support academic excellence as "mental proficiency" and the mark as the product of highest instrumental value reduce the quality of "community" and hence the potential for forms of excellence as becoming.

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It is an honour to have been a graduate student in the Department of Secondary Education. I feel privileged to have studied with most members of my committee, and with many other faculty in the Department. They are all truly teachers and scholars. There is unfortunately not enough space to list all those in the Department of Secondary Education to whom I am indebted, but I do wish to acknowledge one person, Dr. Ted Aoki, former chair of the Department. His inspiring example during my early graduate student days was instrumental to my growth.

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PROLOGUE

In an earlier research project (Franks, 1986), I asked young adolescents to rate themselves academically in mathematics: Were they "poor," "fair," "good," or "excellent"? I did not tell them how they were to evaluate themselves. I obtained a range of responses, including a few "excellents," and asked each person the basis of their choice. Marks achieved served as the general basis in most cases, but there were interesting variations. For example, two students - one boy, one girl - whose marks were often below 80% rated themselves as excellent. (I suggest that an average mark of at least 80%, implying frequently obtaining ratings of 80% and more, has been the dominant school criterion for academic excellence.) The typical range of mathematics marks for these two students was 65-80%. For these students their recent achievement level on tests at best could have been only partially responsible for their self-perception of excellence. Further probing revealed that over years of schooling their history of studying mathematics had been marked by frequent success; by being able to "do mathematics." They still believed they were quite capable of "doing it" with relative ease, even though their teachers would not have considered these two students to be excellent in mathematics.

The students' perspectives of their ability seemed to have two effects on their study in mathematics, one positive, the other limiting. First, the self-perception of excellence in mathematics sustained each of them in the study of the subject. They held a positive attitude toward the subject. On the other hand, considering themselves as excellent at their current level of test performance appeared to inhibit these two students from pushing for greater achievement on tests. As long as they could maintain their current levels, supplemented by the occasional higher mark, they were doing "O.K." in their opinion. Student performance on tests often stabilize at a certain level, and that level of performance becomes identified by students as "their" level of ability (Maehr, 1984). However, these were two grade eight students who saw themselves as excellent yet achieved at levels which, according to the dominant school criterion, could at best be described as "good."

One final important note: Perhaps it was the method of evaluation - paper-and-pencil tests - that was limiting. Evaluated in other ways, these two young people may have had a greater opportunity to reveal their claimed excellence in mathematics.

I found the views of the two students intriguing. The 1989 Oxford English Dictionary defines "excellence" as "surpassing merit, skill, virtue, worth, etc.; dignity, eminence," as "that in which a person excels" i.e., "surpasses others or is preeminent in the possession of some quality, or in the performance of some action." From the perspective of test achievement alone, there were certainly a number of other students who routinely surpassed these two and who would have, therefore, been considered more preeminent. On the other hand, there is an aspect of the contemporary definition above that does not explicitly infer competition and ranking against others. "Excel" derives from the Latin excellere, meaning "to rise or raise oneself, to distinguish oneself, to surpass" (Klein, 1971). Perhaps in their own mind the two students felt that over time they had raised and distinguished themselves.

"Excellence" thus became a possible focus for further study. These were student views of personal achievement in mathematics. They were attributed to a history of success and ability. This brief excursion into personal views of excellence was, however, limited to the psychological perspective. I wanted to pursue more broadly the issue of the meaning of excellence in mathematics education for both teachers and students through a hermeneutic study. Such an approach would permit an exploration of the theme of excellence in school mathematics at the levels of academic achievement and personal paradigm, and, potentially, at a level that is deeper, and more ontologically-focused.

CHAPTER 1
A NEED TO EXAMINE 'EXCELLENCE'

Introduction

Recently the phrase "excellence in education" has gained considerable prominence in the education literature, particularly in the United States (e.g. Altbach, Kelly, & Weis, 1985; Mangieri, 1985; National Commission on Excellence in Education, 1983; National Science Board Commission on Precollege Education in Mathematics, Science and Technology, 1983; Tomlinson & Walberg, 1986). Parsons (1987) notes that over three hundred reports have been produced on the subject. Several of the U.S. national reports have spoken of a "crisis" in education. Calls for curriculum and instructional changes have been made in the name of educational excellence.

In Canada, the focus on "excellence in education" has not been as intense or as vocal (Levin, 1986; Podrebarac, 1986). This is not to say that "excellence" and educational change have received no attention. The term, "excellence," is often, even routinely, used to describe institutional programs (e.g., in Alberta, Concordia College's 1988-89 calendar is headed "A Tradition of Excellence"; a senior University of Victoria physical education faculty member comments in the alumni newsletter that "excellence in sport is what it is all about"; the University of Alberta's Faculty of Medicine is congratulated in a 1988 alumni newsletter by other hospitals for "75 Years of Excellence"). McConaghy (1990) notes that "the search for excellence" (cf. Peters & Waterman, 1982) might well turn out to be the catch phrase of the 1980s in North America.

In the 1980s, every provincial Department of Education has conducted a review, frequently involving extensive canvasses of the public in attempts to form policy directions (Council of Ministers of Education, Canada [CMEC], 1988). (See, for example, the British Columbia Royal Commission on Education's <u>A Legacy for Learners</u>, Saskatchewan Education's <u>Policy Direction for a Core Curriculum</u>, Alberta Education's <u>Secondary Education in Alberta</u>, and the Prince Edward Island School System Review Commission's <u>Expectations and Excellence ...</u>

Meeting the Needs. The last title sums up the emphasis of all these reviews.)

The "excellence" term itself can be found occurring frequently in Canadian government educational literature, usually as a description of current educational programs, and as an exhortation to educators to continue their efforts. For example, the 1988-89/1989-90 edition of Nova Scotia's Public School Programs admonishes each school "to do all it can to inspire its students with the desire to achieve the highest degree of excellence that is possible for them and to help them achieve this" (p. 12). Saskatchewan's Policy Direction for a Core Curriculum notes that "the public response also revealed an underlying commitment that, regardless of changes which are made, high standards of academic excellence must be maintained in our schools" (1987, p. 2). And while the Alberta government believed that its education system was not "in crisis" (Alberta Education, 1985a), it does want change. The 1985 Policy Statement on secondary education is replete with statements of concern for "excellence" (Alberta Education, 1985b).

The meaning of "excellence" in this recent literature is often not clear (Podemski, 1985; Parsons, 1987). Still, the general thrust is discerned by critics and proponents alike to be: improved quality of schooling equals higher student test scores (Astin, 1985; Cusick, 1985b; McNeil, 1985; Howe, 1987; Noblit & Pink, 1987; Sirotnik & Goodlad, 1985). The nature of excellence perceived in this way is what Prakash and Waks (1985) refer to as "mental proficiency." It is essentially a technical perspective in which levels of excellence are determined on the basis of scores on achievement tests. Such a perspective of what it means to be "educationally excellent" is narrow. In this perspective the extrinsic or instrumental value of education is principally honoured, with "the major indicator of excellence" as "schooling that produces social and economic utility" (Yeakey & Johnson, 1985, p. 165). Instruction aimed at producing higher scores on these "objective" tests and a disciplined, "no nonsense" school environment (Slaughter, 1985) are critical cornerstones to reaching this technical excellence. The intrinsic value of schooling, "learning for the sheer pleasure of learning, the affective aspects of learning, the building of a cooperative spirit, of policy and of community," is absent or much diminished (Yeakey & Johnson, 1985, p. 165). In this perspective, also, the meaning of education as the personal growth of students (holistically) is less important than the meaning of education in terms of utility and status.

Other meanings of excellence relevant to education need to be considered in depth. Aoki (1990), Greene (1984) and Prakash and Waks (1985) are among those educators who offer different perspectives on what it means to become personally excellent through education. These are discussed in Chapter 2.

School Mathematics

School mathematics is a subject that lends itself to an "excellence-as-high test scores" orientation. In typical secondary school mathematics curricula, (e.g., Alberta Education, 1983, 1989), mathematics is built up gradually, one year upon the next. Topics are slowly expanded and deepened bit by bit. Concepts tend to be precisely defined. Mathematical operations tend to be routinized and rule-governed. Problem solving generally involves identifying the appropriate concepts and mathematical operations to apply in any given problem situation, and knowing how to apply them. The instructional presentation of this mathematics development in the classroom is frequently narrow.

The content of high school mathematics curricula remains subject to considerable discussion (e.g., NCTM Commission on Standards for School Mathematics, 1989). However, achievement in any given school mathematics course is measured by relatively "straightforward" and "objective" testing of students' knowledge of topical concepts, their ability to perform correctly the mathematical operations taught in each clearly delimited topic, and their ability to solve problems within a topical area. Mathematics thus tends to be presented in school as a closed system (Burton, 1987; Fey, 1979; Romberg & Carpenter, 1986). Evaluation tends to focus on so-called objective assessment of student knowledge of that system as taught. (This typical, limited approach to evaluation is challenged in the National Council of Teachers of Mathematics' 1989 Curriculum and Evaluation Standards for School

Mathematics. Recent Alberta Education documents such as the 1989 Mathematics 10/13/14 Teacher Resource Manual also encourage a broader instructional approach.)

Purpose of the Study

The purpose of this interpretive study is to explore the meanings the notion of excellence in a school mathematics context has for high school teachers and students of mathematics. The values - intrinsic and extrinsic, for example - that underpin these meanings are an important aspect of this exploration.

The research was set in Western Canada. Two experienced high school mathematics teachers and seven senior mathematics students from four of the teachers' classes participated in this exploration during the 1988-89 school year. The research principally involved in-depth "qualitative research interviews" (Kvale, 1984) and classroom observation. Supporting documents, such as teachers' tests, school newsletters and related newspaper articles were also collected.

Experienced mathematics teachers are likely to have views of education that have become relatively stabilized. They may also consider themselves as teachers of content and teachers of students. (Teachers have referred to this as being a "mathematics teacher" and an "educator" respectively (Blase, 1986, p. 104).) Experienced mathematics teachers are also established community citizens.

The young people involved are not only students of mathematics but also students of other school subjects. In addition they are adolescents who soon will be leaving school to seek employment or begin post-secondary study, and in general continue their development as citizens. The students thus come to the research situation with beliefs and values which may be significantly different than those of their teachers.

In the context of this interpretive study seeking to understand the meaning and significance of excellence in school mathematics for teachers and students, the major research questions are:

(a) What forms of excellence for students in mathematics are recognized by mathematics teachers and students? How are these forms recognized, and valued? Why are these forms of excellence valued? What variations in views are there among the teacher and student participants?

(b) What standards are associated with the various forms of student excellence? Why have these standards been set? What is the nature of the values that shape these standards?

(c) What purposes and values for teaching and studying mathematics do teachers and students hold? How does this understanding of the purposes and values of school mathematics support, or form the foundation for, the forms of student excellence and their associated standards identified in the study?

(d) What forms of student excellence and associated standards are not valued?

(e) Is excellence in mathematics and schooling stressed, or identified as a goal of teaching? Why is this so, or not so?

(f) What significance is attributed, or not attributed, to student excellence in mathematics, or schooling in general, by the participants?

(g) How do the perceived social values of the school student body influence, or interact with, the desire to be excellent, or the recognition of excellence, according to the student participants?

(h) Upon what aspects of the human character do the identified forms of student excellence appear to draw? How are these forms of excellence shaped by competitiveness, cooperation, community, and individualism?

Significance of the Study

Mathematics traditionally has been seen as an important but difficult school subject (Bishop & Nickson, 1983; Dorfler & McLone, 1986). Achievement in mathematics has often been used as a career "screening device," or "critical filter" (Howson & Wilson, 1986; NCTM Commission on Standards for School Mathematics, 1989), and by authorities as a sign of qualification for "society's rewards" (Howson, Keitel, & Kilpatrick, 1981, p. 53). Thus excelling in mathematics (according to the standards the authorities apply) immediately elevates one's societal status (even if it does not raise one's school social status). What we understand mathematics to be, what its purposes are, and how we come to judge mathematical ability and excellence are, then, important issues.

This study considers these issues in terms of where these judgements are being made, and where these beliefs about mathematics and education are being established: in the classroom where the teachers and students are engaged in the process of teaching and learning mathematics. Here, through question and answer conversations, supported by "interested observation," one seeks to gain an understanding of (i) what teachers and students believe is excellence in school mathematics, and (ii) what teachers and students believe is the significance and value of excelling in mathematics.

These interpretations then need to be considered in terms of the possible aims of mathematics education and education in general, and for what they imply in terms of an expanded view of the possibilities for and meanings of human excellence personally and socially.

<u>Interpretation</u>

"All understanding is interpretation," notes Gadamer (1984, p. 350). This research has as its focus that of gaining a shared understanding of the experience of school mathematics, and what it means to excel within the context of the mathematics classroom. Context is vital, Atkins notes in her examination of the philosophical hermeneutics tradition: "understanding can never be bracketed or separated from a concrete cultural/social situation" (1988, p. 439).

Chief among means of gaining understanding were the interviews. The interviews needed to be carried on, and be seen, as dialogues, or "true conversations" - "a process of two people understanding each other" (Gadamer, 1984, p. 347). A genuine openness to each other was required in order to reach a point of understanding what the person was saying. For this reason, observation of one person by another could never directly produce understanding. However, through observation the classroom environment became a somewhat shared experience, and this may support and facilitate entrance into the dialogical process.

The research process of gaining understanding extended over time, and occurred on at least two levels: One-to-one "qualitative interviews" (producing an expanding "text" to be understood), followed by "dialogues" with the transcribed texts of these conversations. The far greater responsibility for reaching shared understanding therefore laid with the researcher.

The hermeneutic circle, "fundamental to all understanding," (Gadamer, 1984, p. 261), signifies the ongoing movement from the whole to the part, and back again, in our attempts to understand a text or a conversation. As participant and researcher we each stand in our own perspective, our own traditions, which have served as the ground for what we believe. In interpretation, we are not trying to "recapture the [speaker's] attitude of mind," (a psychological view of interpretation) but rather the "perspective within which he has formed his views" (p. 259). The circle is fully realized when understanding is at its fullest, and Gadamer refers to this state as a "fusion of horizons" (p. 273). Kvale (1984), of whom more will be said in Chapter 3, prefers to speak of the "hermeneutic spiral" to avoid the connotation of "vicious circle," and to highlight the deepening understanding that develops.

Three "levels" of description or interpretation were developed. The first, the most "superficial," described an "entry" level view of excellence as achievement. The second level explored the personal meanings that mathematics, and excellence in the mathematics classroom, has for the participants. The third, deepest, level pointed to the ontological character of excellence, although in this study questions of being and excellence are not fully explored. Becoming, community as an essential human quality, and the active moral dimension of human excellence are considered.

<u>Dissertation Overview</u>

There are seven chapters in the dissertation. Chapter two examines the literature of excellence in a general context, in the context of schooling, and in the context of mathematics education. The general discussion begins with an examination of values, drawing attention to the important distinction between instrumental and intrinsic values. A brief overview of human excellence from an historical perspective follows, supplemented with an extended discussion of the Greek understanding of *arete*, particularly Aristotle's writings in *Nichomachean Ethics*. Contemporary views of excellence are considered next. This discussion includes such topics as individual excellence as personal aspiration, the problematic of human excellence, the potential for excellence in all humans, seeking excellence as becoming, the active moral aspects of excellence, excellence of skill, standards of excellence, excellence of mind, excellence of the master, and linking forms of excellence.

The topic of excellence in Chapter 2 then shifts to excellence in an educational context. First discussed is the meaning of educational excellence and possible interpretations in terms of personal excellence, followed by Bouwsma's (1975) interpretation of historical ideals of "educated man [*sic*]." This is followed by a review of educational debate and change in North America in the 1980s in the name of excellence. An interpretive model of contemporary conceptions of education and associated standards of excellence is described next, centered around the work of Prakash and Waks (1985). This model is developed further by correlating the work of Prakash and Waks with Eisner's (1985) orientations to curriculum, Bouwsma's historical ideals, and Slaughter's (1985) analysis of recent educational reports. This "excellence in education" model has significance as a framework for interpreting the meanings of excellence for the participants in this study.

The final section of Chapter 2 is directed to school mathematics. It includes discussions of the perceived values of studying mathematics in school, alternative perspectives of a dynamic and critical school mathematics, common criticisms of current mathematics classroom practices, and the literature of excellence in school mathematics.

Chapter 3 focuses on the process of exploring the meanings of excellence for teachers and students in the context of (mathematics) education. It describes the teacher and student selection process, and the means and processes by which the participants' understanding of excellence in a mathematics and school context were gathered. This is followed by a discussion of the hermeneutic nature of the study and the process of interpretation. Kvale's (1984) analysis of the qualitative research interview is significant here.

Chapter 4 first provides a description of the school, and the teachers and students in the study, focusing particularly on school philosophy, personal backgrounds and views of education, and student self-assessments. The participants' views on the nature of school mathematics and the purposes of school mathematics study close out the chapter.

Chapter 5 offers interpretations of excellence at the school. First, consideration is given to the nature of (the possible) excellence of the school, mathematics program, and the teachers, to help provide a context for the discussion which follows, a description of what teachers and students consider necessary in order for students to achieve consistent success in school mathematics. The chapter then describes those groups of students whom the participant teachers and students identify as being in some way excellent. This teacher and student interpretation of individual excellence represents a consideration of excellence as personal paradigm. The relative instrumental and intrinsic character of these paradigms is an important aspect of this interpretation, and draws upon the literature of values and _aretē_.

Chapter 6 is a synthesis of the empirical and theoretical conceptions of personal and educational excellence, using an "enhanced" Prakash and Waks (1985) model as the principal basis for this synthesis.

The closing chapter, Chapter 7, explores the significance and implications of the study. The possibilities for excellence as "becoming," developing a sense of individuals in community, and the significance of an active moral dimension in school mathematics are considered. Tension as a fundamental quality of excellence is discussed.

CHAPTER 2
EXCELLENCE, EDUCATION, AND MATHEMATICS EDUCATION

Introduction

The literature of excellence, and in particular, human excellence, is examined in this chapter. It begins with a brief, general discourse on values because they are fundamental to what human beings deem worthy of doing, and doing well. An important distinction in this discussion is that between instrumental and intrinsic values. Second, historical perspectives of excellence are summarized. One historical vision of excellence, the Greek perspective, with particular attention to Aristotle's views of intellectual and moral virtues and excellences (<u>areté</u>) which emphasize the intrinsic value of excellence, is examined in greater detail. Set down more than two thousand ye , ago, this perspective is still influential today. The relation between intellectual and moral excellence is significant.

This look at historical perspectives is followed by an examination of various contemporary views on the general concept of excellence. It includes discussion on individual excellence as personal aspiration, the potential for individual excellence in all human beings as an ideal, the problematic of excellence, the possibility of excellence as becoming, the active moral dimension of excellence, excellence as skill and the question of standards for performance, excellence of mind, and excellence of the professional, and of the master.

The focus shifts to education, where, in a parallel development, Western historical perspectives of the ideal "educated person" are first described based on the work of Bouwsma (1975), followed by an examination of contemporary perspectives of excellence in education. The "effective schools" literature is briefly discussed as one interpretation of educational excellence. This is followed by an extended discussion of the North American debate in the 1980s regarding educational change and excellence.

The possibilities for excellence in education are then described in terms of the model provided by Prakash and Waks (1985). This conceptual scheme is further developed through the inclusion of Eisner's (1985) curriculum orientations, and Slaughter's (1985) description and analysis of "technical" and "liberal" educational reports. This model serves as the basis for one level of interpretation of the meanings of excellence held by the participant teachers and students in this study.

The final section of the chapter focuses on school mathematics and excellence in mathematics education. Perceptions of the value of mathematics study are described first, followed by a discussion of various dynamic and critical models of mathematics education. Current practices in many mathematics classrooms stand in contrast to these possibilities, and a critique of these practices is then offered. The literature of excellence with a specific focus on mathematics education is limited, but two studies which identify some possibilities are described, followed by a review of two authors' interpretations of the potential, and the difficulty (given the individualistic, competitive nature of mathematics study) of attaining both excellence and equity in school mathematics and the individual mathematics classroom.

The Notion of Excellence

Values

The Nature of Values

I start with a general consideration of values because, as Crittenden (1973) states,

> [values] are concerned with determining and applying appropriate standards of excellence - whether for inanimate things, people, activities, states of affairs, or styles of human life. An object [or human activity] cannot be said to be valuable unless it possesses features that meet such standards. (p. 4)

It is in the realm of values that excellence in, for example, mathematics and education is essentially defined (e.g., Doyle, 1987; Fantini, 1986; Prakash and Waks, 1985).

Rokeach (1973) defines a value as "an enduring belief that a specific mode of conduct or end-state of existence is personally or socially preferable to an opposite or converse mode of conduct or end-state of existence" (p. 5). According to Bond (1983), having values means valuing some objects, activities, and states of being above others. Valuing means that some things are worth doing, or having, or getting; valuing makes life worth living.

Values are basic to understanding human beings as such. Stern (1962) claims that values "always need a concrete carrier," they cannot exist independently of human experience. Ingarden, in Man and Value, believes that what is

> essential to man's [sic] nature [is] the fact that man experiences the need at all, and even feels the necessity, to have and to come to know values as well as to realize them to the extent that is possible in general, and in the world surrounding him in particular. Man is deeply unhappy without an immediate and intuitive contact with values, without the joy that such contact affords him. (1983, p. 22)

Values, fundamental to aspects of our belief system, are prescriptive or proscriptive guides of our actions (Broudy et al., 1964; Fantini, 1986; Rokeach, 1973).

Rokeach (1973) describes a number of ways values serve as guides or standards, for example, they are employed (a) when presenting oneself to others, (b) when evaluating and judging, blaming and praising oneself and others, (c) when comparing one's own morality and competency with that of others and (d) when taking particular positions on social issues.

As valuing human beings, we have no choice but to accept and use some standard(s) or measure(s), for to claim that nothing is better or worse than anything else is itself a standard-invoking value claim (Weiss, 1974). Similarly, claims that standards are simply relative guides in personal action and judgement, with none better than any others, will not hold indefinitely. Whether done arbitrarily or on reflection, the individual "will submit to a standard, justifying the excluding of others even if that exclusion be based on no other grounds than that one does not care for it" (Weiss, 1974, p. 368). Weiss also makes the point that judgements of personal and societal value are themselves always open to question, implying recourse to "transpersonal" and "trans-social" standards (p. 184).

Values are enduring; they are neither completely stable nor unstable. That is, personal and social change does take place, but seldom so rapidly or completely that "continuity of personality and society" is impossible (Rokeach, 1973, pp. 5,6). Values do vary among people, however, and society does seem to be less consistent in its demands for competence than for moral behaviour, Rokeach notes. Still, as the Rockefeller Fund (1958) report The Pursuit of Excellence claims, those excellent performances which society does warrant fostering are those grounded in purpose and values deemed worthy of societal allegiance.

Instrumental and Intrinsic Values

One significant classification of human values evident in Rokeach's (1973) definition is that of their instrumental or intrinsic orientation (e.g., also Bond, 1983; Rescher, 1969; Stern, 1962). Rokeach refers to intrinsic value as terminal value. Instrumental values are beliefs concerning desirable modes of conduct; intrinsic or terminal values are those beliefs concerning desirable end-states of existence. Stern (1962) makes the connection that "intrinsic values are appreciated for their own sake.... Instrumental values are appreciated only as means fit for the realization of ... intrinsic values. Instrumental values are only deduced values" (p. 103). Neither form of value is necessarily negative or positive in nature.

Terminal values may be personal or social (Rokeach, 1973), that is, they may be values held by the individual which concern personal or societal end-states (e.g., honesty, happiness, world peace). Instrumental values may also be divided into two groups, those such as behaving honestly and responsibly having a moral focus, and those concerned with, for example, behaving logically, intelligently, and creatively, the terminal focus of which is personal competence or self-actualization.

Historical Perspectives on Excellence

A Summary of Some Major Historical Ideals of Humankind

Bouwsma (1975), based on his study of Western cultural tradition, provides a historical perspective of excellence in the form of "ideal human types" (p. 196). These span the period from the time of the Homeric epics and the scribes of the Old Testament to the present. Because Bouwsma's focus is essentially educational, this present discussion of his "ideals of educated man [sic]" is brief, and aims primarily to name and describe the general characteristics of each type, and provide the period(s) of time during which each had ascendency. The form and intent of the education associated with each model is described in a later section of this chapter under the heading "Historical Perspectives of Educational Excellence."

The seven ideals are the aristocratic, the scribe, the civic, the personal self-cultivation, the Christian-secular, the romantic-naturalist, and the research. These models are not sequential; some are recent, others reappear several times over hundreds, even thousands of years. They reveal a gender-biased, patriarchal orientation. Some are still influential today. Each of these ideals is briefly discussed here.

Aristocratic Ideal

The "admirable warrior" of the Homeric epics was an early exemplary human possessing *areté*, or virtue and excellence, and marked the first appearance of Bouwsma's (1975) aristocratic ideal. *Areté* will be described in greater detail in the next section on the Greek perspective. Over the centuries the ideal evolved, appearing again during the Middle Ages as the knight, and, by the sixteenth and eighteenth centuries, as the courtier, and the gentleman. The focus was on the development of the person in all dimensions - physical, moral, and social. Thus, a man was expected "to excel simultaneously in bodily strength, skill, and stamina, in vigor of personality, social gifts, reliability, and good sense" (p. 196). This is a highly elitist ideal, marked by personal superiority in "conspicuous achievement, prestige, and leadership" (p. 196).

Scribe Ideal

Grounded in the scribe culture of the Old Testament, the scribe ideal represents a contrast to the aristocratic insofar as intellect is the preeminent aspect of personality. It, too, is an elitist ideal, wherein social superiority is derived from the scribe's greater literacy. There is also a strong ethical component to the scribe ideal, and its exemplar is expected to be a model of social responsibility. This exemplar is not the hero but the learned, practical individual who is able to manage personal affairs and those of society while demonstrating such "useful but equivocal virtues as prudence, calculation, and foresight, economic enterprise and thrift, vigilance and reticence" (Bouwsma, 1975, p. 198). This early ideal has been influential, particularly in educational terms, through the centuries.

Civic Ideal

This ideal of the model citizen appeared first in the Greek polis, and will be elaborated in the later discussion of excellence in Aristotelian times. The civic ideal reappeared in Rome and again during the Renaissance, and has remained prominent in contemporary discourse. Exemplars of the civic ideal first and foremost understand and perform their social duty. The ideal "is based on a notion of man [sic] as a political animal whose potentialities are realized in the degree to which he is effectively socialized and a participant in the life of his community" (Bouwsma, 1975, p. 200). It is rooted in both the early aristocratic and scribe ideals, being concerned in the first instance with the development of the whole person, and in the second instance with a heavy reliance on literacy. A keenness for "aristocratic competitiveness to identify excellence" (p. 200) means that this, too, is an elitist perspective.

Ideal of Personal Self-Cultivation

The ideal of personal self-cultivation may be identified with the pursuit of individual perfection as an end in itself, and a Stoic isolation or alienation from the social world.

> This ideal has tended to emerge when an effective role in the world's affairs is foreclosed to educated men by historical conditions, as in the Hellenistic world with the decline of the polis, during the earlier Middle Ages, and in the later Renaissance with the loss of civic freedom. (Bouwsma, 1975, p. 202).

The aim of self-cultivation is to pursue a very private kind of human freedom, in order, for example (as at the time of the Stoics), to contemplate the "eternal verities." Marked by pride in distance from "the crowd," this ideal shares a "quintessential elitism" with that of the scribe ideal (p. 203).

Christian-Secular Ideal

All of Bouwsma's (1975) ideals are models of the educated "man" [sic], giving particular attention to the nature and intent of the education necessary to form the exemplary individual. Bouwsma says of the ideals so far discussed:

> The pagan culture originally underlying these other ideals was not secular, in the sense that it sought to understand every dimension of human experience - physical nature, politics, and anthropology - within the context of a single holy and cosmic order governed throughout by a uniform set of rational principles.... education was the process of bringing man into harmony with nature by strengthening the sovereignty of his higher faculties and, ipso facto, making him harmonious within himself. In this sense, the educational ideals of antiquity were generally religious. (p. 204)

The traditional conception of Christian education, the Christian-secular ideal, took issue with this religious perspective of education. For the Christian, education was necessarily secular because "the most important capacity of man is his ability to respond to the love of God" (p. 204), which is beyond the limits of education. The intellectual, then, was not the exemplar of human excellence. Instead, through a devoteness to God, and a practical, yet civilizing education, the good Christian was restrained in his overt sinfulness, and capable of functioning well "in the particular and concrete circumstances of his existence" (p. 205).

Romantic-Naturalist Ideal

The ideals discussed so far agree that "the human personality is basically malleable" (Bouwsma, p. 206) and can be shaped. The romantic-naturalist human ideal, which emerged late in the eighteenth century, "differs radically" in its belief that the telos of the person is immanent, and is no longer derived from religious, ethical, or social sources and "imposed ... from the outside" (p. 206) on human nature. The nature of the child, not some idealized view of the mature person, becomes the ruling principle in the development of the human. Greater individuality and a less social view of humanity are promoted in this model, although "by its indiscriminateness and its lack of objective norms, it is also singularity democratic" (p. 207).

Research Ideal

The last of Bouwsma's (1975) models is the most recent, most narrowly-based, and is "deeply affected by the 'knowledge revolution'" and the resultant conception of education "as preparation for research" (p. 207). The idea of the primary task of the university being to provide a general education or pass on inherited knowledge has been supplanted by that discovering new knowledge. The educated individual best suited to the "broader service of a changing society" has become the specialist trained in research.

Indeed, specialization is the general implication of such an ideal. Whether the specialization has been developed through education, training and apprenticeship, or life experience, in any particular endeavour the exemplary individual is the person who is "bold, critical, imaginative, industrious, innovative, independent, and active" in the generation of specialized product (p. 208). Implicit also in this ideal is its relative devaluing of intrinsic values in favour of the instrumental.

Bouwsma's historical review of human ideal types helps to inform and remind us that notions of personal excellence have changed substantially over time. These changes are non-linear; they are closely tied to the conditions - social, political, and so on - and cultural values of the period.

The Greek Perspective

As shown in the previous section, the idea of excellence as a trait of the individual has been with us since antiquity. The Greek word arete meant excellence, and was a key aspect of Greek ethical thought. Generally translated as "virtue," arete referred to

> excellence of any kind, but from the beginning it was also associated with the idea of fulfillment of function: excellence, whether in animate or inanimate objects, consists in the fullest performance of the object's function or its power to achieve the fullest performance. (Kerferd, 1967, p. 147)

Arete was closely associated with the adjective agathos, traditionally translated as "good." MacIntyre (1966) explains the general preclassic Greek relationship between arete and agathos:

> A man [sic] who performs his socially allotted function possesses [arete]. The [arete] of one function or role is quite different from that of another. The [arete] of a king lies in ability to command, of a warrior in courage, of a wife in fidelity, and so on. A man is [agathos] if he has the [arete] of his particular and specific function" (pp. 7-8).

By the fifth and fourth centuries B.C., changes in Greek society were such that

> we find startling changes in the uses of ... [arete].... [It] now denotes not those qualities by means of which a particular function may be discharged, but certain human qualities which may be divorced from function altogether. A man's [arete] is now personal to himself; it has become far more like what modern writers think of as a moral quality. (MacIntyre, 1966, p. 9)

This general view of _areté_ continued to be developed by such philosophers as Socrates and Plato, culminating with Aristotle. As MacIntyre (1981) notes, if the paradigm of human excellence in Homeric times was the warrior, in Aristotelian times it was the gentleman of Athens.

For Aristotle,

> ...every virtue or excellence both brings into good condition the thing of which it is the excellence and makes the work of that thing be done well; e.g. the excellence of the eye makes both the eye and its work good; for it is by the excellence of the eye that we see well....if this is true in every case, the virtue [or excellence] of man [_sic_] also will be the state of character which makes a man good and which makes him do his own work well. (_Nichomachean Ethics_, II, vi, 1106a15-23)

In other words, for Aristotle, human excellences are primarily properties of persons, not products or actions (Hudson, 1986; Norton, 1980). They are "states [capacities or tendencies of persons] bound up conceptually both with good actions and good agents" (Wallace, 1974, pp. 183-184). It is possible for an individual to perform an act which is identical to that done by an excellent person, and thus is characteristic of the excellence, yet the individual cannot be said to be excellent. This is so, for example, because he or she did not know the action was characteristic of the excellence, or because the particular performance was not done with the desire to perform in an excellent way. As Wallace interprets Aristotle, such an action is characteristic of the excellence, but not _fully characteristic_. "To be _fully characteristic_ of an excellence, an action must be, _strictly speaking_, the sort of action which the excellence is the tendency/capacity to perform" (p. 184). Only then does the praiseworthy action reflect credit on the agent.

Aristotle claims that objects and individuals may have particular functions at which it is their task to excel. Furthermore, there is one trait common to all humans not shared by other species in nature, namely, rationality. "In man's exercise of his rational powers therefore the specific human activity consists, and in the right and able exercise of them lies the specific human excellence" (MacIntyre, 1966, p. 62). Aristotle claims that rationality is exhibited in two types of activity: (a) thinking, where reasoning is constitutive of the activity, and (b) "in such activities other than thinking where we may succeed or fail in obeying the precepts of reason" (MacIntyre, 1966, p. 64). The intellectual virtues represent the excellences of the first, the moral virtues represent the excellences of the second. Aristotle explains that "intellectual virtue [such as art or craft, practical wisdom (phronesis), philosophical wisdom (sophia), or understanding] in the main owes both its birth and its growth to teaching (for which reason it requires experience and time)" (Nicomachean Ethics, II, i, 1103a12-15).

In contrast, Aristotle believes habit gives rise to moral virtues such as courage, liberality and temperance. As human beings, we all have the potential to be morally virtuous, but we are not born virtuous. Virtuous habit is acquired by first performing the acts. "States of character arise out of like activities" (II, i, 1103b22-23). Furthermore, beginning the development of these habits early in life makes all the difference. Because experience and time are required, Aristotle claims that youth cannot possess the moral or intellectual virtues or excellences - with the exception of excellences in such fields as mathematics, whose objects are concerned with universals and do not require familiarity through experience (I, iii, 1095a1-6; VI, viii, 1142a10-20; X, ix, 1179b30-1180a5).

The standard which guides the excellent person in his or her actions is the mean of the function or virtue, according to Aristotle. It is almost always possible to act in an excessive or deficient manner, and the excellent person, using reason, makes right choices, relative to the function or virtue, and to the individual. There are no fixed universal rules of conduct, and in each case the context of the occasion must be taken into account.

What are the relationships between the intellectual and moral virtues? We do not all have the capacities for excellence in particular types of functions or work in which people engage (e.g., cobbling, flute-playing, sculpting), however, we do have the potential for moral excellence. Aristotle states, "...choice cannot exist either without reason and intellect or without a moral state; for good action and its opposite cannot exist without a combination of intellect and character" (VI, ii, 1139a33-34). Hardie (1979) interprets Aristotle's position thusly: "a man [sic] who has practical wisdom (phronesis) necessarily has all the ethical virtues and that, unless he has phronesis, man cannot have all the ethical virtues" (p. 36). Why is this? Practical wisdom is concerned with the affairs of human beings. Practice and experience are critical to phronesis. Those who demonstrate such wisdom have developed their capacity to deliberate and act correctly in universal and particular matters. Therefore Aristotle claims that a person who acquires reason - as in practical wisdom - will demonstrate in his or her action a state of virtue, as shown by those who are virtuous. Now also a state of virtuousness "implies the presence of the right rule, that is virtue [according to a chosen mean of action, neither excessive nor deficient]; and practical wisdom is a right rule about such matters" (Nichomachean Ethics, VI, xiii, 1144b28-29). Thus, both directions of the proposition - as noted by Hardie (1979) - hold.

Now, virtuous actions are signals of human excellence, not ends in themselves. This raises the question, What is the purpose or aim of being virtuous? which in turn becomes a matter of defining the telos of human life. All activities aim at some end which is thought to be good, Aristotle notes in the opening lines of Nichomachean Ethics. Some actions are ends in themselves; others produce ends separate from the activities. In the latter case the ends are "better" than the actions. In turn, subordinate ends are less preferred than the greater end for which the former may be pursued. The final goal, the highest end, is eudaimonia, usually translated as "happiness," or more fully as, for example, "living a good life for a human being" (Nussbaum, 1986, p. 6), attained in the fulfillment of humankind's functions, and most completely realized in the attainment of philosophical wisdom. Aristotle's ethics clearly emphasize the intrinsic, rather than the instrumental, value of excellence or virtue (Klein, 1988; Rescher, 1969). Ross (1953/1980) notes that Aristotle acknowledges that as we humans are composite beings having bodies and irrational elements of soul as well as reason, we cannot solely and completely live the contemplative life. We can find happiness or well-being as a "good person," whose virtues, as Knitter (1988) summarizes them, "are that set of skills, dispositions, and propensities of feeling and action, which enable us to live and do well" (p. 486).

Society and the social character of life is fundamental to Aristotle's politics and ethics (Eby, 1944; Beauchamp, 1982). In the words of Dewey and Tufts (1932), the state for Aristotle was "not merely the goal of the individual's development, but the source of his life" (p. 117). When the ideal, harmonious state is reached, excellence of character flourishes and "each person is encouraged to pursue his special excellence, in accordance with one central principle - that the improvement of citizens is the crucial social undertaking" (Nash & Griffin, 1987, p. 553).

Contemporary Perspectives on Excellence

Introduction

Excellence is a quality which may be attributed to many forms, living or non-living, concrete or abstract, natural or synthetic. Human excellence as the particular excellences of persons is only one form. In this study, however, the excellence of human individuals is the principal focus. The major exception to this is that of educational excellence, to the extent that the focus of educational excellence may be on what collectivities of people accomplish as well as on qualities and merits of individuals. This matter will be discussed in greater detail in later sections of this chapter, and in later chapters. In the sections which follow immediately, attention is given to general considerations of excellence of the person.

The Potential for Human Excellence

The individual is typically paramount in general discussions of human excellence. For example, Arisian (1974) claims in his preface to Individual Excellence and Social Responsibility that "the dignity of the person, his right to evolve a way of his own, is paramount. This is an ideal of excellence. The achievement of excellence and the realisation of individuality go hand in hand" (p. v). The 1989 Oxford Dictionary defines excellence as the possession chiefly of qualities "in an eminent or unusual degree"; "surpassing merit, skill, virtue, worth; dignity, eminence." Individual excellence is about personal aspiration in the attainment of these qualities (e.g., Gardner, 1984; Rockefeller Brothers Fund, 1958; Shor, 1986; Timar & Kirp, 1988; Willie, 1987a). Talent alone is not enough. Excellence can never be thrust upon one, says Hale (1978), but must be achieved through motivation driven by tenacity of purpose and controlled by discipline.

The question of whether all individuals are capable of excellence is one that is open to debate. Contemporary authors such as Arisian (1974), Gardner (1984), Nathanson (1974), and Norton (1980) (for whom Aristotle is an explicit source of support) hold that all human beings have the potential for excellence as it is "innate in personhood" (Norton, 1980, p. 284), and that this potentiality can be at least somewhat realized by many. In contrast, authors such as Glazer (1985) and Lyons (1976) contend that such a view implies a devaluation of the meaning of excellence. This latter perspective is discussed in the next section of this chapter. Before discussing later in this section the view that potentiality can more frequently be realized, it is useful to first briefly introduce what some have termed the "pathology of excellence" (e.g., Posner, 1976).

Personal excellence may very well be problematic for the individual. Lyons (1976) states that the explicit ranking and identification of achievers as superior is often considered to be an "undemocratic conclusion." Posner (1976) claims the notion that our society - that is, our schools, the business world, almost any sphere of life - holds superior behaviour to be preferable and to be rewarded accordingly, "that it is advisable to be successful at all costs," is a "cultural myth" (p. 141). Those who demonstrate some apparent trait of excellence are often "stigmatized." Although her examples of excellence - the possesion of natural beauty, the virtue of being a non-drinker - may be open to question, Posner's description of the "pathology of excellence" is telling. She claims that society is driven instead by the "just right principle" to strive after the North American ideal of normalcy (p. 141). Posner concludes:

> By exposing the myth of moral superiority and simultaneously acknowledging the strong urge to conform in our culture it is seen that excellence is as much a problem for sustaining the social order as incompetence or inadequacy. This fact has far reaching implications for educational and work spheres as well as for more general social interaction. (1976, p. 144)

Singleton (1979) makes a related point. The importance of personal drive is a common theme of excellence revealed in the analysis of a variety of human tasks and skills. It manifests itself "in the overcoming of obstacles and resistance to stress.... the creative individual is, in one sense, at odds with society where conservation is endemic, so that he [or she] must have security of self" (p. 311).

The work of Gardner (1984), Norton (1980) and others may be interpreted as a positive response to the "problematic" just described. These authors do agree that the widespread actualization of excellence is not a mark of contemporary democratic society. They also believe, however, that potentiality for excellence is "universally distributed" (Norton, 1980, p. 284). It is Norton's belief that the commonly-held view ("aberration") that potentiality for excellence is sparsely distributed is due to a focus on objectified "product" outcomes that have become disassociated over generations from the labours of the individuals, and the individuals themselves, who created these products. The particular range and quality of products that have come to be valued in a society define the accepted forms and standards of excellence, and the specific talents suited to these ends. To be considered for acknowledgement of excellent achievement, one must create one of these "products" to accepted standards (p. 285). Other potential excellences of human beings are devalued. (Work within school subjects may also be viewed in similar ways.)

The key to moving away from this common view of excellence as sparsely distributed is - following the Greeks - to ground all consideration of excellence in the question of excellence in persons, and only secondarily (as a derivative) in product-excellence (Norton, 1980). For Gardner (1984), this means understanding excellence as a conception "that may be applied to every degree of ability and to every socially acceptable activity" (p. 120). This is the only conception of excellence that acknowledges the "richly varied potentialities" of humans (p. 119). For example, plumbers, political leaders, musicians, inventors, athletes, and parents all may and should strive for excellence. In the intellectual fields alone there are many kinds of excellence, notes Gardner - the theorist, the researcher, the creative engineer, and the poet are only a few examples. Furthermore,

> there are those who perform great deeds and those who make it possible for others to perform great deeds. There are pathfinders and path preservers. There are those who nurture and those who inspire. There are those whose excellence involves doing something well and those whose excellence lies in being the kind of people they are, lies in their kindness or honesty or courage. (p. 116)

For Gardner, all positive forms of excellence are worthy of pursuit and recognition.

Norton (1980) refers again to the Greeks in drawing upon their understanding of personal excellences as the aretai - those "virtues or excellences" such as "justice, love, honesty, courage, wholeheartedness, fidelity, resourcefulness, [and] highmindedness" (p. 286). His aim is to demonstrate how the potentiality for excellence that he believes is in all humans may be cultivated by reconnecting product-excellence "to its roots and taproot to be found respectively in the work and the person" (p. 285).

Norton disagrees with the Aristotelian view that virtue or excellence is developed through habitual action. Instead, he believes that people who love their work are, for example, "wholeheartedly" committed to it, and give of themselves to others because they are personally invested in the creations (products) of that work. It is their desire to ensure that what they give to others is the best of which they are capable, and in the process, become more deeply self-actualized. The aretai, Norton states

> are the natural expression of the engagement of individuals in the distinctive sort of productive work which by nature is theirs to do. In the interest of cultivating excellence in persons (and the derivative excellence in products) the social task is that of providing the conditions under which individuals qua individuals are given the best possible chance to find the distinctive kind of productive work which is theirs by nature to do, the work which they love to do, and in which they experience intrinsic rewards. (p. 286)

To discover one's "loved work" is ("eudaimonistically") to discover oneself (p. 292), and it is society's responsibility to strongly support and assist the self-discovery process (cf. Nash & Griffin, 1987, p. 553).

Excellence in and through one's chosen work is clearly a fundamental theme for Gardner and Norton, and, although less detailed and classical in his derivation and statement, Nathanson (1974) believes similarly that pride in one's work is indispensable in striving for individual excellence because it means "the creation" and "a prizing of the self through what one is doing" (p. 19). In contrast, the "work ethic" notion focuses on the <u>hard</u> worker and not necessarily on the quality of the work performed. Presently considered a virtue, Nathanson says, this work ethic notion must be replaced by a view that promotes pride in quality of work. Following Norton (1980), such genuine pride, which is not to be equated with pride of status, will come first in one's preferred activities.

<u>The Quality of Achievement - Excellence Devalued?</u>

"Excellence once clearly implied <u>superlative</u>" Donaldson (1985, p. 4) claims, but the term has lost value. Whereas it once meant going well beyond the good, it now is often used to describe the "very good." And Donaldson is not alone in feeling that the label of excellence is often applied too loosely, without adequate regard to standards. For example, although Gardner (1984), discussed in the previous section, claims that he is arguing for more than competence; that he is speaking of "a striving for the highest standards in every phase of life" (1984, p. 161), an attainment which few will truly achieve, Glazer (1985), expressing a more conservative view, believes that Gardner <u>is</u> talking of competence. The term excellence properly should refer to "peaks of achievement" implying "the best." It has effectively been denigrated to the level of "exaggerated praise for modest achievements" (Glazer, 1985, p. 217).

Lyons (1976) also challenges Gardner (1984) (whose book <u>Excellence</u> was originally written in 1961). Lyons claims that although it is typically viewed as "undemocratic" to openly rank and identify achievers as superior, he believes it is a myth, even in democratic society, that every fulfillment of the motto "Whatever you do, do well" warrants the title of "excellence" (Lyons's interpretation of Gardner's "excellence"). For example, no one can or will seriously equate the accomplishments of a superior store clerk with those of a great violinist (pp. 280-281). Lyons adopts the view (following the Greeks) that "the excellent person is the one who is disposed to excel, to achieve," and wishes to distinguish between "true achievement and the appearance or feeling of achievement" (p. 277).

Those in democratic society do rank achievement, even though they are often unwilling to openly do so, Lyons (1976) argues. In practice, the influential majorities of the day give tacit, undebated approval to particular "democratic achievements," but Lyons is skeptical of the quality of much of what gets approved. (Recall Norton (1980) says something similar, but with a different intention in mind.) Lyons himself has no difficulty in openly ranking achievement. He believes that "true achievement is doing better things better, and [defines] 'better things' as those with the best long-run results" (pp. 279, 290).

Assessing "the best long-run results" seems a difficult task. Who is to establish standards, and how long must one wait to evaluate the results? It is not at all clear that the accomplishments of a great store clerk are necessarily always inferior to those of a superior violinist (to interchange Lyons's excellence adjectives with their subtle differences of degree), considered over the long-term. Should society more closely approximate that which Norton (1980) suggests as a goal in his discussion of the aretai, it would seem, too, that the assessment of "better things" would be even more difficult. Finally, in such an environment the question of "Which are the "better things"? would conceivably not even arise, given the apparent paradigmatic change in societal outlook and activity.

The Moral Aspect of Excellence of Achievement

There is a moral dimension - often implicit, sometimes made explicit - to the discussions of excellence, particularly when the acts and products of excellence are attributed to qualities of persons, as they are in a perspective that emphasizes intrinsic value. The moral quality of excellence refers here (after, e.g., Norton, 1980) not to morality influenced by religion and conventional morality, which is passive in nature, but to qualities of character to which the Greeks refer - virtues or excellences as aretai. (However, the influence of conventional morality is evident in Posner's (1976) discussion of the stigma of excellence.) The more "active" moral dimension is explicitly evident in Norton (1980) and Gardner (1984), and in Lyons (1976). It is also clear in Grant (1985), who believes that moral and intellectual virtue are inseparable in persons. He remarks, "Publications often feature craftspeople - artists, musicians, carpenters, excellent cooks, mechanics, or gardeners - because this is a concrete way of talking about intellectual and moral virtues" (p. 134).

The moral concern in any discussions of excellence focuses on how and why the individual values excellence. Bond (1983) believes that the pursuit of prestige or status for its own sake is to live "a lie which includes self-deception." Status is desirable, "but only to the extent that it is merited" as a derivative of a personal concern for excellence (p. 161). In a similar vein, Palma (1988) makes the distinction between a true exemplar of human excellence and the individual whom he describes in disparaging terms as a "Somebody" - a person, who "comes to believe that, in one or more respects, he or she is a special or significant person and who succeeds, through whatever means, in acquiring some sort of fame" (p. 373). These people profess their own perceived excellence in some function; they tend to self-exaltation; they fear being considered mediocre. It is morally and spiritually dangerous, Palma claims, to believe oneself to be special or especially significant.

Palma is not promoting mediocrity. Achievement is still to be honoured, pride of worthwhile accomplishment is still a "good thing," and one can still be marvellous - all without being a Somebody. However, a culture that is "saturated with the ideal of being a Somebody" (1988, p. 384) is suffocating, and leads many to self-perceptions of inferiority (or to consider themselves as "irredeemably ordinary", to use Norton's words (1980, p. 285)). Palma instead hails as "beautiful" those unassuming persons who go about their life quietly, usually doing whatever they can as well as they can, trying, sometimes failing, but always genuine, never self-exalting.

Willie (1987a,b) expresses concern with the widespread call, ev . demand, for collective excellence. He defines excellence as a "p· ·perty of the individual," not of groups, such as those in schools. It is a personal matter for the individual to aspire to high accomplishment, and therefore, such aspiration is a personal privilege, not a social obligation. Equating excellence with "preeminence" (1987a, p. 8), Willie believes that those in society who suggest that its citizens are socially obliged to excel are misguided, and ultimately doing social harm. The basis for Willie's concern is a society of "Somebodies," which, as Palma (1988) noted, was a suffocating concept. Society should better encourage in its citizens a willingness to be compassionate and caring, to "serve, sacrifice, and suffer for the sake of others" (Willie, 1987a, p. 8).

Those who are Somebodies, who seek prestige and status for its own sake, who are self-exalting, and those who argue that we all must strive to be superior to others, may be interpreted to be exhibiting or encouraging what Nathanson (1974) refers to as unqualified individuality, which can be destructive. While still supporting the primacy of the individual, Nathanson believes that we should be striving for individuality as "desirable individuality," which allows for individual excellence but acknowledges that persons are "individuals-in-community" (1974, p. 7). Conceiving of human relations in this way avoids the isolationist/"self-enclosed" view of "having relations" <u>with</u> others; instead, each of us "is the relations" we are born into and grow through. We are simultaneously independent of and dependent on others. The active moral dimension of excellence is thus evident in Nathanson in the genuine concern for and valuing of others embedded in the concept of "desirable individuality."

<u>Seeking Excellence as a State of Becoming</u>

In his essay on the perfectibility of humankind generally, Passmore (1970) doubts the possibility of such fulfillment, believing that perfectibility requires becoming godlike, and ceasing to be human. Still, he argues, humans "almost certainly, are capable of more than they have ever so far achieved. But what they achieve, or so [Passmore has] suggested, will be a consequence of their remaining anxious, passionate, discontented human beings" (p. 326). Authors such as Aoki (1990), Bond (1983), Donaldson (1985), DuFour and Eaker (1987), and Duke (1985) emphasize that it is seeking excellence as a process of becoming more human, a better person, as that which is of ultimate personal and social importance. Few will ever attain true excellence in any area, but "placing value on the pursuit of excellence permits [individuals] to feel good about themselves and to appreciate the accomplishments of others" (Duke, 1985, p. 674). Bond adopts an explicitly Greek perspective, believing that excellence must involve virtuous activity - including moral virtue (1983, p. 121). "The pursuit of excellence (moral virtue, development and exercise of one's talents, doing well things that are worth doing) is surely a necessary condition of a meaningful existence" (p. 148).

Donaldson (1985, p. 4) and DuFour and Eaker (1987, p. xxiv) believe excellence is "more a state of becoming than a state of being," "a journey rather than a destination." Seeking after excellence is a process that never results in a final product, a state of being "finally superior." The instrumental values that shape the nature of the "journey" are clearly significant. Finally, however, excellence as a state of becoming is situated in a context of beliefs about desirable end-states, although these end-states are never completely realized.

Aoki (1990) also understands excellence in its deep sense to contain the notion of becoming through the "struggle to surpass who one is, to become, within the world of possibilities, who one is not" (p. 7). These possibilities are not constrained to fields of achievement but stretch to include, and center on, a holistic concern for living excellently the life of a good person (cf. Knitter, 1988, p. 486). Such a life is guided by attention to ethics and morality, by a sense of the "oneness of body and spirit," and in general "by that which calls upon the person to be a better human being" (p. 7).

The remarks by Donaldson (1985), DuFour and Eaker (1987), and Aoki (1990) were made in an educational context about the general condition of excellence. Watson (1978), writing in a similar context, believes that excellence, insofar as it means to be superior to others in achievement or in some desirable quality, is thus "synonymous with merit or virtue" (p. 207S). On the other hand, it is nonsense, in Watson's view, to surround the term with mystique and consider it as some never to be attained state of grace that one seeks throughout life. When presented in this way, the pursuit of excellence is a stifling rather than an inspiring idea.

Watson is right if no relative quality is permitted to inhere in the notion of excellence. If the stress is on excellence as forever out of reach in any context and in any degree, then it is stifling. But I do not believe the views of the above authors are so extreme. Relative excellence within specific areas of achievement, or as a general quality of being human, is attainable, and other human beings are able to, and do, identify excellent qualities in people. This is different from claiming some final state of perfection whether as achievement in some particular field of endeavour, or as a general statement of the quality of being. This latter condition is unattainable. This does not mean that one stops struggling to become who one is not. Indeed, Watson seems to have adopted a wholly interpersonal view of excellence, with little room for intrapersonal possibilities.

<u>Excellence of Skill</u>

<u>Skill and Performance</u>

Performance is the major test of excellence, in the view of many authors (e.g., Kurtz, 1973, Rockefeller Brothers Fund, 1958; von Wright, 1963). The work <u>Compliance and Excellence</u>, edited by Singleton (1979), provides one means of understanding excellence of skill by contrasting a wide variety of skilled performances which attempt to demonstrate the extremes of compliance and excellence. These skills include (a) those within jobs and tasks (e.g. diving, golfing, music playing, and research), and (b) those required by particular kinds of people which are not specific to particular jobs (e.g. occupational disability, old age, safety, visual detection, and creative thinking). The studies are written by different authors with the method of analysis of performance left to each author. Singleton comments on the meaning of compliance and excellence:

> Compliance is appropriate when the performance of the individual is restricted either because he is unfortunate enough to have some peculiar limitation of his capacities (occupational disability, ... old age) or because the system is imposing peculiar demands (safety, ... diving). Excellence seems to be the appropriate description when the operator is well beyond the average skilled performance and is deliberately seeking achievements to which most people do not aspire (... the golfer, ... the musician, the research worker) or which demand the higher levels of human activity (visual detection, creative thinking). (1979, p. 9)

Performance is a crucial test of excellence, but in Singleton's description of excellence of skill there is more than mere performance. Drawing heavily on Aristotle, Wallace (1974) discusses the notion of skill, and what it means to be excellent in some skill(s). Skills, or complexes involving skills, constitute Aristotle's intellectual excellences. They are capacities to proficiently do things, to overcome difficulties inherent in the doing of the action itself. Becoming skilful requires training in techniques. For Aristotle, the excellence of an individual is a personal state bringing credit to both the actions and the person. Actions characteristic of excellence are not sufficient to mark personal excellence. Wallace applies this notion to an individual deservedly recognized as excellent in some skill(s):

> What is needed to make an act characteristic of a skill also an act for which the agent deserves credit [and thus is an act fully characteristic of a skill] is that the agent have the requisite skill and that his act satisfy the criteria of a good performance [i.e. the standards of proficiency for actions] of that kind, not by chance or because of another's skill, but because of the agent's skill. (1974, p. 189)

Nathanson (1974) makes the point that having a skill connotes only training in a field, not exceptional performance. "The truly skilled person," he emphasizes, "is the one who invests himself in his work" (p. 21). Von Wright (1963, p. 34), too, stresses that only through "special training" or having a "special interest" in an activity can an individual hope to achieve "technical goodness" in that activity. However, notwithstanding the valid point that excellence is not implied in simply having a skill, Wirstad (1979) hypothesizes that taking the position that "an advanced performance level can be developed in practically any human activity and every human being can reach an advanced skill level in at least one activity" (p. 278) offers a potential solution to the problem of competition and the resultant stress, anxiety, and unhappiness that is found in highly competitive environments. Wirstad's proposed position lends support to positions taken by Gardner (1984) and Norton (1980). It suggests that technical goodness may be achievable and valued as such in many areas of human endeavour.

"Technical goodness," says von Wright (1963), relates to ability and skill, and is an attribute of persons. He has in mind here what is ordinarily meant when one speaks, for example, of a good chess-player, runner, orator, carpenter, general, teacher, and scientist. Being technically good means being "good at" performing acts appropriate to the label ("an art," broadly understood). Judgements of technical goodness (e.g., "a good K" or "a better K than -") implies "excellence of their kind" (p. 33).

<u>A Commitment to Standards</u>

Achieving excellence implies standards. The crucial aspect of standards, notes Greene (1989), is that for any particular group of standards "to be significant in individual lives, people do indeed have to adopt them, to choose them, to decide to live and work with what they take them to mean" (p. 10). The skilled, excellent person "has regard for the standards which are constitutive of excellence in his art. He does not just know <u>about</u> them; he also cares about them and is committed to them" (Peters, 1975b, p. 10). This care and commitment apply to both practical and theoretical pursuits.

Two brief examples of this care and commitment are taken from the book <u>Compliance and Excellence</u>. In this work, Branton (1979) investigated the research scientist. One characteristic of the excellent researcher is that he or she remains aware of the open-endedness of his or her system, tolerating a high degree of uncertainty. Hedge and Lawson (1979), writing on creative thinking, remark that one must think of creativity in terms of "excellent finders of problems" (p. 295) as well as excellent problem solvers.

<u>Establishing Community Standards of Excellence</u>

One's actions are always subject to standards, Weiss (1974) notes, and standards of excellence assume the goodness of the presence of "prods, effort, diversity, and the pursuit of independent lines of inquiry" (p. 367). Rokeach (1973) states that humans employ standards in a variety of ways, such as when evaluating and judging others, or when comparing one's own morality or competency with that of others.

Excellence, by definition, according to Arendt (1958, p. 49), always requires the presence of others. Since at least the time of the Greeks, excellence has been assigned to the public realm (not the private). Only the public, constituted by one's peers, provides the "proper space" and necessary formality for performance to be appropriately judged.

In the context of an art or discipline, standards are set by the respective, identifiable communities of carpenters, sculptors, biologists, historians, and so on, being defined out of the particular experiences of the community members (Gowin, 1981; Greene, 1989; Kurtz, 1973; Peters, 1965). To be appropriately eligible for evaluation by one's peers, one needs to be a (would-be) participant in the community.

To determine the "criteria of excellence" of each field by which to judge performance, one looks in particular to the field's "stable and defensible exemplars" (Broudy et al., 1964, p. 38), its "experts" (Gowin, 1981, p. 86) or its "masters" (Drengson, 1983, p. 234). In some circumstances, criteria based on some form of testing may result. On the basis of his study, von Wright (1963) concludes that there are two main types of test which are sometimes available to measure technical goodness: competitive tests and achievement tests. The former are tests between individual or groups of members or would-be members of the particular skill community. The latter type of tests measure the skills and abilities of the member in terms of the criteria established for evaluating degrees of "goodness." Criteria tests relate logically to excellence in the activity. Achievement and competitive tests may also be "symptom-tests" (p. 37), which are "causally" related to activity goodness. Symptom-tests measure various attributes of the individual, and because of apparent causal links between these attributes and the activity of interest, claims are made regarding the individual's ability to perform this activity skilfully. All these types of tests, then, may be used to measure or infer technical goodness.

Still, establishing clear, unequivocal means of determining excellence of skill is a difficult, if not impossible task. Summarizing Compliance and Excellence, Singleton (1979) notes that excellence is difficult to identify because even within the same task it takes different forms. It seems clear, he states, "that it may be achieved to the same level by very different combinations of procedures and individual attributes" (p. 312). This view is supported by Perkins

(1981) in his research on creativity in different fields described in The Mind's Best Work.

Excellence of Mind

In this section I will briefly describe the analysis of excellence of mind provided by Hofstadter (1963). His study leads him to distinguish between the excellence of intelligence and the excellence of intellect. His descriptions of each are quoted at length.

Intelligence, he states,

> is an excellence of mind that is employed within a fairly narrow, immediate, and predictable range; it is a manipulative, adjustive, unfailingly practical quality ... [it] works within the framework of limited but clearly stated goals, and may be quick to shear away questions of thought that do not seem to help in reaching them. Finally, it is of such universal use that it can be seen daily at work and admired alike by simple or complex minds. (p. 25).

On the other hand, Hofstadter claims, intellect

> is the critical, creative, and contemplative side of mind.... [It] examines, ponders, wonders, theorizes, criticizes, imagines .... Intellect evaluates evaluations, and looks for the meanings of situations as a whole. Intelligence can be praised as a quality in animals; intellect, being a unique manifestation of human dignity, is both praised and assailed as a quality in men. (p. 25)

It is not uncommon to find that minds of penetrating intelligence are relatively unintellectual. On the other hand, minds of substantial intellect often reveal strength of intelligence also.

Hofstadter claims that in American society, for example, excellence of intelligence is always regarded with esteem, while excellence of intellect in an individual is often resented, and the person identified as potentially unreliable, immoral, and possibly even subversive. For Hofstadter, the evidence for the "stigma" of excellence of intellect is clear. These two excellences of mind may be related to the following sections on the professional and master.

Excellence of the Professional

To describe the excellence or "goodness" of the professional, von Wright (1963) refers to what he calls "instrumental goodness." The question of the instrumental goodness of a thing (or person) is essentially a question of how well it serves some purpose. Thus, for example, an instrumentally excellent pen (as a member of the class of pens) is one which is judged to be very "good for" writing. Instrumental goodness can also be an attribute of ways of doing things, such as, "a good way of memorizing a poem" (p. 9), or a good way of performing long division. Effective and efficient algorithms, then, may be said to exhibit instrumental goodness.

Von Wright identifies a class of skilled people, the "professionals," for whom the types of tests described in an earlier section ("Establishing Community Standards of Excellence"), if they exist, relate only secondarily to their goodness in their chosen profession. He is thinking here of soldiers, teachers, doctors, and the like. These professions exist largely to fulfill various needs of society, i.e., to serve the ends and purposes of individuals and institutions (1963, p. 37), and measurement of professional goodness is essentially a measurement of how well these doctors, teachers, etc. provide such service. Activity is fundamentally linked to purpose, and technical goodness is therefore secondary to instrumental goodness in these circumstances. Evaluations of instrumental goodness are judgements of how well the individual fulfills the purposes of the profession in which he or she is a member.

Hofstadter's (1963) description of excellence of intelligence is significant to this discussion of the professional, and is largely supportive of von Wright's analysis. Hofstadter states, "Few of us believe that a member of a profession, even a learned profession, is necessarily an intellectual in any discriminating or demanding sense of the word" (1963, p. 26). Instead, professionals - engineers, lawyers, doctors, most professors, for example - function in their vocations by virtue of a "trained intelligence." The knowledge the individual has acquired in the process of attaining professional status - the "stock of mental skills that are for sale" (p. 27) - is foremost of instrumental value in the performance of his or her vocational role. The good professional is highly skilled, but to the extent that such qualities as disinterested intelligence, free speculation, and radical criticism, for example, are missing in this professional role, the person is essentially a "hired mental technician who uses his mind for the pursuit of externally determined ends" (p. 27). Bouwsma's (1975) most contemporary "research ideal" is certainly supportive of this view.

If the individual _is_ also an intellectual, says Hofstadter, it is not by virtue of being a professional, but because he or she happens to bring to the profession "a distinctive feeling about ideas" (p. 27) not required by the job. The consummate _professional_, the person who is judged to be of high instrumental goodness, may be said, then, to demonstrate excellence of intelligence.

Excellence of the Master or Champion

Finally, von Wright notes, there are activities in which excellence cannot be tested or judged in the manner described above. He is thinking here, for example, "of excellence in science, or in philosophy, or arts in the aesthetic sense of the term" (1963, p. 38). One characteristic common to excellence in these activities is the creative aspect. At this level one speaks of "artist," a level of being which cannot be taught. The genius represents highest excellence in the creative arts.

Von Wright's "artist" is very similar to Drengson's (1983) "master" in an art or discipline, which he distinguishes from an "expert." The expert tends to be narrowly focused (specialized), while a master has a deeper, more holistic understanding of the art or discipline. Fluency and creativity in the field [illegible] exhibited by both master and expert, but only a master "understa[illegible] limits of the discipline or art" (p. 233). Drengson suggests that a master grasps better the significance and communal values of the art or discipline: "The [master] artist and [his or her] art [or discipline] are one" (p. 244).

There is, in addition, a relationship between the notions of artist or master, and excellence of intellect (Hofstadter, 1963). Whereas the goals to which the professional attends are externally set, "the intellectual life has a certain spontaneous character and inner determination" (p. 27). What distinguishes the intellectual from the person of intelligence is their attitude toward ideas. The intellectual lives for them, balancing this regard for ideas between playfulness and piety. The intellectual has, in essence, a "religious" commitment to the life of the mind. He or she "imperatively feels" the need to explore ideas and abstractions, implying "a special sense of the ultimate value in existence of the act of comprehension" (p. 27).

Qualities of "disinterested intelligence, generalizing power, free speculation, fresh observation, creative novelty [and] radical criticism" (p. 27) characterize those who demonstrate excellence of intellect. These are qualities of mind, too, that one would expect of the master in science, the humanities, or the arts.

The intellectual also sees his or her work as fundamentally moral, not only in terms of a personal dedication to a life of ideas, but also as a medium in the larger human community for the anticipation and potential clarification of moral issues and their grounding values. The intellectual may be moved to strike out publicly when reason and justice in the pursuit of truth appear to be abused.

Branton (1979) adds what can be described as a footnote to this discussion with a comment on the excellence of a champion. There is an element of mystery involved when one speaks of the champion "excelling her- or himself." "The excellence seems to reside in the Self" (p. 245), but we do not fully understand the Self. Branton claims that there are likely many elements to the strivings of a champion-status individual, but one can discount the competitive element, because that means striving to excel others, something that has already been accomplished.

The champion has reached such status through competitions, however. In terms of von Wright's forms, Branton may be interpreted to be saying that the champion, for the time-being at least, is beyond the level measured by competitive-type tests and has reached the level of creative master.

One might ask: Does this notion of the champion excelling her- or himself contradict the claim that excellence is assigned to the public realm? The tests and judgements that von Wright describes have clearly been established by the public, i.e., the members of the community to which the champion/master/creative genius belongs. These are also the tests which the individual had to pass on the way to his or her high level of development and accomplishment. To the extent that these criteria are no longer adequate measures of the person and his or her capabilities, there is a shift of criteria from the public realm of the community to the internal realm of the individual. On the other hand, the individual must continue to meet these benchmark standards of excellence to publicly maintain that status.

Linking Forms of Excellence

In summarizing his views on technical goodness, von Wright (1963) notes:

> ...the notion of being *good at* covers, not one, but several *forms* of goodness. There is first the excellence, of which skill in a game or game-like activity is the standard example. It can be measured by tests of its own. There is secondly the excellence of the skilled professional. It is, mainly at least, assessed in terms of instrumental goodness. Thirdly, there is excellence in the creative arts. This seems to defy assessment by means of tests and in terms of instrumental (or utilitarian) goodness. (1963, p. 39)

The three forms are related to one another: The professional skill of a teacher may, for example, rise to the level of creative genius, while the creativity may well involve aspects of play (1963, p. 39; cf., Hofstadter, 1963). One can also note a correlation with the levels Drengson (1983) describes. His "expert" would appear to correspond well to the first two of von Wright's forms of technically excellent individual; "master" would appear to be a reasonable title for the individual who demonstrates creative excellence.

Lastly, one may say that implicit in von Wright's forms or levels of excellence or technical goodness is the sense of excellence as a process of becoming. From an achievement perspective, Branton's (1979) remarks on the champion excelling him- or herself help to make this point more evident. One may be described as excellent, even a creative genius or master, but one is never in a state of being "finally superior."

Excellence in Education

Introduction

In this portion of Chapter 2, the focus is on excellence in education broadly considered. More specific considerations of excellence in mathematics education follow later in the chapter.

Bouwsma's (1975) analysis of the ideals of "educated man" [*sic*] again serves as the basis for a discussion of historical perspectives of educational excellence in the first section. This is followed by an extensive presentation of contemporary views on the subject.

Among the issues examined are (i) the potential distinctions between personal and educational excellence, (ii) effective schools, and (iii) educational debate and change in the United States and Canada in the 1980s. This latter topic is considered from a number of perspectives. The dominant views of excellence expressed in such reports as A Nation at Risk (1983) are presented, as are brief summaries of critiques of the positions put forth by these dominant reports. Slaughter's (1985) analysis of some of the major technical and liberal U.S. reports is summarized. This is followed by a short discussion of recent educational debate and change in Canada.

The Prakash and Waks (1985) model of education and excellence is then described, supplemented by the work of Bouwsma (1975), Slaughter (1985), and Eisner (1985). The model presents four broad conceptions of education - technical, rational, personal, and social - and the standards of excellence associated with each. Underlying values, appropriate forms of curricula and instruction, evaluation, and so on are discussed for each concept. This model serves as a major conceptual framework in Chapter 6 for interpreting the meanings of excellence for the teachers and students of the study.

Historical Perspectives of Excellence in Education

Earlier in this chapter (p. 19) a historical perspective of excellence was provided, based principally on Bouwsma's (1975) study of Western cultural tradition. His work was, primarily, an essay on the the "ideals of educated man [sic]," and thus had an educational focus. These ideals are the aristocratic, the scribe, the civic, that of personal self-cultivation, the Christian-secular, the romantic-naturalist, and the researcher. The brief, general historical discussion provided in the first section is expanded here to focus on the educational character of Bouwsma's models. The patriarchal orientation to "being educated" and achieving excellence is evident in Bouwsma's descriptions.

Aristocratic Ideal

The warrior, knight, courtier, and gentleman, as aristocratic types spanning the period from the time of the Homeric epics to the eighteenth century, were predominantly concerned with high achievement, status, leadership, self-respect, and the respect of others. Education, therefore, had as important aims the strong development of a sense of personal honour and the "formation of effective men [sic], who, through their independence, ambition, initiative, and personal strength can take a prominent role in the world" (p. 196). Attention to past high achievements was assigned particular educational value, but learning and intellect was not, especially in the earlier stages of the ideal. Even when it became more acceptable and valuable, by the sixteenth century, for the aristocrat to attend university, formal schooling was always secondary to "education for life in the world, an education that only the world itself could provide" (p. 197).

Scribe Ideal

The scribe ideal, derived from the scribe culture of the Old Testament, like the warrior (early aristocratic) ideal, also represents the idealization of a professional group. The mark of distinction of the scribe, in contrast to that of the warrior, was literacy. Scribe education pointed, over time, to a need for schools and eventually universities. Book learning and the accumulation of knowledge through books "suggested that education might consist in the acquisition of a body of knowledge and that the educated man [sic] is a learned man" (Bouwsma, 1975, p. 198). The formation of practical, efficient personal and social managers, not heroes, was the aim of the scribe ideal. The learned scribe also inherited the responsibilities of teaching - not only "worldly wisdom" but also the lofty character of an ideal ethical life. But "books rather than direct experience," "precept rather than practice" (p. 199) was the dominant basis of this education. The intellectual faculties are preeminent for the scribe, and as an ideal type it "is preoccupied with what can be planted in the mind" (p. 199). The educated person as philosopher and sage is closely related to the scribe ideal, as is the origin of the idea of a "liberal education."

Civic Ideal

"Educated man [sic]" as model citizen represented the civic ideal. The aristocratic and scribe ideals were important elements in the formation of this third ideal, but here "education is no longer the possession of a particular professional group; it becomes for the first time fully identified with general culture" (Bouwsma, 1975, p. 201). Education was viewed as "civilizing men [sic]" and was concerned with literacy and with developing the whole person - intellectually, physically, emotionally, and morally (cf. Klein, 1988, and "the spirit of ancient Greek education" (p. 64)). Still, individual talents, while important, were ultimately subordinated to society's collective needs. To pass on these collective ideals, a standard body of written classics which provided a common culture became "the bond uniting all civilized men" (Bouwsma, 1975, pp. 200-201). There was also a strong moral quality to the civic exemplar, but this moral quality was based on an assumption that virtue can be taught. (Although Aristole was of the view that moral virtue was inculcated through habit.) In practical terms, then, the civic ideal was concerned with the development of the intellect and "the notion of the educated man [sic] as the intellectually disciplined man" (p. 201), a view supported by Renaissance thinkers such as Bacon and Newman. The morally and intellectually disciplined character of the ideal citizen, for example, "the autonomous rational man of the Enlightenment," is also demonstrated in the ability on occasion to take a critical stance, feeling a duty "to oppose the collectivity when it is wrong" (p. 202).

Ideal of Personal Self-Cultivation

General education tends to flourish at times when it is of highest social value. In contrast, the ideal of personal self-cultivation, emphasizing "the pursuit of individual perfection as an end in itself" tended to emerge at times "when an effective social role in the world's affairs" was difficult (p. 202). In these times, the model of the educated person was "narrowed to include those human qualities, chiefly intellectual, most appropriate to the cultivation of private excellence" (p. 202). Transcending the human condition became the aim of the disciplined mind; learning became a means to escape from the sufferings inflicted by the world. Educated, self-disciplined people used their private freedom to contemplate the eternal verities.

Christian-Secular Ideal

Education was necessarily secular for the Christian because the aim of education and the end of humanity are distinct; it is beyond the power of education to develop in humans the ability to respond to the love of God. Instead, Christians valued education for its utilitarian benefits, and its capacity to "civilize." Bouwsma also interprets the secularity of the Christian ideal as liberating since it implies that a human

> is not compelled to adopt an authoritative (and authoritarian) model imposed upon him [sic] by the abstract order of things, that he is not a slave to forces outside himself but can freely choose the kind of education best suited to his needs, as he defines them for himself in the particular and concrete circumstances of his existence. (p. 205)

Romantic-Naturalist Ideal

This late eighteenth century ideal held that the aim of education was to "protect and aid human development to unfold according to its own innate principles of development" (p. 206). All human potentialities are equally worthy of encouragement, and thus it is not up to the teacher to decide what, and in what order, human faculties should be developed. Each unfolds in a natural order, the powers of rationality being the last to emerge. Indeed, the development of the senses and feelings, the imagination, and the body, and adjustment to the circumstances of daily life were valued above intellectual development. Ideally, education will be enjoyed by students when it is consistent with the needs of each person's nature. In this ideal there is greater room for individuality, and while it thus suggests a less social idea of humanity, the ideal is also democratic in its view.

Research Ideal

The seventh model of "educated man [sic]" is the most contemporary, and is based on what Bouwsma calls the "knowledge revolution" (p. 207). In the research ideal, a general education is less valued than is the development of specialists in preparation for research. The ideal is closely related to the view that the principal task of universities has become the discovery of new knowledge. The ideally educated person, broadly speaking, is foremost an individual who is open to and able to advance new knowledge, who is "bold, critical, imaginative, industrious, innovative, independent, and active" (pp. 207-208) in this endeavour. This narrowing of the ideal education, Bouwsma claims, fits some of society's needs, but leaves open the question of what is to be done with this new knowledge. Education as it is understood in this perspective thus shares a secularity with the traditional Christian view of education.

As was noted in an earlier section in this chapter, Bouwsma's treatment assists us in seeing how perspectives on human excellence have changed over time. The place and the nature of education in shaping those ideal types has been critical. But one also gets a sense of how social and cultural conditions and values, and indeed the very interpretation of what are important human qualities to be valued, have in turn shaped the nature of education. The meaning of "getting an excellent education" has changed over the centuries.

Contemporary Perspectives of Excellence in Education

Distinguishing Personal and Educational Excellence

"'Excellence' is a curiously powerful word ... about which people feel strongly and deeply," notes John W. Gardner (1984), "[b]ut it is a word that means different things to different people" (p. 10). Before continuing, one important clarification of difference that must be made is the level to which the concept of excellence is applied: "personal excellence" or "educational excellence." The discussion of excellence to this point in the chapter has focused primarily on personal or individual excellence. In the context of education, it is necessary to distinguish the person who is identified as excellent in some educationally related capacity from the educational program or organization which may be considered to be excellent according to some criteria.

In this study, the notion of "excellence in mathematics," for example, refers to personal excellence in mathematics. Personal excellence is inferred in such questions as What does it mean to excel in mathematics? and Can you identify an excellent mathematics student? The markers in this case are referenced to the conditions of excellence in (school) mathematics applied to the individual.

Personal excellence may also take the form of, for example, "an excellent student in this mathematics class." Here the focus is still on the individual, but the criteria of excellence now <u>may</u> refer more to the state of being a <u>student</u> as such, and less to being a student of mathematics. It will be important to ascertain where the emphasis does lie in such cases. These issues are discussed in Chapter 5.

Educational excellence refers to the general state of excellence, according to some criteria, of some educational program or organizational level. It may, for example, apply to the specific program of a single teacher; to a particular program within a school, school district, or province; to the general educational practices of an entire school, school district, or province; or to a general state of education. Typically, the school is the "unit of analysis" of educational excellence in the literature. When used to infer excellence at the program or organization level, therefore, the expression "educational excellence" does not explicitly signify individual excellence. However, the determination of educational excellence may be based on the collective performance of groups or populations of people (e.g., a statistically-based assessment and evaluation) <u>or</u> on the actions of persons individually identified (e.g., educational excellence as the development of the talents of students).

(Lightfoot (1989) finds the term "educational excellence" too much surrounded by nostalgia and idealization and too narrow in its implications for intelligence, achievement, and schools generally. In the context of schools, she prefers the term "goodness" which implies a different reality.

> Goodness refers to the complex culture of schools - to academic achievement, of course, but also to the craft and aesthetics of pedagogy; to the moral tone of the institution; to the quality of human encounter; and to the nature of organizational authority. (p. 16).

While acknowledging Lightfoot's cautions, I will use "educational excellence.")

Effective Schools

Excellent schools are often interpreted to be "effective schools" (e.g., Garibaldi, 1987; Timar & Kirp, 1988). Several key aspects of these schools are: (i) clear academic goals, or "a clear vision of what the school members are attempting to accomplish" (DuFour & Eaker, 1987, p. xix); (ii) strong leadership; (iii) teacher efficacy; (iv) high expectations of all students; (v) order and discipline; (vi) an emphasis on high levels of "time-on-task"; and (vii) regular and frequent monitoring of student performance (e.g.; Austin & Holowenzak, 1985; Garibaldi, 1987; Podemski, 1985; Roueche & Baker, 1986). The focus of effective schools is on student outcomes. One might broadly summarize an "ideal effective school" as one that has clear goals and values, shared by all school members and strongly supported and encouraged by school administrators and reinforced through vigilant attention to order and discipline, which promote and produce academic achievement.

What is the nature of this academic achievement? Typically, it is "an emphasis on basic skills instruction" (Kyle, 1985, p. 7). Much of the research on school effectiveness has been done at the elementary level, undertaken primarily in urban settings in an attempt to promote greater educational equality or equity (Corcoran, 1985; Miller, 1985; Noblit & Pink, 1987). Corcoran (1985), however, claims in his review of the research that effectiveness as competency in basic skills - that is, a focus on knowing elementary concepts, performing elementary routines, and so on - is not enough at the secondary level. On the other hand, there is little concensus among researchers about what constitutes an effective secondary school. Corcoran also makes a distinction between good schools (after Lightfoot, 1987), successful schools (after Lipsitz, 1984), and effective schools. "Effective schools" is often a reference to safe, orderly schools in which all students perform reasonably well academically (referring again to their equity-based philosophy of general achievement in basic skills). "Good schools" and "successful schools" do more than meet these minimum expectations.

Noblit and Pink (1987), while generally supportive of the concept of effective schools, are critical of the writing and research that has been done to date. They claim the research "suggests a 'one best model' approach to school improvement, i.e., transport the effective schools practices to less than effective schools" (p. 171). At the high school level at least, they claim, such an approach is misguided; local context must be considered. Noblit and Pink are also critical of the lack of "a single definition" of an effective school in the research (p. 171). However, as Corcoran (1985) notes, "Effectiveness is a construct, an abstraction that has no objective reality. It cannot be defined precisely because it means different things to different people" (p. 79). Indeed, Noblit and Pink's criticism of the lack of a single definition seems inconsistent with their insistence on the need to take account of local conditions.

Educational "Reform" in the 1980s in the United States

The Dominant View of Excellence in Education

Since the early 1980s reports and commentaries that number in the hundreds have been produced on the subject of educational reform in the United States. Some of these reports, proposals, and studies are national (e.g., Adler, 1982; Boyer, 1983; Goodlad, 1984; National Commission on Excellence, 1983) while others have been produced by states and local districts. A Nation at Risk: The Imperative for Educational Reform, published by the National Commission on Excellence in Education in 1983, has typically been viewed as the major U.S. educational report of the decade on the basis of its political status, wide circulation and the response it has generated. It has been described as the "quintessential conservative critique of the American school system" (Latta, 1989, p. 490).

The primary thrust of this report is that American economic and technological, and by extension, American political and military preeminence in the world are at risk because the state of education in the U.S. is in apparent decline. The principal marker of this apparent academic decline is achievement test results (nine of the thirteen "indicators of the risk" refer directly to achievement tests, all of the others infer a test basis for their statement). The authors of A Nation at Risk complain that (a) too often the expectations that schools and colleges have of students are too low, (b) the secondary school curriculum is too often a "smorgasbord" of "cafeteria-style" offerings including "undemanding and superfluous" courses, (c) students spend too little time on school work, and (d) the general quality of teaching and teacher education is inadequate. (pp. 472-474).

A Nation at Risk defines

> "excellence" to mean several related things. At the level of the individual learner, it means performing on the boundary of individual ability in ways that test and push back personal limits, in school and in the workplace. Excellence characterizes a school or college that sets high expectations and goals for all learners, then tries in every way possible to help students reach them. Excellence characterizes a society that has adopted these policies, for it will then be prepared through the education and skill of its people to respond to the challenges of a rapidly changing world. Our Nation's people and its schools and colleges must be committed to achieving excellence in all these senses. (p. 471)

To achieve these "excellences," the report makes recommendations designed to rectify what it sees as the deficiencies in the four main educational areas cited above, including narrowing the academic focus of schooling for all students to concentrate on the "Five New Basics" of English, mathematics, science, social studies, and computer science (p. 475). Frequent standardized testing is to form a major part of charting the student's progress and achievement of excellence through school.

A Nation at Risk has received considerable general support, for example, from commentaries (e.g., Best, 1984; Brown, 1984; Johnston, 1985; Tomlinson & Walberg, 1986), other national reports from various agencies responding to it (e.g., Board on Mathematical Sciences, 1989; National Science Board, 1983; National School Boards Association, 1984), and state- and district-level reports and legislation (e.g., see reference by National Association of Secondary School Principals, 1985). The current turn to business excellence perspectives for guidance in education, briefly discussed in the next section, is another manifestation of this support. More will be said about the general character of A Nation at Risk and reports and commentaries of similar outlook in later sections.

Business Influences on Excellence in Education

The school and school district, and its educational leaders (primarily the principal, but others, such as the superintendent, also) are the focus of much of the educational excellence literature. Several educators and corporate trainers, such as Bowsher (1989), Houston (1986), Lewis (1986), DuFour and Eaker (1987), and Beveridge, Jones, Levine, and MacKenzie in articles in In Honor of Excellence (NASSP, 1985) have turned to business and industry to act as educational partners, or to provide "lessons" in educational excellence for public schooling. Works by business consultants who attempt to identify and categorize the nature of "corporate excellence" frequently serve as the basis for this educational literature. Some of these consultants include:

- Egan (1988), who states, "Excellence is a question of degree, of will, of resources" (p. 12), and who identifies seven logical steps in the pursuit of excellence by business and organizations, including school institutions,
- Peters and Waterman (1982), who urge a shift away from an instrumental, calculative view of rationality in management, and who identify eight attributes of so-called excellent, innovative, action-oriented companies, and
- Peters and Austin (1985), who state, "The superb school is superb only by virtue of its success in developing its ultimate customer: the student" (p. 4), and who stress the need for organizational leadership.

Critiquing the Dominant Notion of Educational Excellence

A Nation at Risk also has a range of critics. Rosario (1986) argues that it is not true that U.S. schools no longer are concerned about quality and excellence; the problem, if there is one, "is that it will always be difficult to produce quality and excellence consistently" (p. 33). Peterson (1985) asserts that for the most part, the reports have said very little that is either new, or reasoned or accurate, or meaningful to [illegible]ment. John F. Gardner (1983), writing from a particular Christian perspective, argues that it is the system of education itself that is in crisis, that as long as education is controlled by the state, it will be bereft of moral and spiritual values. He believes strongly that all schools must be "disentangled" from government.

Education in the U.S. has predominantly been appreciated for its extrinsic or instrumental value (Greene & Raywid, 1987; Nash & Ducharme, 1983; Timar & Kirp, 1988), and reports such as A Nation at Risk continue this emphasis (Boyer, 1985b; Giroux, 1984; Nash & Ducharme, 1983; Yeakey & Johnston, 1985). Yeakey and Johnston, and Nash and Ducharme draw upon Hofstadter's (1963) distinction between excellence of mind as intelligence and as intellect for their analyses. Nash and Ducharme believe that despite the occasional reference in A Nation at Risk to "the creation of a 'learning society' which should 'stretch minds to full capacity,' and 'add to the general quality of one's life'" (1983, p. 39), there is a "barely conceal[ed] ... constricted understanding of the meaning of excellence in education. Throughout the Report, there is an overwhelming bias toward an education which produces social and economic utility as the major indicator of excellence" (p. 39). Nash and Ducharme add that in the report the "educated person is one with no point of view, other than the accumulation of marketable high-tech skills" (p. 40). The report is another indicator of the general loss in U.S. society of such social virtues as "sharing rather than taking, or giving as opposed to receiving; participating as opposed to winning; and sacrificing and even denying one's own pleasures of the moment" (Yeakey & Johnston, 1985, p. 166; cf. Willie, 1987a). This concern may be interpreted as a concern that ir A Nation at Risk and other similar reports there is a call for U.S. society in general to remuster its efforts to be a "Somebody," to use Palma's (1988) term.

Canadian educators Carson and Brouwer (1985) argue that the conception of excellence in A Nation at Risk as "narrowly defined competencies" established on the basis of the achievement testing of prescribed objectives "discourage[s] the creative initiatives and personal meaning making required to make the connections between knowledge, values and action" (p. 23). As knowledge received from authorities, this revealed knowledge is externalized from the knower, thus removing personal responsibility for how it is used. Lightfoot (1987) also argues that the dominant definitions of excellence have been set by a relatively small, powerful section of U.S. society, and are "fairly narrow definitions of achievement and potential" (pp. 203-204). She calls for a reinterpretation of standards based upon a broader and more complex view of intelligence and achievement. As described earlier, Lightfoot opts for "goodness" over "excellence." Goodness, she says

> refers to the complex culture of schools - to academic achievement, of course, but also to the craft and aesthetics of pedagogy; to the moral tone of the institution; to the quality of human encounter; and to the nature of organizational authority.... goodness permits excellence to shine in its myriad forms. (p. 204)

Critiquing the Notion of Equality of Opportunity in Education in the Dominant Reports

A Nation at Risk states that it adheres to the "twin goals of equity and high-quality schooling" (p. 471), but critics believe that the report's agenda for reform actually undermines these goals (e.g., National Coalition of Advocates for Students, 1985; Oakes, 1986; Shor, 1986; Willie, 1987a,b; Yeakey & Johnston, 1985). Indeed the meaning of "equality of educational opportunity" has for some time generally been restricted. Equality of opportunity in the U.S. has for at least much of the twentieth century actually implied quite distinct and stratified educational programs for different students based on apparent innate individual differences of potential intelligence and abilities (Miller, 1985; Oakes, 1986; Yeakey & Johnston, 1985). What this has meant, and what it will continue to mean, given the nature of "equality of opportunity" and the "lack of conviction" (Oakes, 1986, p. 76) in reports such as A Nation at Risk when they call for equality of educational opportunity, is that those in the upper strata of U.S. society benefit materially, socially, and politically much more from education than those in the lower strata.

The tension between excellence and equity in education is a common theme (e.g., Cusick, 1985b; Fantini, 1986; Lazerson et al., 1985; Lightfoot, 1987; National Coalition of Advocates for Students, 1985; Oakes, 1986; Shor, 1986; Stanic & Reyes, 1987; Timar & Kirp, 1988; Willie, 1987a,b). Such tension exists, say those such as Lightfoot, Lazerson et al., Willie, and the National Coalition of Advocates for Students, but excellence and equity need not be at odds; in democratic society both are essential to public schooling.

Shor (1986) argues for an "egalitarian" perspective: "Equality is excellence and inequality leads to alienation. Excellence without equality produces only more inequality. Inequality leads to learning deficits and to resistance in the great mass of students" (p. 411). Educational egalitarianism is empowering, and raises aspirations, leading to greater motivation to become educationally involved. Greater learning and literacy result. Reinterpreting the success of schools in terms of their goodness instead of narrowly defined notions of excellence will permit "the "cohabitation of excellence and equality," Lightfoot (1987) believes. Equality becomes a valued part of seeking the many forms of excellence accepted under the umbrella of goodness.

In Barriers to Excellence (National Coalition of Advocates for Students, 1985), the authors substantially accept the meaning of educational excellence as the development of individual talents and abilities, but issue a strong critique of the current notion of equality of opportunity and its implications for the underdevelopment of "the talents of millions of children who happen to be born different by virtue of race, language, sex, or income status" (1985, p. v). Equality must mean equality of outcomes (e.g., the proportion of black Americans entering a given profession to be equivalent to that of white Americans). Excellence without such equity, the authors claim, is inconsistent with the aims of democratic society.

Willie (1987b) believes that equality and excellence can be complementary notions. Equity is a property of groups and institutions, including schools. Excellence as aspiration to sacrifice and achieve higher than required levels of performance is a quality or property of an individual - not a collectivity. There can be no mandate, then, that everyone shall be excellent. Schools, therefore, ought to strive for an equitable distribution of resources, services, and opportunities among all students in order that they may all be "competent, adequate, and good" (p. 206), while at the same time schools should be open to those who, by their own desire, wish to excel at some endeavour.

Authors such as Fantini (1986) and Timar & Kirp (1988) agree with the notion of individual excellence as the development of personal talents to high levels, but also view educational excellence as the aspiration of schools to encourage development of the diverse talents of students. They argue for flexibility at the school level to permit this development. The excellence of a school cannot be adequately measured by standardized tests, imposed by rules and regulations, or mandated by legislation (Timar & Kirp). Fantini views excellence as "the intent to reach for an ideal state" (p. 7), and in the context of education

> may be considered more nearly realized when all are learning what they need to become all they are capable of becoming in the most up-to-date way, using the best available resources in ways that are consistent with democratic procedures and dedicated to the further culturation of a free, just, and compassionate civilization. (p. 60)

Fantini draws upon Howard Gardner's (1985) theory of multiple intelligences to argue for a non-standardized approach to education to avoid the marginalization of those students whose talents do not lie in such fields as, for example, science and mathematics.

Claims for Civic Virtue in Education

Doyle (1987), and Nash and Griffin (1987) find tension in the above perspective, claiming that, on the one hand, excellence (in general agreement with Fantini (1986)),

> in any endeavour is often a solitary pursuit requiring self-discipline and commitment that is special and particularistic.... Over the life of a student the pursuit of excellence calls for progressively greater specialization and more complete immersion in the peculiarities of a given discipline." (Doyle, 1987, p. 2)

On the other hand, in order "to have a shared sense of community and a shared destiny," a "national, core curriculum" must be seriously considered, according to Doyle (p. 22). Doyle, and Nash and Griffin (1987) both harken back to the time of Aristotle and the Greek polis to support their separate calls for "civic virtue." Civic virtue, note Nash and Griffin, is a "form of moral endeavour whose purposes are the attainment of social justice, personal autonomy, and the public good" (p. 552). Private aspirations must not come at the cost of cooperative endeavours; education must not be "primarily an instrument for individual careerism, self-actualization, or mastery of a technology," for "then it is powerless to provide either authentic personal meaning or civic virtue" (pp. 561-562; also Nash & Ducharme, 1983).

This major section over the last several pages has revealed some of the perspectives which have been put forth in the U.S "excellence in education" debate. Slaughter (1985) attempted to synthesize and describe the positions expressed in some of the major reports and studies published up to the time of her paper. She interprets these reports as aligning themselves in a technical-liberal continuum. In order to further help summarize the U.S. debate, Slaughter's review is briefly discussed in the next section.

Interpreting the "Technical" and "Liberal" Education Reports

Slaughter (1985) analyzed several of the U.S. reports on education, which she describes as on a continuum from "technical" to "liberal." Together these perspectives - especially the technical - dominate contemporary U.S. education. A Nation at Risk (1983) is identified as technical and, on the basis of Slaughter's analysis, reports and commentaries such as, for example, Educating Americans for the 21st Century (1983), Brown's Crisis in Secondary Education (1984), Tomlinson and Walberg's Academic Work and Educational Excellence: Raising Student Productivity (1986), and Kearns and Doyle's Winning the Brain Race (1988) can also be interpreted as near the technical end of the spectrum (although the latter book is critical of the dominant reliance on test scores). In contrast, Adler's The Paideia Proposal (1982), Boyer's High School (1983), and Goodlad's A Place Called School (1984) are identified by Slaughter as representative of the "liberal" end of the continuum. Sizer's Horace's Compromise (1984) and Lazerson et al.'s An Education of Value (1985) can also be considered "liberal." (Not all agree with Slaughter's categorization: Shor (1986), for example, considers Adler's proposal much more conservative than the "liberal" works of Boyer, Goodlad, and Sizer.)

The technical reports see education as a product, the quality of which is typically measured by quantitative means, such as standardized achievement tests. However, this "product" is presented as a means to societal ends (usually economic), not as an end in itself. "Nineteenth century notions of moral and mental discipline" (p. 111) are honoured by the technical reports in order to achieve the desired levels of proficiency. Concern for equality of opportunity of education is limited, as was discussed in an earlier section (see also Marcus, 1985).

The liberal reports "tend to see secondary education as an end in itself and address themselves as best they can to the general welfare of all students" (Slaughter, 1985, p. 108). Streaming is considered unacceptable, as <u>all</u> students are capable of first class work, a view that Slaughter calls "democratic elitism" (p. 109). There is thus an emphasis on "learning styles." The more liberal reports and commentaries are critical of the technical focus on test scores as the principal measure of excellence (e.g., Boyer, 1983; Cusick, 1985a; Sirotnik & Goodlad, 1985; Sizer, 1985). The "liberal" values typically espoused are cooperation, commitment to the common good, democracy, pluralism, ethical principles of living, and the rights of citizenship. One can relate the earlier "everyone-has-the-potential-to-be-excellent" discussion of John W. Gardner (1984), Norton (1980), and others to the liberal reports.

The liberal and technical reports do share some common ground. One example is a demand for a core curriculum of "no-nonsense new basics" (Slaughter, 1985, p. 111) - although Sizer (1984) is an exception (as would be later "liberal" authors such as Fantini (1986)), and Goodlad's (1984) placement in this group of those who call for a core curriculum must be somewhat qualified. He calls for a curriculum which emphasizes mathematics and science, literature and language, society and social studies, the arts, and the vocations, approximately two-thirds of which is common for students. However, he argues "against a common set of topics constituting this core but for a common set of concepts, principles, skills, and ways of knowing" (p. 286).

<u>Educational Change in Canada in the 1980s</u>

As noted in Chapter 1, the "excellence in education" debate in Canada has not risen to the levels that one finds in the United States (Levin, 1986; Podrebarac, 1986). Nevertheless, Canada does have its own "excellence movement" (Nixon, 1987), based at least in part on the debate in the United States. Provincial departments of education have been conducting surveys in an attempt to gauge the public mood toward schooling and the need for educational change. They have been preparing educational reviews of curricula, student achievement, measurement standards, and so on, in order to establish where officials believe schooling should be headed in the 1990s. The rhetoric of excellence is evident in these reviews. For example, in <u>Secondary Education in Alberta</u>, its authors state,

> Education is a high priority for the Government of Alberta. This policy statement reflects that priority by setting a new, more challenging direction for our secondary school program - a new direction which will provide the basis for an educational system committed to excellence. We believe a commitment to excellence in our schools will encourage excellence in students and all others involved with education. (1985b, June, p. 3)

Some of these provincial Reviews and Commissions were cited in Chapter 1. The Council of Ministers of Education, Canada [CMEC] (1988) provide a summary of the current trends in Canadian curriculum reform at the secondary level. First, "a strong trend" (p. 13) toward the adoption of a compulsory, core curriculum, typically of mathematics, language arts, science, social studies, and sometimes physical education, is becoming evident. The provincial arguments for this trend, according to CMEC, are similar to those in A Nation at Risk: greater accountability and program coherence, and a shift "clearly away from the 'cafeteria' approach" of the 1960s and 1970s (p. 14).

The introduction of various student evaluation and assessment measures is a second trend, again aimed at greater accountability and "greater rigour" and consistency of standards over a particular range of competencies. Among these are standardized achievement tests, which are administered at various grade levels.

The Alberta Department of Education also administers province-wide final examinations in several, often required, academic subjects at the grade twelve level. This current program was instituted in the mid-1980s. These compulsory exams account for 50% of the students' final grades in these subjects. A 1986 provincial report describes the examinations program as "an integral part of the high school diploma requirements ... intended to develop and maintain excellence in educational standards through certification of academic achievement" (p. 1).

Another trend noted by CMEC (1988) is the redefinition of the basic elements of schooling to include "critical and creative thinking, independent learning, familiarization with and use of information technology, media awareness, and knowledge of the principles and social impacts of science and technology" (p. ix). Still another secondary level trend is the increasing development of courses and programs to prepare students for the world of work.

McConaghy (1990), in his review of the CMEC presentation, appears to find promise at least in the general character of many of the trends, but asserts that "the search for excellence does not end with a core curriculum" (p. 17). One high priority, for example, is the inclusion of teachers in the decision-making process.

Other Canadians express concern over the narrow economic and academic elitist orientation of the excellence movement evident in reports such as <u>A Nation at Risk</u> and <u>Secondary Education in Alberta</u> (e.g., Aoki, 1990; Carson & Brouwer, 1985; Parsons, 1987). In the Alberta policy statement, Parsons claims, can be seen

> the imposition of rules by those from 'above,' the tying of excellence to standardized testing, the stress on competition, the growing spectre of a common academic program for those who are the academic elite, and ignoring the floor for the ceiling. (1987, p. 7)

Aoki (1990) acknowledges that the call for educational excellence is currently a very popular exhortation, but he questions the nature and depth of that which is being called for. The notion of excellence is typically understood as "the best, the top, ... the super" (p. 5). Within a theoretical, academic framework in schools, such a view implies "superiority in thinking power and in the power to acquire knowledge. Academic brilliance would be a paradigm case of this understanding of excellence" (p. 7).

A second educational framework within which excellence as "the best" is commonly interpreted (for example, in <u>A Nation at Risk</u>), is that which signifies a high standard in skills development. Within this practical or utilitarian perspective the focus for students is on excelling in the skills dimension in such basic subjects as reading, writing, and mathematics.

These two views of excellence in school dominate the spectrum. Aoki (1990) believes that by limiting our attention to these perspectives of human excellence we have "tuned into the half-life of excellence and thus have become neglectful of the original meaning of excellence." This original meaning, he states, "contains in a deep sense the notion of one's struggle to surpass who one is, to become, within the world of possibilities, who one is not" (p. 7). An excellent person in this deeper sense is more than "good" in a "merely" intellectual or skills sense; this is a "good person," guided in the process of becoming "by that which calls upon the person to be a better human being" (p. 7). This is a person whose actions are fundamentally guided by a sense of the "oneness of body and spirit" (p. 7), by a commitment to the ethical and moral quality of a life lived well.

This more complete view of excellence of the human being, Aoki (1990) notes, is one which we typically have difficulty contemplating in an educational context. The root of our difficulties can be traced to the grounding of the dominant educational orientation to achievement in the contemporary "technological ethos" which generally shapes our thinking and doing. Aoki does not deny the need for attention to the development of intellect and skills in students (and teachers). We must, however, he argues, move beyond the limits such attention imposes to consider in education a yet more fundamental notion of human excellence, that of coming to a deeper understanding of who we each are, and thus, potentially, of becoming more fully human.

Only a small portion of the literature that in some way has contributed to the educational debate of the 1980s in Canada, and especially in the United States, has been cited in these last sections. Still, even within this limited sampling a considerable range of views has been described. Prakash and Waks (1985) provide a framework within which these views may be interpreted. This conceptual framework of educational excellence is also used in this present research to interpret the beliefs and positions of the participating teachers and students. This interpretive model is described in the next section.

Conceptualizing Educational Excellence: A Model

Prakash and Waks (1985) offer four conceptions of education, identified as the technical, the rational, the personal, and the social perspectives. Their respective standards of educational excellence are mental proficiency, disciplinary initiation, self-actualization, and social responsibility. Each of the four conceptions has had to attempt to come to terms, over time, with the fundamental issues of education, including the meaning and purpose of education, desirable forms of knowledge and understanding, theories of mind and learning, and appropriate teaching forms, curricula and teacher-student relationships. Prakash and Waks describe the significance of each perspective in terms of excellence as follows:

> The verb "to excel" means, for all concerned, "to perform in a superior or exemplary manner"; each of the four conceptions relates excellence in education to superior or exemplary achievement. Advocates of the four conceptions of education differ on their assessment of cases, however. The four conceptions generate different, more or less coherent, standards of value against which judgements of quality, and hence of excellence, are made. Advocates of the different conceptions will conflict in their educational evaluations and prescriptions, their judgements of the should-be-done, the good, and the best. It is in this sense that we speak of four conceptions of excellence. (1985, p. 81)

Prakash and Waks's work will be used to help structure the analysis and interpretation of my empirical research with the high school mathematics teachers and students. These four conceptions are supplemented by Eisner's (1985) discussion of five orientations to the curriculum, Bouwsma's (1975) historical analysis and interpretation of ideals of the educated person, and Slaughter's (1985) analysis of some of the major reports in the current educational debate. The four conceptions of education and their respective standards of excellence are detailed in the sections that follow. Figure 1 provides a summary of the discussion.

Conception 1: Technical/Mental Proficiency

The technical conception of education is marked by a concern for method, for an efficient means-ends relationship in the rational production of excellent educational outcomes. The emphasis is on providing information and training in skills, memory, and problem solving routines; the "mind is seen in its more mechanical dimensions." Knowledge is considered to be information possessed in memory; understanding is identified with the ability to classify problem types and apply appropriate routines to their solution. Excellence of mind conceived technically is what Hofstadter (1963) refers to as "trained intelligence." "Standards of value are quantitative: excellence is proficiency in the sense of exemplary test scores" (Prakash & Waks, 1985, p. 81). The teacher with this view of education always has the standardized achievement test in mind, and gears lesson planning and instruction accordingly. Ideally, the curricula are teacher-proofed as much as possible, and the standardized tests are seen as "fair and

A CONCEPTUAL MODEL OF EDUCATION AND EXCELLENCE (After Prakash & Waks, 1985)

	Conception 1: Technical	Conception 2: Rational	Conception 3: Personal	Conception 4: Social
Standard	mental proficiency	disciplinary initiation	self-actualization	social responsibility
Image of Education	means-ends rational production; means to further (economic) ends.	cognitive socialization of young as central to development of humanness.	"individual;" private quest for personal wholeness and authenticity.	socially transformative.
Educational Emphasis	training in skills, memory, standard problem solving routines; accountability.	transmission of current working conventions and value standards in disciplines; creative problem solving.	"free space" to encourage full, rich unfolding of specific individuality.	lead young people to act upon and transform their world for public good.
View of Curricula; Instruction	curriculum-as-technology; given ends operationalized; instruction is geared to testing.	unit of learning is conceptual schema illustrating rational structures; students move through increasingly complex schema; projects, lecture-discussions.	resources in and and out of school of most benefit to the individual; sympathetic interaction with pupils.	focus on substantive social problems local, regional, global; move students out of school to more actively learn, take ameliorative action.

Figure 1

A CONCEPTUAL MODEL OF EDUCATION AND EXCELLENCE (After Prakash & Waks, 1985)

	Conception 1: Technical	Conception 2: Rational	Conception 3: Personal	Conception 4: Social
View of Teacher; Educational Leader	information provider, trainer; manager of school.	engaged in rational presentation of evolving ideas and concepts revealing rational disciplinary structure; master scholar-teacher	one of many possible resources; autonomous, able to relate, care for learners as autonomous persons; learned sage.	public spirited; trained in social action; other individuals in community potential social role models also.
View of Knowledge, Under-standing	possession in memory of information; ability to subsume problems under standard problem types, apply problem solving routines.	inherently social or intersubjective, taking place in institutional contexts; ongoing evolution of ideas, standards in disciplines.	standards of thinking derived from common human nature and unique individual natures (not convention).	ability to interpret complex social situations; practical know-how in creating, managing resources; personal strength necessary to act in public good.
Evaluation	"objective"; achievement in measurable behaviour objectives; standardized testing central.	"intersubjective"; value judgements of student's creativity, imaginativeness, insightfulness within limits of discipline.	sense of degree to which person becoming centered; in touch with self.	shaped by concern for cooperation and group interests; degree of student motivation to take responsible action; to care for, share with others.

Figure 1 (cont'd)

objective means" of holding teachers accountable (p. 82). There is also an insistence on increased, more demanding, content, and concern for equality of opportunity is limited. Education is viewed largely as a product to instrumentally serve further ends, usually economic (Slaughter, 1985).

Eisner's (1985) "curriculum-as-technology" corresponds closely to Prakash and Waks's (1985) "technical." Curriculum planning is conceived as operationalizing given ends, and designing appropriate means to achieve them. Virtues of this orientation, Eisner claims, include its demand for the systematization of educational planning and purposiveness of schools: meaningful, measurable goals should guide each school. On the other hand, the approach attempts to control human activity. Curriculum planning and teaching in this orientation are seen as technical problems, and educational aims which do not lend themselves to operationalization as specific, measurable behavioural objectives, to which all students are subjected, fall by the wayside.

Thorndike and Skinner (Prakash & Waks, 1985), and Bloom, Dewey, and Tyler (Eisner, 1985) are among the educational theorists who have shaped this conception of education and educational planning. A Nation at Risk is a prominent contemporary document endorsing this view.

Bouwsma's ideals are not strongly visible in this perspective of education because the educational ideals are descriptions of (idealized) human beings; the technical conception of education, and its standard of excellence, is not so much about people as it is about instructional techniques and curriculum content, and measures of samples and populations of students. However, connections can be made. To the extent that both the technical and aristocratic perspectives may be considered "anti-intellectual," it can be hypothesized that the general character of the aristocratic ideal is also evident in the spirit of the technical perspective. On the other hand, to the extent that the technical view of secondary education and the post-secondary research ideal are both primarily concerned with the instrumental production value of education - producing a college education and/or a career in the case of the former, producing new knowledge in the latter - they also share common ground.

Conception 2: Rational/Disciplinary Initiation

The rational conception of education views human excellence "as significant participation in the adventure of the mind" (Prakash & Waks, 1985, p. 83), as the evolution of various forms of thought such as the aesthetic, the scientific, and the moral. Knowledge alone has no value; thinking involves creative problem solving and inventiveness, within the limits of evolving institutional norms. Educational excellence is marked by a thorough initiation into the disciplines through the attainment of skills, habits and attitudes "that promote the full participation in and contribution to this dynamic process" of mindful adventure and evolution. "Education is thus the cognitive socialization of the young, justified as central to the development of humanness" (p. 83).

"Teaching involves the presentation of evolving ideas and concepts in a rational manner, lucidly revealing the rational structure of the discipline. It consists primarily of exemplary intellectual acts" (Prakash & Waks, 1985, p. 84). Lecture-discussions and student projects are typical learning activities. Knowledge and understanding are viewed as inherently social, and thus evaluation for rational excellence is based on intersubjective criteria and performed by those who, in their community of colleagues, are judged most competent.

Prakash and Waks's rational conception of education encompasses Eisner's (1985) "academic rationalist" curriculum orientation. The school's curriculum should focus heavily on helping students to read and critically understand the meaning of major works in various fundamentally essential academic disciplines in order that students may better address the "major concepts, issues, and problems" (p. 66) they will face in their lifetime. This should be a core curriculum required of all students (cf. Adler, 1982; Boyer, 1983; Goodlad, 1984). Many of the attributes Slaughter (1985) ascribes to the "liberal" reports - no streaming, a cognitive emphasis on learning styles, a commitment to democracy, pluralism and the common good, for example - are consistent with a rationalist education. On the other hand, any active social component of a rationalist education would only be an "add-on," not integral to the very nature of the entire educational program (Prakash & Waks, 1985).

Aspects of Eisner's (1985) "development of cognitive processes" curriculum orientation are also present in the rational conception of education. The rational outlook is concerned with content, but, within a disciplinary perspective, this conception of education is also concerned with process. Eisner notes that the curriculum of the cognitive processes orientation "would generally be problem-centered," the major aim of such programs being "the development of intellectual power rather than the simple dissemination of a body of ideas or information" (p. 65). To the extent that a rational perspective also has this aim, it shares common features with the development of cognitive processes orientation.

"Liberal" educators such as Sizer (1984), Goodlad (1984) and Boyer (1983) are supporters of the rational conception of education. Other proponents of this conception include such educators and educational philosophers as Broudy et al. (1964), Crittenden (1973), Hirst (1975), Lazerson et al. (1985), Peters (1965, 1975b), and Vulgamore (1983).

Many features of Bouwsma's (1975) scribe ideal - the educated person as the learned person through book study, responsibility for teaching, preeminence of the intellectual faculties - are strongly evident in the rational view of education. The research ideal is clearly evident also, although it is somewhat narrower in scope than the "liberal education" interpretation one may give to the rational conception of education. One may also situate within the scribe and research ideals, and within the rational conception of education, Hofstadter's (1963) notion of intellectual excellence of mind. Features of the civic ideal may also be identified in the rational/initiation perspective. Educational practices such as using a standard body of written classics to provide a common cultural tradition, and the Enlightenment notion of the "autonomous rational man [sic]," for example, are among the links which may be made.

Conception 3: Personal/Self-Actualization

Self-actualization, understood as "the end of human development" (Prakash & Waks, 1985, p. 85), is the standard of "personal" excellence, the third conception of education. This perspective is shaped by a vision of each person being in a lifelong quest for authenticity. Attaining excellence in this regard means having undergone "the fullest and richest unfolding of the individual personality." Disciplinary study is valued only insofar as it is seen to be useful in the unique development of the individual student; it is not a sufficient or even a necessary part of every individual's education. Educational rules, principles, and systems must be subordinated to the purpose of bringing out the individuality of the person. It is up to each individual to integrate his or her mental and other powers in the pursuit of personal ends - cognitive and otherwise. The "learner" is the centre of the education situation, with the teacher only one among many possible resources.

Standards of cognitive achievement and thinking are not derived from convention but "from our human nature found in our common understanding and common human potential, and our individual natures, our unique ways of being and our inherent ends" (Prakash & Waks, 1985, p. 86). Being in touch with oneself - being "centered" - is the mark of a good learner.

Eisner's (1985) "personal relevance" orientation to curriculum is closely related to the "personal" conception of education. The curriculum, instead of being mandated and handed down from a central curriculum development office, "is to emerge out of the sympathetic interaction of teachers and students within a process called teacher-pupil planning" (p. 69).

The curriculum orientation stressing the development of cognitive processes also shares some territory with Prakash and Waks's (1985) personal conception of education. Eisner (1985) states that the problem-centered curriculum is designed to encourage students to define and pursue problems of interest to them. The problems may be of interest to individual students, small groups, or the entire class. It is the task of teachers to promote deliberation leading to students pursuing their cognitively challenging problems, and to help provide guidance and appropriate materials.

Among those broadly associated with the personal conception of education are A.S. Neill, A.H. Maslow, and Rudolph Steiner (Prakash & Waks, 1985), and John Holt, Max van Manen, Madeleine Grumet, William Pinar (Eisner, 1985), and Ted Aoki.

Bouwsma's (1975) descriptions of the personal and romantic-naturalist ideals reveal parallels to Prakash and Waks's personal conception of education. However, Bouwsma's "personal" exemplar is an individual whose development is principally intellectual for purposes of distancing oneself from "the crowd." This is neither the major focus nor intent of contemporary "personal" development. The romantic-naturalist ideal is closer to the present view. Some aspects of the aristocratic and Christian-secular ideals are also evident in this conception, insofar as they represent a more individual, perhaps less intellectually focused, vision of appropriate education.

Conception 4: Social/Social Responsibility

Under the social conception, education is extended beyond the individual and is concerned with the community, interpreted locally and globally. Self-actualization is still vital, but is ultimately for the common good: personal ends are satisfied in the "context of the community of ends" (Prakash & Waks, 1985, p. 87). The standard of excellence is concerned with responsible social action, as, for example, in the capacity to care for and share with others. Achieving an excellent social or public education means learning "to think and feel and act as a 'we' as well as an 'I'," to be "guided by common public interests" (p. 88). The principal aim of education is the "actualized individual in the just society" (p. 88). There is a need to develop in students such intellectual and practical excellences as

> (i) the ability to interpret a complex social or interpersonal situation, identifying the problem and generating suitable options for its solution; (2) practical know-how in creating and managing the human and material resources involved in the solution; and (3) the heart, motivation, courage, or strength to act - to do what must be done to serve the common good. (1985, p. 89)

The standard of social responsibility may be identified at a curricular level with Eisner's (1985) "social reconstructionism" orientation. A concern for the common good is the central organizing principle of the entire educational enterprise. The "poverty of social life in schools" (Prakash & Waks, 1985, p. 89) is problematic; schools usually emphasize personal acquisition of information and disciplinary competence. In the social reconstructionist orientation, the curriculum frequently focuses on controversial issues, the aim of which is to help students recognize and do something about the real problems of the time. The knowledge provided by the academic disciplines serves as a tool for analysis, understanding, and action. Group projects and evaluations, and moving the students out of the school to experience significant community problems first hand form major curricular and instructional aspects of the social conception of education.

Paulo Freire, John Dewey, and George Counts are among those Prakash and Waks (1985) consider as having an education-as-socially responsible action outlook. Claydon (1979) notes, "Counts' notion of excellence in education is to do with social excellence. This, in its turn, is essentially a form of moral excellence" (pp. 85-86). Eisner (1985) places educational theorists such as Michael Apple in this group. Dewey is identified with the curriculum-as-technology orientation, not with social reconstruction. This may not, however, represent a contradiction between Prakash/Waks and Eisner. Curriculum-as-technology is concerned with means, and although it tends to serve conservative ends, in principle it need not. Dewey (1916/1963, 1927/1954) was certainly concerned with the social aims of education. Others who may be identified with the social conception include Henry Giroux, Jonathan Kozol, and Ira Shor. The peace education views of Carson and Brouwer (1985) are also consistent with this perspective.

The civic ideal (Bouwsma, 1975), in which individual development is important but subordinate to society's collective needs, and the social perspective have much in common. However, the civic ideal places a greater emphasis on the strictly intellectual development of the person than is the case in the social conception of education.

Discussion of the Model

The technical (especially) and rational views dominate contemporary secondary education (Prakash & Waks, 1985; Slaughter, 1985). One finds progressively fewer supporters as one moves through the four conceptions from the technical to the social views of education. Prakash and Waks claim this is because in the short term the first two conceptions serve the "consciously perceived interests of many members of society, ... and more important, they serve the interests and have the full support of ... those [in formal education] who shape and administer educational policies" (1985, p. 97).

Prakash and Waks (1985) see the values of each conception being included - reinterpreted and transformed - in those conceptions that follow, with the limitations being excluded. For example, the ability to problem solve mathematically may be valued in all four conceptions of education, but the meaning of problem solving varies, as does the meaningfulness of being skillful and creative in problem solving. The authors see the technical conception of excellence as the most limited and the social as the broadest, and the general form of excellence which educators ought to grasp. Thus, being able to efficiently solve mathematical problems by matching routines to identified patterns in the various problems is of no value to the advocate of social responsibility if the problems have no real, immediate, social significance. Furthermore, a restricted view of mathematical problem solving may limit the ability of the individual to interpret mathematically a social problem.

All the conceptions are concerned with educational structures, with how curriculum is conceived and made part of the classroom, and with the nature of the teacher-student relationship. However, I interpret the technical conception of education to be the least concerned with persons as such. It is people, of course, who must learn the course content, write the tests and raise the test score levels, but the technical view is generally less concerned with the nature of the education, development and social awareness of the <u>person</u> than it is with the efficient instruction of the group or the general population. In the technical conception, education is seen least (of the four conceptions) as having intrinsic value.

Finally, in interpreting and applying the model, the clear differences in the four categories of education and associated excellence standards are often not so sharply seen in individual educators when one attempts to correlate the two - concept and person.

That is, while educators may hold positions that identify them predominantly with one category or another, aspects of their beliefs or practices are apt to suggest placement in additional categories. This may be briefly illustrated by referring to two educators, Maxine Greene and Nathan Glazer, whose views are decidedly different.

Glazer (1985, 1987) believes that excellent (high achieving) students need their own programs and schools. All students cannot be treated alike ("equity") because not all students are alike. In particular, not all students can be excellent (1987). There is an argument, then, Glazer says, for a positive view of "elitism." He believes that (i) placing excellent students with other excellent students affords a much better chance for them to realize their potential, (ii) excellent students need motivations (such as the possibility of attending an elite high school) to put forth the effort that will distinguish them from other students, and (iii) elite academic high schools provide the most effective atmosphere and teachers for the pursuit of excellence, and the rewards for the achievement of excellence. Glazer's outlook clearly reveals aspects of both the technical and rational conceptions.

Greene's views on excellence seem foremost to be of a "personal" nature. Her discussion of "excellence" (1984) focuses on aspects fundamental to human experience in general. "Excellence refers to a quality of mind" (p. 286), where mind is to be understood as being active and involved with experience, giving rise to a broad range and depth of meanings. She draws heavily upon Howard Gardner's (1984, 1987) theory of "frames of mind": Multiple intelligences - logical-mathematical, linguistic, spatial, bodily-kinesthetic, musical, intrapersonal and interpersonal intelligences - signify the vast array of potential that is present in humanity. (Coles (1987) believes that other intelligences, such as moral intelligence, can be meaningfully added to this list.)

Rather than getting entrapped in the one-dimensionality of the excellence notion proposed in many of the recent reports, educators must nurture "mindfulness," must "open perspectives," must empower "diverse persons to become critically conscious of the lives they live together"

(Greene, 1984, p. 293). Such human capacities as "critico-creative thinking, integrity, autonomy, fidelity, imaginativeness, adventurousness, self-reflectiveness, cooperativeness, moral sensitivity and even strength of will and persistence or stubbornness" (p. 288) ought to be developed in the name of excellence. There must be opportunities for people to display these developed capacities. Only with opportunities for development and display can potential be realized. Diverse potentialities implies the necessity, not restriction, of diverse opportunities.

Greene devotes much attention to expressions of self-actualization in her writings. It is clear, however, from the attention she also gives to the development of standards by "community" members (1989), and the view of "excellence as a quality of mind," (1984) in keeping with Hirst (1975) and Peters (1965, 1975a), that she also acknowledges the value of the "rational" perspective. (Her understanding of quality of mind, is broader than that of the academic rationalist, however, who seems most to espouse an "intellectual excellence of mind" (Hofstadter, 1963).) Furthermore, in Greene's writing there is a strong concern for the "social" significance of education.

Excellence in Mathematics Education

This major section of Chapter 2 represents the third and final element of the progression from excellence to educational excellence to excellence in the mathematics education context. Perceptions of the status and value of school mathematics as an important area of study are examined first. Following that, some contemporary perspectives of school mathematics and mathematics education, and criticisms of typical practices are described. The section then examines some perspectives on excellence in mathematics education.

Perceptions on the Status and Value of School Mathematics

In many countries, school mathematics is widely perceived as a high status subject (Bishop & Nickson, 1983; Howson & Wilson, 1986), and its successful study is seen as important and necessary (Dorfler & McLone, 1986). Howson and Mellin-Olsen cite four reasons mathematics educators typically give for mathematics' place in the curriculum. Mathematics:

(i) contributes to the basic knowledge of any educated citizen;
(ii) contributes to the study and advancement of numerous disciplines, professions, and trades;
(iii) contributes to a student's general education through the inculcation of particular attitudes or approaches;
(iv) possesses an inherent interest and appeal. (1986, p. 10)

Dorfler and McLone (1986) note that while the popular view is that mathematics is essential and important, specifying <u>why</u> it is essential often presents difficulties for people, and adds to the "awe" in which mathematics is typically held. Nevertheless, high among the perceived benefits of school mathematics study is the subject's "usefulness" - in everyday life, in some occupations, in scientific and technological development, or as tools in management and commerce. The fact that mathematics is an important aspect of human cultural heritage also makes it worthy of study according to some people, as does the claim by some that mathematics is aesthetically appealing (1986, pp. 49-50).

The development of young people's cognitive abilities is also often high on the list of purposes for mathematics study (e.g., item (iii) in Howson and Mellin-Olsen's, 1986, list; Boyer, 1985a,b; Goodlad, 1984), but research has suggested caution is advised in generalizing the effects of such study. Two examples of mathematicians with widely differing perspectives on learning mathematics but who hold similar views on the value of mathematics study in developing logical thinking are Whitney (1987) and Dieudonné (1973). Whitney (1987) believes that a principal purpose for studying mathematics, particularly at the secondary level, is the growth of one's mathematical reasoning powers. Dieudonné (1973) also saw the development of "a clear mind and a rigorous judgement" as the essence of mathematics study (p. 100), but his was from a "new-math" perspective which did not acknowledge the student as a personal constructor of mathematical knowledge. The new-math emphasis was on mathematics content consistent with a deductive approach; transmission of this content through lecture and instruction was an accepted teaching mode (Howson, 1983, pp. 25-26; Howson, Keitel, & Kilpatrick, 1981, pp. 100-101).

Many U.S. secondary mathematics teachers consider the development of logical thinkers and good problem solvers to be the principal purpose of teaching mathematics (Fey, 1979; Goodlad, 1984). In the United Kingdom, Bishop and Nickson (1983) report that in a 1970 survey of secondary mathematics teachers and employers which sought to determine where the emphasis in mathematics teaching should be placed, the employers ranked number one the choice (out of six given) "training children to think logically," while the teachers placed this third out of six. (The teachers as a group ranked mathematics "as an enjoyable and satisfying activity" number one.)

The view that school mathematics study will help develop students' ability to think logically in non-mathematical situations has been seriously questioned, however, (e.g., Board on Mathematical Sciences et al., 1989; Dorfler & McLone, 1986; Howson & Wilson, 1986), although Howson and Mellin-Olsen (1986) note that recent work by psychologists "would indicate that transfer of a broad type, that is, of attitudes and high level processes, can take place" (pp. 10-11). This appears to be a reference to the development of metacognitive skills. Howson and Wilson (1986) suggest that perhaps one should speak of the development of "critical powers" rather than "reasoning powers" (p. 11) through the school mathematics study of, for example, simple statistical ideas. Critical powers may enable people to better "handle" all the information with which they are bombarded.

The development of any such powers through mathematics study is highly dependent on the manner of teaching, and the "simply repeated performance of routine tasks" is unlikely to promote this development (Dorfler & McLone, 1986, p. 53). Goodlad (1984) asks of the teachers who promoted the "logical thinking" transfer perspective, "Why, then, did so few mathematics teachers in our sample appear to get much beyond a relatively rote kind of teaching and textbook dependency not likely to develop powers of critical reasoning?" (p. 210).

"Reasoning skills" is not the only aim of school mathematics study: Romberg (1986) spoke for many concerned with the state of mathematics education in the U.S. when, as chairman of the 1984 conference, "School Mathematics: Options for the 1990s," he wrote "Serious problems exist with respect to the opportunity most students have to learn the mathematical concepts and skills they need for college, for future employment, and for responsible citizenship" (p. 204). These goals also form a major part of the rationale for the call in the 1989 NCTM Standards document for a "mathematically literate" population (pp. 3-5).

Mathematics teachers (like other teachers) also tend to have other, non-mathematical goals in teaching; these are socialization goals (Blase, 1986; Fey, 1979). "They believe students should be encouraged to work hard, keep busy, be polite, aspire to improve, work independently, and prepare for things to come" (Fey, 1979, p. 503).

A Dynamic, Constructivist Perspective of Learning School Mathematics

(a) Thinking Mathematically

In his book Thinking Mathematically, Mason (1985) offers an interesting and in-depth "hands-on" approach to developing one's capacity to think mathematically. Mathematical thinking is defined as "a dynamic process which, by enabling [one] to increase the complexity of ideas [one] can handle, expands [one's] understanding" (p. 158). Mason identifies three factors which influence the effectiveness of one's mathematical thinking:

> ...competence in the use of the processes of mathematical enquiry;
> ...confidence in handling emotional and psychological states and turning them to [one's] advantage;
> ...understanding of the content of mathematics, and if necessary, the area to which it is being applied (p. 146).

Mason focuses on the first two factors.

Mathematical thinking proceeds in phases when dealing with a question - "entry," "attack," and "review," in Mason's "RUBRIC" language - and is associated with such emotional states as "getting started, getting involved, mulling, keeping going, insight, being sceptical, [and] contemplating" (p. 158), many aspects of which are part of the important process of developing an "internal monitor" (p. 115). Students and teachers are strongly encouraged to extend their activities beyond the limits of the immediate problem. Gaining experience through practice, and reflecting on that practice are critical aspects of developing mathematical thinking.

Mason argues that mathematical thinking is personal, and cannot be developed by a direct study of the advice he offers. He also believes that the the typical mathematics classroom routine, where the focus tends to be on "getting the answer," is not conducive to the development of mathematical thinking because it does not provide the challenging atmosphere or necessary time and space to permit widely ranging practice and reflection. Only in an environment which encourages such questions as "How do I interpret that?", "Why do I assume that?", "When is that so, and not so?", and "What do I mean by that?" is mathematical thinking supported (p. 154).

It is clear that the focus of Mason's book is mathematics; it is addressed to students (and teachers) of mathematics, and the questions are generally of a mathematical nature. The recognition of pattern and its symbolic articulation are important aspects of thinking mathematically. Yet it is also clear that in Mason's view, mathematical thinking extends well beyond the domain of what is "conventionally" viewed as being mathematics (often associated with specific content). Mathematical thinking is not an end in itself but increases one's understanding of the world and extends one's choices through wide application in mathematical, scientific, and general life situations. Further, one's self-awareness grows, serving as a "bridge connecting disparate areas of knowledge, information, experience, perception and feeling to each other and to the world outside" (p. 155). More is said of the potential for interconnectedness in school mathematics in the following section.

(b) Emphasizing Interconnectedness and Constructivism

Post-secondary mathematics educators such as Barbeau (1985), Freudenthal (1973), Mason (1985), and Romberg (1984) believe that the power of mathematics lies in the ability, through an understanding of the subject, to make connections: "The interconnectedness of ideas is critical" (Romberg, 1984, p. 21). Problems must be seen as systemic; "interdependent and interactive" (p. 18). These connections refer not only to those between mathematics concepts, but also, and even more importantly, to those between "ideas about real world objects and situations" (p. 20; see also Freudenthal, 1981). Freudenthal (1973) observes that mathematics can and should be taught "fraught with relations" (p. 132). Both members of the relation must be taken up, the mathematics member on the one hand, and the mathematics, science, or everyday life aspect on the other.

Romberg (1984), among others, asserts that the way to develop in young people insights into the interconnectedness of ideas through mathematics is by honouring a constructivist approach to teaching, which acknowledges the young person as an active agent in his or her own learning. Students must be encouraged to "take responsibility over the work being done" (Whitney, 1987, p. 230). In a constructivist approach, the teacher recognizes that the student comes to class with certain beliefs and ideas about what constitutes mathematics and mathematical knowledge. In class, mathematical knowledge cannot be given to children; each child must construct his or her own such knowledge (Kamii, 1985; Yackel et al., 1990). Mathematical knowledge becomes the student's ("appropriated"; Vergnaud, 1987) through a process of constructing personal meaning while engaging in mathematical activity (Gordon, 1978; Whitney, 1987).

In 1989 the National Council of Teachers of Mathematics published Curriculum and Evaluation Standards for School Mathematics (hereafter referred to as the "Standards" document). It is considered to be a major, comprehensive policy document, very prescriptive in nature. The standards were developed as a response by the U.S. mathematics education community to calls for reforms in reports such as A Nation at Risk. In a mathematics education that meets the goals set by the Standards document

> students should be exposed to numerous and varied interrelated experiences that encourage them to value the mathematical enterprise, to develop mathematical habits of mind, and to understand and appreciate the role of mathematics in human affairs; ... they should be encouraged to explore, to guess, and even to make and correct errors so that they gain confidence in their ability to solve complex problems; ... they should read, write, and discuss mathematics; and ... they should conjecture, test, and build arguments about a conjecture's validity. (1989, p. 5)

A mathematics education that truly honours the personal construction of mathematical (and other) knowledge is a "liberating experience," and has "both intrinsic and practical value to the person ... in that the experience becomes part of the person, enriches the person's lived experience, and relocates the person's efforts in and toward the world" (Gordon, 1978, p. 252).

Critical Mathematics Education

Another, less widely held perspective on mathematics education is that expressed by educators such as Frankenstein (1983), Mellin-Olsen (1987), Skovsmose (1985), and to a certain extent Gordon (1978). This is a perspective that explicitly argues for a critical or emancipatory aim for mathematics education.

It was noted earlier that Gordon (1978) described the "liberating mathematical experience" as one in which "the concern was for the personal construction of knowledge." The student becomes a "problem poser/choser" (p. 263). (Recall Branton's (1979) reference to the research scientist as "excellent problem finder.") According to Gordon, a curriculum that provides a liberating mathematics experience must do two things. First, it has to be "sensitive to the acts of choosing and valuing and emphasize the value of personal attempts and rationales for constructing knowledge" (p. 265). The mathematics curriculum must "share how and why mathematical knowledge is developed, with special emphasis on its grounding in belief, intuition, and subjectivity" (p. 265). The processes and contexts that produced mathematics must be revealed in its presentation. These in turn must be considered from epistemological, personal, aesthetic, and historical perspectives.

Second, the mathematics curriculum must "facilitate our understanding of the world in which we live and create and the beliefs we act upon" (Gordon, 1978, p. 265). This means exploring the interrelationships between mathematics and the physical and social sciences in terms of the human construction of "explanations and relations of phenomena (including ideas)" (p. 266), and how these (tenuous) constructions are grounded in belief.

There are critical aspects to Gordon's (1978) constructivist perspective. Students should be encouraged to question the "givens" in (formal) mathematics, and this should lead to questioning the "givens" of school and society as well. The liberating mathematical experience should lead students to a <u>commitment</u> to inquiry: "Why would one do that?" "Why would anyone want to know that?" and "What does this experience mean to me?" (pp. 266-267; cf. Mason, 1985).

> The emphasis on formal operational thought keeps each of us from testing the truth of the given - once one practices the prevailing

logic and makes this the goal, one has lost sight of the genesis and meaning of the enterprise itself. (Gordon, 1978, p. 269).

Skovsmose (1985) argues that critical education must infuse mathematical education, something which to the present time has not occurred. He identifies what he considers to be the three dominating forms of mathematics education for the last twenty-five years: structuralism, associated with Piaget, Bruner, and the Bourbaki school of mathematics (e.g., Dieudonné), which calls for teaching the structure of the discipline; the pragmatic trend, which presents or interprets mathematics as problem-solving; and the process-orientation, closely related to a constructivist position, and identified with mathematics educators such as Freudenthal. (Skovsmose makes some rather broad groupings here; Howson (1983) prefers to separate Dieudonné, Bruner, and Piaget into the "new math," "structuralist," and "formative" mathematics curriculum "movements" respectively. Kamii (1985) identifies Piaget as a constructivist.) Skovsmose states that none of the dominant forms he identifies meet very well the criteria for a critical mathematics education, particularly his structuralist school form.

There are three prominent features of a critical education. First, students must be granted a "critical competence" to become thoroughly involved "in the control of the [mathematics] educational process" (Skovsmose, 1985, p. 340). In other words, mathematics should not be viewed as a static body of knowledge to be imposed upon the students - a view that has been expressed by several mathematics educators already. Second, students and teacher alike "must establish a <u>critical distance</u> to the content of the education" (p. 340). The establishment of a mathematics curriculum is not an objective and value-free enterprise. All the participants in the mathematics classroom need to engage in "curriculum critique," posing questions regarding the applicability of the subject matter, and the underlying assumptions, functions, and limitations of the subject (pp. 340-341). Third, a critically-oriented mathematics education must involve a "critical engagement" (p. 341). Mathematics study must be problem-oriented; the problems must be relevant to the students, and they must deal with existing social problems.

Frankenstein (1983), whose mathematics teaching to 1983 was apparently with working class adults, has attempted to introduce the work of Freire into her teaching. She believes that "most current uses of mathematics support hegemonic idealogies, ... mathematics education ... reinforces hegemonic ideologies, ... [while] critical mathematics education can develop critical understanding and lead to critical action" (p. 327). To this end, mathematical literacy is vital. She implicitly supports the dimensions of critical education identified by Skovsmose (1985).

Frankenstein (1983) also takes issue with the notion of "mathematics anxiety," seeing it as a label which in effect puts the blame on the victim. Math anxiety becomes, for mathematics educators, a pathological condition in an individual who needs to be cured. People take for granted that this is a "natural" condition, leading them "to believe and act as if they have 'nonmathematical minds'" (p. 329). In any event, the label masks the need to look at the broader societal context that created the personal stress over mathematics.

Like the other educators in this section, Mellin-Olsen's (1987) explicit aim is to "politicize" mathematics education. His focus is particularly those young people for whom the conventional, dominant, mathematics program carries little meaning, either in terms of the content of school mathematics itself, or as an important credential in further life possibilities. These students consequently fail to learn mathematics. They are "prevented from an important field of knowledge," Mellin-Olsen claims, "because of the design of the curriculum or the mechanisms of the examination system" (1987, p. 191). These structural barriers mean for Mellin-Olsen that mathematics education does not need to be politicized; it already is a political enterprise. The task is to make it explicitly so for young people.

To develop his position, Mellin-Olsen draws from a number of fields and from a number of thinkers. These include, for example, a concern for context and the notion of folk mathematics, Vygotsky's activity theory and the notion of "thinking tool," Freire's concern for critical conscientization, Bateson's "double-bind" concept, theories of language, the psychoanalytic theories of Freud, and contemporary Marxist educational literature.

Mellin-Olsen conceives of mathematics as "a structure of thinking-tools appropriate for understanding, building or changing a society" (1987, p. 17). He argues that what is needed is for these young people to engage in projects involving mathematics thinking-tools which lead to a critical awareness of some relevant, problematic social situation, and, most importantly, to the students (and the teachers) taking some form of concrete action leading possibly to social change. Not only does this approach lead to more critically aware young people, it also provides a means by which the "resistant" young may see mathematics as a useful, meaningful enterprise.

Some Criticisms of Current Practices

School mathematics is seldom consistently practiced as described in the previous sections, and it is therefore not difficult to find educators who are critical of what goes on in many mathematics classrooms in North America, and beyond. Classroom research has shown that mathematics is very often taught as "a box of well-worn useful tools" (Barbeau, 1985, p. 69) or, in more corpselike fashion, as "a body of fixed facts and skills to be acquired (Goodlad, 1984, p. 209), as "dead 'facts' and 'techniques'" (Davis, 1984, p. 347) or as "formalized, codified and lifeless mathematics" (Burton, 1987, p. 307. See also Freudenthal, 1973; Gordon, 1978; Haylock, 1987; Romberg & Carpenter, 1986; Whitney, 1987). Mathematics curricula are overly fragmented into isolated pieces (Romberg, 1984), while classrooms are teacher-dominated with students present as passive learners (Fey, 1979; Freudenthal, 1973; Romberg, 1984).

Romberg and Carpenter (1986) identify three problems with school mathematics as described above:

(i) The perception of mathematics as a static bounded discipline leads to the view that "there is a lot to teach" (p. 851). Mathematics becomes divorced from related disciplines such as the sciences. The division into subject areas, which are in turn divided into topics, and so on into smaller pieces often leads to the loss of "such essential characteristics of mathematics as abstracting, proving, and applying" (p. 851).

(ii) The acquisition of mathematics-related information becomes an end in itself. Students lose the opportunity to have experiences of their own. Consequently, much of what is "absorbed" by the student carries little meaning for the person.

(iii) The mathematics teacher's role is managerial or procedural, functioning within established blocks of time to ensure that the lesson is covered, and according to topic-oriented curriculum guides and textbooks. "In this traditional classroom, the teacher's job is related neither to a conception of mathematics knowledge to be transmitted nor to an understanding of how learning occurs" (p. 851).

Steffe (1990), a constructivist, argues that changing from the current perspective held by many mathematics teachers that mathematics is given a priori to teaching, to a view that mathematics is a human activity requiring ongoing decisions about what students might learn, will require a change in world view on the part of teachers. In so doing, teachers will come to better understand the mathematics they thought they knew, and the process will provide them with a sense of ownership of the mathematics, and empower them to rise above the compartmentalization found in many mathematics textbooks.

This thesis considers change in mathematics education through the notion of exellence. Some research has been done in terms of explicitly examining excellence in school mathematics. Various frameworks for understanding the concept of excellence have been employed in the course of this research. For example, within the "effectiveness" framework of improving student achievement outcomes, and process/product research, Good and Grouws (Good, Grouws, & Ebmeier, 1983) have worked to improve mathematics teacher effectiveness at both the elementary and junior high school levels. They specifically measure teacher effectiveness in terms of student outcomes. Two other studies of excellence in the mathematics classroom are described below.

Locating Excellence in School Mathematics: Two Studies

One can see in the various perspectives on mathematics education so far described aspects of the educational excellence views of Aoki

(1990), Prakash and Waks (1985), Slaughter (1985) and Greene (1984). The criticisms of Romberg and Carpenter (1986), for example, are directed against the largely technical approach of much of contemporary mathematics education, while the themes of academic rationalism and (to a lesser extent) personal relevance seem closely related to the general constructivist/NCTM views. Critical mathematics education is clearly associated with the social responsibility criteria of excellence. The boundaries are not sharp, however.

The focus of the Good and Grouws mathematics teacher effectiveness work referred to above is largely within a technical conception of education. Aspects of the two studies described below, one a series of case studies, the other a highly interpretive field study, can be situated within various Prakash and Waks (1985) conceptions of excellence.

(a) "Exemplary Programs"

In 1987 the National Council of Teachers of Mathematics (NCTM) published an account of case studies of "exemplary mathematics programs" in ten U.S. schools, eight of which are high schools, including a specialty school for those talented in mathematics and science (Driscoll, 1987). The schools were chosen for study on the basis of "excellent student outcomes" - "e.g., high test scores, exceptional enrollments, awards, notable success with females and minorities, special success with extracurricular mathematics, and so on" (p. 12).

Recall that Singleton (1979) made the point regarding individual excellence in a skill that there are a number of paths to achieving a level of excellence. Driscoll (1987) also finds that the eight high schools demonstrate that there are a "variety of routes to excellence in mathematics [programs]" (p. 58). Some schools achieve the desired student outcomes by sticking closely to the program and text, and watching tests results carefully - the "safe routes." Other schools stream the students, offering challenging, non-traditional courses to their "top students," and traditional but "still demanding" courses to those students who are "average" and "below." In a third group of schools all students experience some "innovative" mathematics; there is a basic reliance on traditional textbooks, but teachers engage in non-traditional activities whenever the need and the opportunity present themselves.

Driscoll (1987) speaks of levels of excellence, even among these schools with exemplary mathematics programs. One of the higher levels is based on the nature of classroom interactions: It is an "approach to teaching that aspires to developing mathematical thinking as well as inspiring the learning of mathematics; the classroom questioning that challenges students to analyze their own thinking, refine their explanations, and ask good questions" (p. 66). Driscoll is speaking here not only of excellence in mathematics programs and in mathematics teaching, but also of the personal excellence of individual students in mathematics, a level of skill and understanding in mathematics not wholly assessed by performances on achievement tests. The mathematical thinking discussions of Mason (1985) and Gordon (1978) have significance here.

Two aspects of these mathematics programs appear repeatedly in Driscoll's (1987) review. They have already been identified as important and necessary characteristics of "good" or "effective" schools. The first is "visionary leadership in mathematics," referring usually to the mathematics department head, often supported by the school senior administrator(s), and occasionally district personnel. Driscoll notes two kinds of leadership. The first sets the standards of excellence in the programs and points the way to reaching them, while the second type provides the leadership and fosters the team effort necessary to maintain and improve levels of excellence already attained. The second aspect of these mathematics programs that keeps reappearing are the mathematics teachers who "buy into the vision [of the leader(s)] and apply it to their teaching" (p. 62). Without this commitment the "vision" is meaningless.

Using the Prakash and Waks (1985) model to interpret Driscoll's research, his descriptions of school mathematics excellence fall essentially within the framework of the technical and rationalist conceptions, depending upon how "traditional" or "innovative" the mathematics programs in the eight secondary schools were. It is difficult to identify much that is of a clearly personal nature in the programs, although the extracurricular mathematics identified in some schools for those students with a strong interest in the subject can be considered as an opportunity for increased personal development. There is little or no evidence of an intentionally well developed social action character to the mathematics programs.

(b) Markers of Excellence in Mathematics Education

In another approach to exploring educational excellence involving mathematics, Solomon (1986) uses Gowin's (1981) theory of educating as shared meaning based in part on Schwab's four commonplaces of education - the teacher, learner, curriculum, and governance (or milieu) - to research and identify "markers of educational excellence" (Solomon, 1986, p. xx) in geometric and philosophical events (usually in the classroom). These events of shared meaning between teacher and students occur in the context of two high school courses Solomon taught. His mathematics markers are reminiscent of those at the higher level of excellence described by Driscoll (1987).

The markers Solomon (1986) identifies emerge in specific events in specific courses, however, they are frequently intended as general markers of educational excellence. He identifies approximately forty-six markers from events in the philosophy and geometry classes. Six markers which make specific reference to mathematics are:

(i) the involvement of students in doing mathematics (mathematizing vs. mathematics as content);

(ii) the re-examination of the meanings of terms taken for granted, such as What is a line? as a good inroad into opening up meaningful learning;

(iii) the distinguishing of three levels of meaning in mathematics (the idea, theoretical or abstract, and the concrete levels);

(iv) relations of mathematics to other areas of study, and relations between different areas within mathematics;

(v) the use by teachers of multiple approaches to problems (finding meaning vs. getting an answer);

(vi) the presentation and discussion of philosophical ideas in a mathematical context is a specific example of the more general possibilities of the interrelation of arts and sciences. (pp. 225-229)

The perspective presented here is principally a rationalist one. There is also potential within Solomon's orientation to provide the student with substantial opportunities to engage in educational and mathematics actions and activities of a more personally relevant and meaningful nature.

Excellence and Equity in Mathematics Education

The tension between the goals of equity and excellence exists in mathematics education as it does in other subjects. Consider, for example, Atwood and Doherty (1984) and Stanic and Reyes (1987). While these authors believe that both goals are necessary, their views on the issue differ. This difference stems at least in part from their interpretations of the meaning of equity and excellence in education, and how these goals may be achieved.

Atwood and Doherty (1984) make the claim that equity in the form of special programs (e.g., for minorities) can and does produce statistically higher student outcomes in their high school mathematics and science courses. They base this claim on the results of a California program. Atwood and Doherty refer to this as "improving both the excellence and equity of math/science education" (p. 238). Excellence and equity in this instance are defined at the "program" and "group" levels. Equity is concerned with providing equal post-secondary and career opportunities for an identifiable group of students (cf., National Coalition of Advocates for Students, 1985). Excellence is interpreted in terms of how well the group of enrollees as a whole does, as measured mainly by mathematics standardized achievement test and GPA scores. Excellence is also understood as a relative notion, capable of being "improved."

Stanic and Reyes (1987) argue that in the reality of classroom life, treating all students fairly or justly (i.e., equitably), even when the teacher genuinely wishes to do so, is extremely difficult. They draw this conclusion from their ethnographic-type study of a grade seven mathematics classroom. On the one hand, they note, because there are individual differences among students, mathematics teachers do treat them differentially, indeed they are taught to do so. Also, students, when treated in exactly the same way, often respond differently. On the other hand, teachers' intentions in their interactions with students are very often different. Personality, gender, perceived student ability and interest, and so on, are all factors which influence the nature and intentions of a teacher's interactions with students.

Notwithstanding the enormous difficulty of treating all students equitably in the classroom, another major difficulty for Stanic and Reyes (1987) is the definition of excellence. Defined, as excellence usually is, as "to surpass, to be superior to, or to outdo others" (p. 27), the necessity of equity to achieve excellence at the level of the individual seems extremely difficult to argue for. The authors consider two alternatives for determining excellence: "outdoing oneself, or surpassing some criterion, so that all of us can be excellent" (p. 27). The first, they claim, is a problematic concept. (This is in contrast to Branton's (1979) view presented earlier of the champion as one who does "excel her- or himself" (p. 245). It is in contrast, in a different sense, with Aoki's (1990) interpretation of the original meaning of excellence "as one's struggle to surpass who one is" (p. 7)). Stanic and Reyes appear to suggest that the second alternative has merit, but runs up against the competitive character of the current operationalized view of excellence in many of the recent calls for excellence in U.S. education, and the competitive nature of most mathematics classrooms.

The tension between equity and excellence in the mathematics classroom is strong, Stanic and Reyes (1987) claim. On the one hand, "striving for excellence is ... empty at best and harmful at worst without a concomitant concern for equity" (p. 28). On the other hand, the present reality is that the joint achievement of both is very difficult.

Summary

This chapter has explored at some length the notion of excellence as it pertains to general human character and achievement, to education broadly considered, and to mathematics education. It has provided historical ideals of the educated person which help provide a sense of how visions of the connections between human excellence and education have varied over time and context. The chapter has helped illuminate the wide range of contemporary views on excellence and excellence in education. The current major perspectives in mathematics education and the significant problems in contemporary school mathematics were briefly examined in the chapter. A framework of educational conceptions and excellence standards (Prakash & Waks, 1985) from within which the research in the school with teachers and students will be analyzed and interpreted was discussed at length in the chapter.

Values, the basis for the establishment of standards and thus fundamental to any discussion of excellence, were explored first. Important distinctions between instrumental and intrinsic values were noted. At the higher levels of skill performance, the notions of excellence that those such as von Wright (1963), Nathanson (1974), Singleton (1979), and Norton (1980) describe seem particularly to be based on the personal, intrinsic value of performing at such levels in the task or activity. Visions of being a "Somebody," on the other hand, imply placing instrumental value on achievement essentially for the purpose of status and prestige. Of course, valuing something and acting in certain ways for instrumental reasons is not necessarily negative. What must be considered is the nature of the ends, or the intrinsic values, which are finally intended to be realized through the actions. It was noted that at least in the United States, education has typically been valued primarily for instrumental or extrinsic reasons, and this continues to be the case in the dominant educational reports of the 1980s, where national and personal economic ends appear to be the focus. Similar values seem to predominate in Canadian education. The relative emphases that teachers and students in this present research place on education will need to be interpreted in the light of instrumental and intrinsic value differences.

As part of the historical discussion, the early Greek, and especially Aristotelian perspectives on personal excellence were described at some length. Subsequent sections of the chapter revealed that many contemporary views on excellence are rooted in this classical orientation. Of particular importance are issues of the potential for some form of positive excellence in all persons, the idea that excellence is a property of persons and only derivatively in the product, the active moral quality of positive human performance, and the notion of seeking excellence as a state of "becoming." These aspects of excellence will again be considered in Chapter 7.

The matter of individual skilled excellence, that is, technical goodness, of professional excellence, and of the excellence of the champion or master was discussed at some length. One might ask how such a discussion bears on the exploration of excellence at the secondary school level. After all, skilled, excellent performance, or the excellence of the professional or of the master seem to imply extensive study and training, considerable experience, and quite possibly substantial talent in some area or areas which has been developed over time. The aims, structures, and practices of secondary schools, and the youthfulness of the students in those schools, would seem to indicate very limited opportunities for the development of people with considerable skills in various areas of interest, and certainly the possibility of actively aiding those students who might aspire to be masters in some field of endeavour to reach such levels seems remote. Finally, secondary schools are not generally mandated to produce professionals in any field upon graduation.

Looking first at the last category, that of professionals, Hofstadter's (1963) and von Wright's (1963) discussions of the nature and "goodness" of the professional will aid in establishing the context of the research, in this instance, the apparent understanding which the teachers have of themselves as teachers, the context of the school as a place conducive to the achievement of excellence, however they may interpret that notion, and whether such an atmosphere is what they considerable most desirable in a school.

Talk of skilled excellence and becoming a master or expert implies community. It will be important to seek out what, if any, community or communities can be identified in the understanding that teachers and students have of school and mathematics, and what criteria, if any, appear to mark the actions of exemplary students within those communities. The notion of "individuals-in-community" and one's "loved work" are taken up in Chapter 7 to expand typical perspectives of excellence as achievement.

One can also relate the notions of skilled technical goodness and becoming artist or master to conceptions of proficiency, initiation and self-actualization. It thus becomes important to distinguish between what the students actually accomplish in their years of secondary school, which will be relatively limited, and what the visions and practices of the students and teachers are, and where they point, so to speak, in terms of human potential. One needs to ask, What are the intentions and values of teachers in teaching mathematics, and of the students in attending school, and studying mathematics?

The interpretations of these intentions, and the explicit and implied meanings of excellence embedded in these intentions is, of course, the purpose of using the expanded Prakash and Waks (1985) model of four conceptions of education and the respective standards of excellence. Following the description of the school, teachers, and students in Chapter 4, and the presentation of interpretations the teachers and students themselves have of achievement and excellence in Chapter 5, the meanings of excellence for the participants in terms of the model will be taken up in Chapter 6.

CHAPTER 3
THE STUDY: PARTICIPANTS, METHODOLOGY, AND INTERPRETATION

Introduction

Two field studies were undertaken in this research: a pilot study in February and March, 1988, and the major school study during the 1988-89 school year. The pilot study is discussed briefly in this chapter, and is elaborated in Appendix J. The major field research is discussed in detail here.

The focus of Chapter 3 is centered on (i) the processes of selecting the school, the students and the teachers who took part in the major study, (ii) the forms of gaining access to students' and teachers' understandings of excellence, that is, the artifact collection, the classroom observations, the group interview, and the individual interviews, and (iii) the issue of interpretation and the hermeneutic character of the study, addressed in the last part of the chapter. The descriptions of the chosen school, its mathematics program, and the participants are kept brief in this chapter; Chapter 4 provides a more extensive description of these matters. Chapter 3 begins with a discussion of the basis for an interpretive study involving experienced teachers and senior students.

Rationale for an Interpretive, Contextual Research Orientation in the Study of the Meaning of the Notion of Excellence for Mathematics Teachers and Students

European mathematics educator, Heinrich Bauersfeld (1980), states that research in education which will contribute to mathematics teacher education, for example, ought, in a substantial way, to "follow the interpretative paradigm" (p. 39). This study is intended as a contribution to the interpretive research tradition in mathematics education. Eisenhart (1988) notes that, in considering such research, "It makes no sense for the interpretivist to do things like catalogue beliefs about mathematics without considering the contexts in which these ideas are important" (p. 103). Teachers and students are the fundamental empirical source for this study. It is their understanding of excellence in a particular educational context, established through the process of in-depth interviews and interpretation, which give empirical depth to the dissertation.

The participants are experienced secondary mathematics teachers and grade twelve senior high school students. The following sections on teachers and students are presented to help strengthen the rationale for choosing experienced teachers and grade twelve students. In particular, the section on teachers focuses on the matter of the teacher's vision of education and its compatibility with that of the school, the socialization, over time, of teachers in the school culture, and the teacher's relations with students in establishing a classroom environment which is acceptable to both parties. The section on students focuses on student perceptions of the purposes of school education, the question of student academic success, and student beliefs and attitudes regarding such success.

Teachers: Educational Vision, Classroom Negotiation, and Socialization

Rosario (1986) believes that contrary to claims that schools are not committed to the principle of quality and excellence, it is the primacy of this principle that "seems to preoccupy, sustain, and give meaning to the activity of schools" (p. 33). The culture of schooling is deeply affected by a concern for quality. Teachers are at the centre of that culture.

Cusick (1985a) claims that

> schools have an integrated sense of themselves, a sense best expressed by the vision that staff hold of their lives, their students, and their students' future prospects. From that vision events proceed, curriculum is processed, and activities are undertaken. And it is within that vision that teachers are more or less successful at caring, demanding, commitment, and reflection. (p. 362)

Teachers achieve the greatest satisfaction when their vision of education and what they want for their students accords well with the school's vision. They are dissatisfied when there is dissonance. "Like everyone, teachers need to find some meaning in their work. The meaning of teaching is best expressed in the vision of the school" (Cusick, 1985a, p. 363).

As Blase (1986) and Brousseau, Book, and Byers (1988) indicate, it is clearly important in any study involving the views of teachers to recognize that these views tend to change over time. For example, the meanings of educational excellence for experienced teachers may appreciably differ from those generally held by beginning teachers.

Blase (1985, 1986) notes that teachers are socializers and are themselves socialized during their teaching experiences. He identifies two principal teacher socialization processes that take place over time: rationalization and humanization. Moreover, teachers are more powerfully affected in their socialization by students than by other faculty or administrators (Blase, 1986).

The rationalization process "identifies changes in teacher attitude and behavior more specifically related to classroom management and instruction" (Blase, 1985, p. 237). His research is supportive of the claim (e.g., Lortie, 1975) that teachers tend to become more conservative and authoritarian over time. The rationalization process involves a narrowing of the curriculum-as-implemented, and a simplification of classroom processes. Teachers tend to place greater emphasis on "basic skills" and become more rigid and less creative. Brousseau, Book, and Byers (1988) agree, on the basis of their survey research, that experienced teachers are more conservative in their preference for common or clearly specified curricula. They found, however, that experienced teachers are more likely to disagree that students require close supervision in a highly structured environment.

Blase (1985) states that while teachers increasingly adopt these classroom management and instructional approaches to "survive," they generally do not consider them as positive personal changes. In his ethnographic studies, Blase found that teachers view as discouraging the apparent need to rationalize their teaching activities. This concern may account for the difference between Blase and the Brousseau, Book, and Byers (1988) survey study. This latter study also found that the experienced teacher's sense of efficacy is growing weaker; this seems more supportive of the rationalization process claimed by Blase.

Sedlak et al. (1985) suggest that teachers frequently "negotiate" with students to improve teacher-student personal relations in the classroom. The authors claim, based on their review of the literature on American high schools, that

> The essential features of this bargain include the following: relatively little concern for academic content; a willingness to

> tolerate, if not encourage, diversion from the knowledge to be presented or discussed; the substitution of genial banter and conversation for concentrated academic exercises; improvisational instruction adapted to student indifference toward content; the "negotiation" of subject matter, assignments and standards; and a high degree of teacher autonomy for managing the level of engagement, personal interaction, and course content....(1985, p. 205)

This bargain has the effect of making the relationship between teachers and students "more comfortable and less troublesome," and facilitates classroom management. Bargaining takes place in all high school classrooms to some extent, with the balance between academic learning and social relations favouring the former in some classrooms, but tipped toward the latter more often. For Sedlak et al. (1985) it is apparently not often the case that a strong academic environment and good teacher-student social relations coincidently exist in the class. Bargaining for improved classroom relations is at the expense of academic achievement, and implies a disengagement by both parties from the teaching-learning process. Boyer (1983), Carlson (1985), and Sizer (1984) in the U.S., and Reid (1986) in the U.K. make similar claims about the negotiation process that purportedly occurs in many classrooms.

Blase (1986), and Wood (1990) take issue with this Sedlak et al. (1985) view, that the instructional program is negotiated away in order to obtain student compliance. Blase argues that it simply need not be the case, although he does acknowledge that the two interests - academic learning and friendly social relations with students - do at times produce classroom tensions. Wood, a Canadian mathematics educator, argues that in Ontario the educational system is very different from that in the United States. He claims that in the Canadian situation there is less disparity among schools in terms of funding, that teachers as a group are more highly qualified and better paid, and that the credit system in use in Ontario is more demanding, and therefore there is in general much less room for negotiation than in the programs often found in U.S. school districts. These are sweeping claims, of course, and need to be considered as a personal position. The centralized educational system in the province in which this study occurred, while not the same as that in Ontario, is more like Ontario's than those in the United States. If one accepts in the main Wood's arguments, one might assume, then, that many of them also apply to the research province's classrooms.

Notwithstanding the possible differences between U.S. and Canadian schools, one is left to take the position that context is likely to play an important role in any scenario that suggests negotiation, or its lack, in senior academic mathematics classes. The potential is there, but any negotiation is highly dependent upon the local school environment, the classroom teachers, and the students in those classes.

The second of the teacher socialization processes identified by Blase (1986) is "humanization." Along with the general pattern of a narrowing, rationalized instructional focus that comes with teaching experience, Blase maintains that teachers increasingly pursue "relational, moral and counseling outcomes with students" (p. 103). Their relationship with students shifts from being somewhat "peer-like" to one that is "parent-like." Teachers see themselves in their relations with students as more than subject instructors. This humanization process appears to provide some compensation for the instructional rationalization process. The phrase "I'm more than just a teacher, it's more than just a job" is an appropriate statement of the experienced teacher's work perspective (Blase, 1986, p. 104).

Students: Academic Interests and Socialization

According to Csikszentmihalyi and Larson (1984), academic success is perhaps the most valued goal held out for middle-class adolescents. In (North) American society this is, the authors maintain, not for the good of the children, but rather for the adults the children will become. This goal exists because of the particular type of society we have become; such a society requires this type of education for its young citizens.

This academic success is fostered during the process of adolescent socialization, writes Radin (1985), primarily through competition, rather than cooperation, in the family, in the schools, and by all presently existing political systems. The result is a repression of creative thinking, and a feeling of insecurity leading to permanent self-doubt or attitude petrification. On the other hand, Radin also claims that there is a brief period in many adolescents' lives wherein they express "a strong belief in humanistic ideals: freedom, love, friendship, justice, solidarity, etc. It is the period when they, above all, cherish truth as an absolute" (p. 454). This period will not disappear for some persons, particularly those who during this time of "essential youth" (a) experience other cultural and social environments or (b) "enjoy" a humanistic education. From among these people, Radin claims, will come those who from time to time radically challenge the status quo.

The insecurity of high school students in the 1980s is also noted by Elkind (1984) in his book, <u>All Grown Up and No Place to Go</u>. They are experiencing considerable stressful ambivalence at the hands of society, he believes. Even while adult society may be placing pressure on students to succeed academically, Elkind claims that many youth are finding the after-high school prospects limited, unappealing, and frustrating.

The mixed messages of secondary education are also evident in Arnstine (1987). He notes a number of meanings of the (North) American secondary school: preparation for jobs or for college, training in submission to the demands of authorities, keeping youth in school and thus out of the ranks of the (un)employed, and a "banking" conception (Freire, 1983) of education. The first two tend to be standard, Arnstine claims. The third and fourth often are not recognized fully. Secondary education provides a means of "shoring up" and maintaining an economic system which would have extreme trouble coping with the great numbers of young people now in school if they were instead seeking jobs. The last of Arnstine's meanings of secondary school, "based on a very ancient conception of learning" of "seeing/hearing and remembering" (p. 3), leads to his suspicion "that most of the time, most students in high schools aren't learning anything" (1987, p. 3). He questions where students get the often-stated idea that what they are learning in school will be useful to them in later life.

The earlier remarks by Sedlak et al. (1985) on the "bargaining" by students and teachers that takes place in American high schools tend to support the views expressed above. Sedlak et al. argue that students increasingly find the high school diploma to have diminishing economic or educational value (cf., Peterson, 1985). Accordingly, their desire to strive academically is also diminished. Thus they negotiate with their teachers to decrease academic learning.

The possible relationships that exist between students' views about the purposes of education, beliefs about the causes of academic success, and personal goals in the classroom were studied by Nicholls, Patashnick, and Nolen (1985). For example, they examined the U.S. students' views of education as an end in itself (its intrinsic value), that is, education as the development of responsible and knowledgeable members of society, versus views of education as a means to an end (its instrumental value), that is, education to enhance one's chances of gaining wealth and status.

Perhaps not surprisingly, the authors found that students who were inclined to avoid academic work, yet who wanted to do well on tests, also tended to be those for whom the purpose of education was to increase one's economic and social status. These were the students who were also least likely to believe a high school education was to develop a commitment to society, understand the world, or strive for high achievement. Nicholls et al. (1985) conclude that the recent stress on U.S. education primarily to improve personal (and national) economic status (e.g., A Nation at Risk) is misplaced. Those for whom such status is a high priority tend to be among the academically alienated.

Experienced teachers, then, have views of education which may have changed over time, but which are becoming more stabilized. They also tend to see themselves as more than subject specialists in their relationship with the students. They are likely to be reasonably secure in their vision of education, and of mathematics education and its purposes, in particular.

Senior level students' views of education and school mathematics may vary, but having experienced all grade levels, they will have developed, or be well into the process of developing, a perspective on those experiences which should be conducive to the exploration of the question of excellence in education, and especially in school mathematics. They will also be looking to the future, beyond school.

This, too, may be conducive to their placing school, and mathematics, into broader perspective in their lives.

Field Research

The field research consisted of two phases, a pilot study and a major study.

Pilot Study

In February and early March, 1988 a pilot study was undertaken with one high school mathematics teacher and four of his students, two in grade ten, and two in grade twelve. The purpose of the pilot was to (a) provide a preliminary interpretation of the meanings of excellence for mathematics teachers and students; (b) assess the general feasibility of a study such as this, (c) assess the feasibility of involving both teachers and students, (d) assess the appropriateness, comprehensiveness and relative value of the various data gathering methods, and (e) in general, provide a clearer focus for the fall study. It is described in detail in Appendix J.

Major Field Study

Based upon the results of the pilot study, a field study involving two high school mathematics teachers and seven students was undertaken principally during the first semester of the 1988-89 school year. The research methodology is described below.

Choosing the School

School selection was based generally on the city high school having (a) a broad mathematics program (thus ruling out primarily vocationally-oriented or strictly academic schools), (b) a relatively settled mathematics program/staff, and (c) some experienced mathematics teachers. In addition, at least two mathematics teachers had to be willing to participate.

Mathematics teachers at four schools were approached. The "Introduction to the Research - Doug Franks" document (Appendix A) was provided to the mathematics spokespersons. After some discussion, two staff members at one of the schools volunteered to participate. The research school, a suburban high school of approximately 1200 students, is fictitiously identified as Fairfield High in this study. While the school offered programs to a relatively broad spectrum of students, Fairfield was also known to be academically-oriented, and thus achievement-oriented. This factor was also considered to be favourable to its choice as the research school.

The school offered (a) Mathematics 15 (a terminal basic mathematics course usually taken in grade ten), (b) Mathematics 13-23-33 (a general, non-academic grade ten, eleven, and twelve mathematics program), (c) Mathematics 10-20-30-31 (an academic program generally taken in grades ten, eleven, and twelve, but some courses may be taken concurrently; Mathematics 31 is an optional introductory calculus course), and (d) Mathematics 10X-20X-30X-31X (the International Baccalaureate academic program for grades ten, eleven, and twelve).

The Mathematics Department had five full-time mathematics teachers, one half-time mathematics teacher, and four teachers from other school departments who taught some mathematics classes. The mathematics courses are described more fully in Chapter 4 and Appendix D.

Choosing the Participants

Teachers

Each of the two male mathematics teachers who agreed to participate had more than twenty years of secondary mathematics teaching experience, and had administrative experience in the mathematics program at Fairfield. They are identified fictitiously as Frank Tilson and Len Coleman. At the time of the research, both were teaching academic and International Baccalaureate level courses. The teachers' backgrounds and teaching perspectives are described more fully in Chapter 4.

Students

The student selection was made after spending approximately two weeks observing in the classrooms of the participating teachers. A number of criteria served as the basis for selection. First, there was to be an approximately equal number of males and females participating. Second, senior students with substantial high school experience were to form at least the majority of the student participants. Third, the pilot study results suggested that one to two students from each of two of the teachers' classes would provide useful breadth as well as depth to the study, and still be manageable. Fourth, there was a desire to have students take part who were and who were not "excellent," on the basis of early identification by the teachers and students. This point is discussed next.

The conventional criterion of academic excellence is an average mark of at least 80%. (The provincial Department of Education in 1987 awarded students with the "Advanced High School Diploma with Excellence" if they completed five specified academic courses with a minimum of 65% and an average of at least 80%; City Public Schools District identifies a report card mark of at least 80% as "Outstanding" (see Appendix F), and awards "Honours Standing" status to grade 12 district students "who qualify for a High School Diploma and obtain an 80 percent or higher standing in each of their highest grade 12 subjects for a minimum of twenty-five credits."

Notwithstanding this conventional criterion, other possible standards of excellence were to be considered. The views of the teachers and students were to be sought when choosing students. The bases for asking students if they would participate were to include: (a) their marks to date, (b) teacher comments about student qualities, (c) classroom observations, and (d) student comments about their peers. The latter criterion, student peer comments, proved difficult to implement effectively. The unsuccessful attempt to use peer comments was documented in the personal journal and classroom observation notes.

Two main approaches to having students identify other students in the class who were very good or excellent in mathematics were considered or tried: (i) personal, face-to-face discreet questioning, and (ii) written identification (with reasons for the choice) on a question sheet. The following reasons made this task difficult: (a) the newness/tentativeness of my relationship with members of the classes, (b) deciding which students to ask, (c) the lack of appropriate classroom opportunities to discreetly ask the question or give out the question sheet, (d) the inability of students, early in the school term, to identify "very good" students, and (e) the "personal" nature of the question (one female student sat for several minutes looking at the question sheet, then finally said that she just could not do it). The identification and discussion of mathematically-capable peers became instead a research item in the individual interviews.

Teacher comments, student marks, and classroom observations became the principal means of making student participant choices. All of the participating students had passing grades in mathematics, and some were conventionally "excellent." Frank and Len were asked for their opinion on the possible "quality" of the students' participation. Classroom observations focused on behaviour: the degree of participation in class discussions (for example, attentiveness, apparent ability to answer questions, frequency of asking questions), and student activities during seatwork time (for example, works alone/works with others, source of assistance to others/seeks help from another (who?)).

One criterion, not considered at the start, was applied to eliminate some students who appeared otherwise to be good candidates: repeating grade 12 mathematics. Some of the participants were repeating grade 12 mathematics to improve their course grade. It was considered unadvisable to have all repeaters, even though these were generally students who were doing well in mathematics in terms of marks.

A second point to make clear is that International Baccalaureate mathematics classes were not observed, and students presently in IB mathematics at Fairfield were not considered for participation. The concern was that the focus of the research would be skewed to become a comparison study: first, a comparison of IB student and regular academic student participants, and second, a comparison of the IB and regular academic mathematics programs. To avoid this, all students were from the same program: the "regular" academic Mathematics 30 course and, in some cases, the Mathematics 31 course. As will be evident in later discussions, however, the International Baccalaureate program is a significant factor in the views of the teachers and many of the participant students.

Seven students, all of whom were in senior mathematics classes, volunteered to participate. They were in Mr. Tilson's two first-semester Mathematics 30 classes (dubbed 30A and 30B for research identification purposes only) and Mr. Coleman's full year Mathematics 30 and first-semester Mathematics 31 classes. The relationship between teacher, class, and student is shown in Table 1 below. The students have been given fictitious names. Their sex is indicated in brackets.

STUDENT (M/F)	TEACHER: Frank Tilson	Len Coleman
Sarita (F)	Math 30B	
Gordon (M)	Math 30B	
Marie (F)	Math 30A	
Adam (M)	Math 30A	Math 31
Yee (F)	Math 30A	Math 31
Jan (F)		Math 30
Darren (M)		Math 30

Table 1

All student participant candidates were first asked to read the "Information Sheet and Parent/Guardian Research Permission" sheet (Appendix B). Those under 18 who wished to take part were asked to have the attached "Parent/Guardian Consent Slip" signed. At the first interview, the nature of the research was again discussed. All participation was strictly voluntary.

More details on each of the student participants is provided in Chapter 4.

Methodology

The major data gathering approaches were individual interviews and classroom observation. One group interview with three students was held. Teacher resource material was collected, and various artifacts that contained information potentially useful to the study were collected, or noted. A personal journal of the field research was also kept. These processes are described in more detail in the following sections.

The Qualitative Research Interview

The principal method was audiotaped "intensive" (Williamson et al. (1977)) individual interviews with teachers and students. These are interviews in which some common questions are asked of all, but which also go in unique directions based on what is said in the particular discussion. They are based upon a trust that is built up over time. Hull describes this interview as "a conversation, but of a particular kind, where actors talk to a specific and conscious purpose" (1985, p. 30). Kvale (1984) refers to these as "qualitative research interviews," which he distinguishes from "everyday conversation" by noting that the former "is characterized through a methodical consciousness of question forms, a consciousness of the dynamics of interaction between interviewer and interviewee, and a critical consciousness towards that which is said, and interpreted" (p. 179).

Kvale outlines several characteristics of such interviews, many aspects of which are relevant to the present study.

1) The interview is centred on the teacher's or student's life-world and his or her relation to it. The interview is "theme-oriented .... Two people are talking together about a theme, which is interesting to and important to both persons" (p. 174).

2) The main task in qualitative interviewing is to understand the meaning of what is said about the central themes. The researcher must be conscious of directly expressed descriptions and meanings, the "non-verbal" statements, and what is said "between the lines." In the context of conversation, Gadamer (1984) notes that "a person who seeks to understand must question what lies behind what is said" (p. 333).

3) The qualitative research interview focuses less on general opinions than on the description of specific situations of the teacher or student - particular experiences, and reactions to them. However, general opinions are not ignored, and can serve valuable comparison purposes.

4) The researcher avoids bringing "ready-made categories and schemes of interpretation" to the qualitative research interview. This does not imply that the interviewer is devoid of any theoretical/conceptual or life experience preunderstandings (cf. Gadamer, 1984), but rather brings an "openness to new and unexpected phenomena," and a critical self-consciousness (Kvale, 1984, p. 176).

5) The interview is focused. It is neither strictly structured nor entirely "non-directive." "The task of the interviewer is to focus upon, or guide towards ... themes, but not to guide the interviewee towards certain opinions about these themes" (p. 176).

6) In a qualitative research interview the possibility of ambiguity and contradiction exists and must be accepted. The researcher must seek clarification, but the aim is not to arrive at unequivocal and quantifiable meanings.

7) The possibility of change on the part of the teacher or student in their descriptions during the interview exists, and must be accepted.

8) The interview situation is an interpersonal situation, an interaction between researcher and student or researcher and teacher, the two of whom react to and reciprocally influence each other. The interpersonal dynamics must be taken into account by the researcher.

9) The qualitative interview is a "conversation where two people talk about a theme of interest to both parties" (p. 178). As such, it may be a positive experience for the teacher or student, who may seldom have the opportunity to talk for an extended period of time with someone who is interested in their experiences of some subject matter.

Some distinctions should be noted between Kvale's notion of a qualitative research interview and the interviews in the present research. Kvale's focus is phenomenological, as well as hermeneutic, and he therefore wishes as much as possible to obtain "uninterpreted descriptions" of what the interviewee "experiences and feels, and how he [or she] acts" (p. 175). In the present research the interviews are descriptive, but participants are also invited at times to provide interpretations of their experiences, to put their experience in some larger context. Therefore, in addition to being theme-oriented, present research interviews are somewhat person-oriented, at which times participants are asked to step away from their descriptive mode and reflect on some experience or condition in their life-world relevant to their general and mathematics education. These personal interpretations are not invited for any psychological research purposes, thus limiting the person-orientation. Finally, it should be noted that the theme-orientation of the interviews implies that their main focus is not that of addressing the question of "what is going on here?" in the student's or teacher's life-world - an ethnographic question.

Introduction to the Interviews

Five individual interviews were held at the school with each of the participating teachers and students, for a total of forty-five interviews. The interviews varied in length, increasing in time from approximately twenty-five minutes each for the first two, to an average length of nearly fifty minutes for the last interview. The major exceptions to these average times occurred with Interview #2 with each of the teachers, and with many of the interviews with Jan. The second teacher interviews focused on each teacher's reaction to, and interpretation of, mathematics tests written by students in Mr. Coleman's Mathematics 31 class, and Mr. Tilson's Mathematics 30A and 30B classes. The test had been graded but not yet handed back to the students. Both these interviews lasted no longer than fifteen minutes. Many of the interviews with Jan lasted fifteen to twenty minutes longer than those with the other students. Jan typically provided extended responses to questions.

The focus of questioning varied from interview to interview, and from participant to participant. There was, however, a general framework which was shaped by "question-themes." These may be identified as

(i) Describe Fairfield High School - For example: educational orientation, ways of honouring students.

(ii) Describe Self - For example: school-related personal biography

(iii) Describe Sense of Self with Respect to Mathematics - For example: as mathematics student, as mathematics teacher, degree of success with subject.

(iv) Describe Mathematics - For example: mathematics/school mathematics, evaluation, direct description, indirect description through relating to other subjects, purposes and study value.

(v) Describe Teachers as Mathematics Teachers (directed to students and teachers) - For example: nature of mathematics teaching (to teachers), participant teachers as mathematics teachers (to students).

(vi) Describe Students in Mathematics - For example: excellent in mathematics (directed to teachers and to students).

Greater detail of the interviews and questions is provided in the sections that follow.

Focus of Teacher Interviews

The first interview with each teacher dealt with such matters as: background school information, academic and teaching backgrounds of the two men, personal educational teaching philosophy and interpretations of Fairfield High School's educational philosophy (questions influenced by Cusick (1985a)), personal perceptions of themselves as teachers - generally and with respect to mathematics (questions influenced by Blase (1985, 1986)), descriptions of the nature of mathematics and views on the value of school mathematics for students, hopes for their present students twenty years in the future, and descriptions of ways in which Fairfield acknowledges the various achievements of its students.

The second interview was an attempt to get each teacher's description and interpretation of a test they had just administered and marked. Questions focused on the expectations of the teachers regarding achievement levels and the quality of work, the range of types of test questions and any special questions, and the identification of particular students showing mathematics ability and the possible special mathematics qualities these students may have revealed in the test. The desired depth of discussion about the test, testing, and the discrimination of student mathematics qualities which the test revealed was only partly achieved.

Interview #3 was centered on the teachers' interpretations of a student progress report which appears in Appendix F. The initial questions posed to the teachers also are in this appendix. This report card for discussion was an actual report of a grade 12 student's progress in another high school in the same school system. The student, who was not one of the participants, had just received the report a few days prior to the third interview. I happened to see the report with its interesting teacher use of the notion of excellence, and requested and was permitted to use a copy of it, free of identifying features, in my teacher interviews. The report's availability as an important interview prompt was serendipitous. As the questions in the appendix indicate, the general focus was on (a) the particular student's grades and teacher remarks, and the teachers' interpretations of that student's work and attitudes, and (b) the nature of the report form, and the adopted definitions of excellence ("outstanding") displayed on the form.

The focus in the latter part of the interview shifted to other aspects of student excellence, including a discussion of what it would mean to speak of excellent Mathematics 10, 13, and 15 students. Mr. Tilson's interview also included a discussion of the grade twelve Diploma Examinations, while Mr. Coleman's also considered some questions from the Interview #1 which had not been taken up at that time.

The fourth interview with each teacher was quite different from one another. The Coleman interview began with the use of the prompt shown in Appendix G. The intent of this prompt, a short personal statement about my views of an excellent student based on my teaching experiences, was to induce the teachers to speak of the excellent student, or excellent students, based upon their own experiences. I identified specific students, and provided brief descriptions of these people. My background is that of a mathematics teacher in a vocational school, a different environment from that of Mr. Tilson and Mr. Coleman, and I attempted to make this clear. The intent was not to seek necessary agreement or to deliberately promote a different view of student excellence from that of Len and Frank. I anticipated that there may be differences, given the different teaching contexts, and the difficulty I had in identifying a thoroughly excellent student.

The use of this prompt was moderately successful, but not quite in expected ways. Mr. Coleman interpreted my descriptions and questions as seeking one definition of an excellent student, something he was not prepared to provide. This led to a discussion of different types of excellent students, with consideration of his experiences with specific people he had known in his mathematics classes. This in turn led to further explorations of Len's understanding of excellence which had begun in earlier interviews, and his mathematics and achievement expectations of students.

The "excellent student" prompt was not used with Mr. Tilson in the fourth interview. The focus was on continued exploration of Frank's understanding of student excellence which had been initiated in earlier interviews, including his expectations of students in different course levels, and his understanding of the relationships between ability, effort, and excellence.

The fifth interview with Mr. Tilson included the use of the "excellent student" prompt. His initial reaction was to identify students similar in ability and attitude to those of whom I had written, students he did not consider excellent. He went on to identify and discuss specific students who he felt were excellent.

The fifth and final interview with each teacher, held in the second semester after most of the observed courses had concluded, also explored each teacher's feelings about the accomplishments of the students in those classes. A major focus was the validation of my interpretations of excellence. Many questions were based on analysis of earlier interviews, observations, and teacher resource material (for example, tests). I continued to deepen my understanding of each person's beliefs about student excellence in general and in mathematics, its measure, and its significance. I continued to investigate the teachers' beliefs about the nature of school mathematics and what they as mathematics teachers hoped to accomplish with students.

Focus of Student Interviews

The first of the five individual interviews held with each student focused on further elaboration of the research process; a discussion of past school history, especially in mathematics; a request to be kept abreast of grades received in the courses being observed; a personal assessment of mathematics ability and achievement; and a description of particular experiences of mathematics in school - positive or negative - which stood out as highlights for the student.

Students were requested to bring their class mathematics notes and recent tests to the second interview. These were to serve as a basis for a discussion of the nature of their current mathematics courses. The tests in particular provided an opportunity to explore the nature of success in school mathematics.

Differences in questioning and the direction of discussion in the interviews with the seven students appeared right from the start, and this process increased in the remaining three interviews. In the third interview, some discussion was directed to the students' description and interpretation of Fairfield High: for example, its general academic orientation, school atmosphere, and ways in which it was perceived to honour its students. Some discussion of the two teachers, as mathematics teachers, was also taken up with all students. They were also asked to describe, if possible, students they had known who they believed were excellent in mathematics, perhaps even in the current courses. Considerable time was also devoted to pursuing clarification of aspects of student descriptions and interpretations made in earlier interviews.

The fourth and fifth interviews continued to increasingly focus on clarifying student descriptions and interpretations of their mathematics experiences, and of the nature of success and excellence in mathematics. In addition, key questions from the group interview (Appendix H) were taken up with those who did not attend this interview. These interviews were critical to deepening and validating my interpretations.

Group Interviews, Observations, Document Collection and Personal Journal

Group Interview

Group interviews have the potential to produce a wide range of responses to the issues at hand (Watts & Ebbutt, 1987). This richness may in turn be used to enhance individual conversations.

One group interview was held with three students - Marie, Adam, and Yee. Five of the seven students agreed to participate in such an interview. In the first three attempts to hold a lunch hour interview, only two of the students appeared. As research time was becoming short, when three students were present on the fourth try, the interview went ahead, and lasted forty-five minutes. The question sheet given to each interview participant is in Appendix H.

This interview served as a basis for further individual discussions with the three student participants. Some of the questions were also taken up with the students not at the group interview.

Classroom Observations

The four classes were observed on a regular basis during the late September - December, 1988 thirteen week period. A total of eighty-two observation periods were held: forty-three in Mr. Tilson's Mathematics 30A and 30B classes, and thirty-nine in Mr. Coleman's Mathematics 30 and 31 classes. Each period was sixty-four minutes long; the total observation time was approximately eighty-three hours. The one-semester Mathematics 30A, 30B and 31 classes met six periods per week; the full year Mathematics 30 class met three times a week. As the Mathematics 30 classtimes coincided with three of the Mathematics 30B classes, a limited number of observation periods were split between the two adjacent classrooms.

Document Collection

A review of teacher tests, teacher resource material, texts, school and school district documents that relate to student achievement and recognition, school artifacts signifying student recognition, student records, and student work and grades on current tests, formed part of the research. Analyses of the observations and the documents served as a partial basis for the interviews. Relevant local newspaper clippings appearing after the field study were also collected and used.

Personal Journal

A personal journal of the research was kept in which events were chronicled and personal responses to the array of research experiences were noted. After observation periods and interviews the journal served as a source for a brief description of the experience, and more extensive reflections on that experience. A sense of the "status" of the research project was sometimes "fleshed out," and ideas for research directions would occasionally emerge. One hundred twenty journal pages were recorded.

General Remarks

The research did not involve any type of mathematics teaching or testing by the researcher. The classes were not audiotaped or videotaped. However, one attempt was made to audiotape some of the classroom discussion of the participants Yee and Adam in Mathematics 31.

This type of activity was discontinued because of poor audio quality and the restricted level of mathematics-related conversation.

The Hermeneutic Character of the Study

The hermeneutical nature of this study is worked out in the context of Kvale's (1984) discussion, "The Qualitative Research Interview: A Phenomenological and a Hermeneutical Mode of Understanding," because the present research centered on interview. Kvale draws upon the contemporary philosophical literature of hermeneutics (e.g. Gadamer, 1984; Radnitzky, 1970; Ricoeur, 1981). Though somewhat structured, Kvale presents a useful discussion of the place of qualitative interviews in a hermeneutical study.

Kvale notes that the fundamental task of hermeneutics is the interpretation of written texts (cf. Gadamer, 1984, p. 352; Ricoeur, 1978, p. 134). Of course, Gadamer and Ricoeur also see hermeneutics as extending well beyond the realm of texts (e.g. action, works of art) and indeed, philosophically, as revealing the ontological character of all understanding.

The hermeneutic circle is central to the interpretation of meaning. It is a process of understanding a "text" through which

> the meaning of the separate parts is determined by the global meaning of the text, as it is anticipated. The closer determination of the meaning of the separate parts may come to change the originally anticipated meaning of the totality, and this again influences the meaning of the separate parts. (Kvale, 1984, p. 185)

In principle, the task of "throwing light" on the "hermeneutic situation" is never complete (Gadamer, 1984, p. 269). In practice, it ends "when one has reached a sensible meaning, a valid unitary meaning, free of inner contradictions" (Kvale, 1984, p. 185). "To understand and to interpret means to discover and recognize a valid meaning" (Gadamer, 1984, pp. 292-293). This does not imply that one has established the correct meaning (nor that one exists).

Kvale describes seven "canons" for the hermeneutic interpretation of meaning, and their significance for interpreting "interview-as-text." These canons are not methodical steps, but they are principles which provide a methodological orientation to interpretation.

First, following from the hermeneutical circle, interpretation involves a "continuous back- and forth process between parts and the whole [emphasis in original]" (p. 186). One often has only a somewhat vague and intuitive understanding of the whole text at first. To get into the interpretive process, Kvale suggests that one might first read the whole interview text to get a sense of the interview's global meaning. Closer attention is then paid to particular themes and expressions, then back to consider them in terms of the text's global meaning, and so on. Kvale prefers the notion of a hermeneutic "spiral" to "circle" to better express the idea of a "continuously deepened understanding of meaning" (p. 186).

Second, the interpretation of meanings in the interview stops when the "different themes ... make sensible patterns, and go into consistent unity" (p. 186). Within the limits of a single interview a consistent unity may not be possible, or at least, may not occur, for perfectly good reasons. Thus each interview must be interpreted in the context of a larger "body" of interviews. This is in essence Kvale's third canon of meaning-interpretation, which suggests that other interviews and information about the person may not only eliminate or reduce inconsistencies, but change the fundamental character of the "consistent unity" itself.

The autonomy of the text is Kvale's fourth canon. "The text should be understood on the basis of itself, by explicating what the text itself states about a theme" (p. 186). The implication for interview interpretation is that the researcher should stick to the content of the statements in an effort to "deepen and extend the autonomous meaning of the statements ... about a theme" (p. 186). Psychological theories about the themes and biographical information become of less importance. It is useful to recall here that one must also "question what lies behind what is said" (Gadamer, 1984, p. 333).

Fifth, the interpreter requires an "extensive knowledge of the themes" of the qualitative research interview. The researcher must be sensitive to meaningful nuances and possible connections to other themes.

A sixth, very fundamental canon of hermeneutics is that interpretation is not presuppositionless. One always stands in a tradition of understanding and brings preunderstanding - "prejudices" (Gadamer, 1984) - to the interpretation act. The researcher cannot "jump outside" this tradition, but must attempt to become aware of his or her presuppositions, and take them into account in the interpretation. The text/interview also has an horizon, that revealed in the themes. In Gadamer's terms, understanding (as all interpretation is) represents a "fusion of horizons."

A seventh principle states that

> every interpretation involves innovation and <u>creativity</u> ....The interpretation here transcends the immediately given and enriches the understanding by bringing forth new nuances and relations in the text, whereby its meaning is extended. Correspondingly the interpretation of an interview may imply an enrichment, an extension, of the meaning of the themes which are focused upon. (Kvale, 1984, p. 187)

Based upon his identification of the (literary) text as the principal object of hermeneutic activity, Kvale names three reservations he has about the interview-as-text. First, he notes that a text normally is (i) "pregiven" or finished (p. 187), (ii) "intended as communication outside the situation where it originated," (p. 188) and (iii) "a well articulated and highly condensed [expression] of meanings" (p. 188).

Interviews, on the other hand, are generated as well as interpreted in the research situation. Indeed, the researcher is co-creator of the text. The interview is not presented to the interpreter as finished text, "but may emerge in the same process as its interpretation, the interview text involving both the generation and negotiated interpretation of the text" (pp. 187-188). The interview text is also context-bound, and is created as a spontaneous process. Finally, the interview text may contain repetition, vague statements, digressions, and in general, considerable "noise," requiring "an extended process of condensation" to get at the essential meanings (p. 188). Kvale does not see these reservations as negating the hermeneutic possibilities.

Kvale's interpretation of the research interview situation is narrow. The process of interpretation that may take place during the conversation itself is hermeneutic, and thus nothing negative to the process. A second limitation in Kvale's work is the sense one gets that he interprets each interview as largely standing alone. In this study, each interview must be interpreted in terms all other conversations with the person. This provides an understanding of the meaning of excellence for that individual, and begins to provide deeper, more general insights into the notion. Further, common themes across the interpretations associated with individuals need to be explored, so that at the most general level all of the "texts" of the research are considered as constituting the whole.

<u>The Process of Analysis and Interpretation</u>

Each interview was first transcribed in full, and followed by a preliminary analysis in which portions of the text were categorized and entered into a notebook under headings. Analyses for each participant were developed individually. Categories such as "background," "Fairfield High," "teachers," "the math class - doing mathematics," "view of mathematics," "sense of self and mathematics," "math tests," "pressure/competition," "significance of marks," and "excellence in mathematics" were typical headings for the student analyses. Categories such as "background," "view of mathematics," "teaching/teaching mathematics," "self as teacher," "students," "view of education," "significance of marks," "examinations," and "excellence in students" were typical teacher headings.

Based upon (a) these analyses, (b) general attention to the "question-themes" described previously, (c) constant specific attention to the need to clarify, extend and verify participants' descriptions and interpretations, and (d) the need to integrate knowledge and insights gained from observations and other sources such as tests, questions were formulated to be taken up in the subsequent interview. New questions were also formulated, of course, during the interview in response to relevant, new directions opening up.

Following the field research, a follow-up analysis of certain themes derived from the notebook work was undertaken to facilitate cross-participant interpretations of these themes. All interviews were closely examined once again, and together with descriptions and interpretations made from work during the field research, extensive data from each of the participants was recorded on large sheets. This better enabled comparison and integration. The four student themes analyzed in this way were "the nature of mathematics," "mathematics tests," "marks," and "excellence." The two major teacher themes were three categories of "students excellent-as," and "other elaborations on excellence." The latter category included the subcategories schooling, testing, and report cards.

The notebook and subsequent analyses provided a basis for writing Chapters 4 and 5, which focus on descriptions of the school and participants, their beliefs about the nature of mathematics, their beliefs about the nature of success and succeeding in school mathematics, and interpretations of excellence in students. These analyses also provided a basis for interpreting the educational orientations of the Fairfield participants and, to a certain extent, of the school and school system, in terms of the Prakash and Waks (1985) model of education and excellence. This is presented in Chapter 6.

Finally, the questions of educational excellence and excellence in mathematics which have been described and interpreted in earlier chapters are considered in Chapter 7 in terms of some fundamental qualities of being human that were first taken up in Chapter 2: "values," "community," "becoming," "loved work," "competition and cooperation," and an "active moral dimension."

Levels of Interpretation

Three levels of interpretation are developed. The first, and most superficial, focuses on the conception of excellence as related to mathematics achievement: What constitutes performance excellence in school mathematics? The second level considers excellence at the level of personal paradigm. The shift is made to this level by considering issues such as the following: What meanings are attached to excellence in the mathematics class for the participants? What scope, and limits, does each individual apply to excellence? Are general beliefs about excellence in the mathematics class consistent with self-perceptions of ability and achievement? Epistemologically, what characterizes the nature of mathematical knowledge, and what is its place? To refer to the discussion of Chapter 2, is mathematics knowledge dead or life-affirming? Is it a tool for success, or is it liberating? Does it inform, and is it informed by, knowledge and understanding gained in other subjects of study, or is mathematics knowledge perceived as isolated? How do such views shape the understanding persons have of excellence in the mathematics class?

The third level points to the ontological meaning of excellence, but essentially remains within an educational context. The shift toward the ontological is made by considering such matters as the place and nature of values and standards, becoming, individuality and community, and the active moral dimension of excellence - that is, basic issues of what it is to be human. Interpretations of educational orientation at Fairfield through the introduction of the Prakash and Waks (1985) model in Chapter 6 help in giving direction to this interpretive shift, which occurs principally in Chapter 7.

Interpretation Quality

(1) A concern related to interviews was raised by Kvale (1984) in his discussion of the qualitative research interview and again in his citation of "reservations." It is restated here more explicitly. The hermeneutic research experience depends very much on the conversational or dialogical quality of the interview. As Yorke (1987) notes, there is a perceived power differential between researcher and participant. The participants' suppositions of what the research might really be about are important. Much depends upon the degree of rapport between researcher and participant. To reach a point of quality which permits the meaning-interpretation of the notion of excellence requires rapport and trust, and making the teacher and student participants partners in the research to the fullest extent possible. Such rapport was a continual focus of the research process. The personal journal in particular served as a "platform" on which to reflect on the process, consider reseacher-participant relationships, and note modifications or new directions procedures which might prove fruitful.

These efforts to establish a stable relationship with each of the participants are part of the process of establishing reliability in qualitative research with human beings. Guba and Lincoln (1982) also see stability in the methods and processes used to gain access to each participant's understanding, in the interpretive process, and in the presentation of those interpretations as critical to reliable interpretive research. Stability, not replicability, is the hallmark of reliability in such work.

(2) On an ongoing basis, all participants were given a copy of each of their interview texts and asked to read them on their own time as a first level form of validation. The texts were lengthy - often twenty to thirty pages, or more in some cases - and participant review of their interviews was sometimes limited. This added to the imperative for careful follow up of key themes in subsequent interviews.

(3) An audiotaped interview with a second reader was held at a mid-point stage in the field research to read and comment on my personal journal reflections and the field observation notes. The intent was to provide a questioning of my preunderstandings, that is, the prejudices as they appeared in these documents. The transcriptions were not provided to the second reader.

(4) In addition to an ongoing process of interpretation development, clarification, and validation, in interviews 2, 3, and 4, significant portions of the final interview with each person were devoted to validating - and clarifying where necessary - interpretations of school mathematics and its significance, and excellence in the mathematics class. The place and meaning of marks, and the types of students who may be considered to be excellent for various reasons, were two critical examples which received particular attention. This approach is in general accord with Guba and Lincoln's (1982) vision of validity in a qualitative study as being based on shared understandings.

(5) My interpretations of the teachers' and students' visions of education and educational excellence in terms of the Prakash and Waks (1985) model was not explicitly taken up with the participants. To do so was viewed as requesting them to speculate and theorize about their beliefs. Not returning to the participants with this interpretation (which was completed some time after the field research) may be considered to be a limiting aspect of the study.

Summary

Two interpretive studies, a pilot and the major research, were undertaken. The pilot is described in detail in Appendix J. A suburban, academically oriented high school, Fairfield High, was chosen as the site for the major field study, which began in the Fall of 1988 and was completed in the early Spring of 1989. Two experienced male mathematics teachers, and seven senior level mathematics students participated. Classroom observation and personal interviews were the principal sources of data, although a group interview, document collection, and personal journal writing were also sources of information and insight into the research. Analysis and interpretation were ongoing during the field work, and continued after completion of that portion of the study. This interpretation focused on the question of excellence as performance in mathematics, the question of the personal meaning of excellence in the mathematics class, and the question of the character qualities of excellence in the mathematics classroom, and in education - what is, and what might be.

CHAPTER 4
DESCRIPTIONS OF THE SCHOOL, THE PARTICIPANTS, AND MATHEMATICS

Introduction

This chapter elaborates on the description begun in Chapter 3 of the high school, Fairfield, and the teacher and student participants. Its purpose is to provide a context for understanding the meanings that excellence in an educational sense had for the people who participated in the study. Such a contextual description implicitly enables one to generalize, and to establish limits to generalization.

The description of the school includes information such as the size of the student body, the programs it offers, and student demographics. It includes teacher interpretations of its programmatic orientation and its philosophy, and student descriptions of its orientation and its "quality" as an educational institution.

The mathematics programs offered by Fairfield are described in a two-part format. A brief, general description of provincially administered high school mathematics courses is provided in Appendix D. In this present chapter, teacher views, and to a limited extent, student views of the grade twelve mathematics courses are discussed, to provide further context for subsequent interpretations.

The description of the two teachers, Frank Tilson and Len Coleman, focuses on their academic and teaching backgrounds, their interests in mathematics and their views on teaching mathematics. Insights gained from classroom observations and from the students are also included in the discussion of the teachers.

The descriptions of the students - Jan, Darren, Sarita, Gordon, Marie, Adam, and Yee - include (a) the mathematics course(s) they were in at the time of the research, and their grade levels, (b) a brief discussion of each student's high school history, particularly in mathematics, (c) their beliefs about their own mathematics abilities, and (d) other, more personal statements which help to develop the understanding of who the participants were.

This chapter also includes a description of teachers' and students' beliefs about the basic nature of school mathematics, and the purposes and value of studying mathematics. This "sets the stage" for Chapter 5 where the participants' interpretations of the evaluation of student success in school mathematics, and the meanings of student excellence, is described.

High School

Program Orientation

Fairfield Composite High School was one of thirteen high schools in the City Public School System. In this system students were permitted to apply to any of the high schools, and many of these schools engaged in active recruitment in junior high schools.

Fairfield offered programs in Home Economics, Business Education, Industrial Arts, Community Living Skills, and Work Experience. It also offered programs in Art, Drama, Music, and Computer Science (Source: 1989-90 Fairfield Orientation Night Brochure). Both Mr. Frank Tilson and Mr. Len Coleman stated, however, that the school had an academic orientation. Indeed, Len suggested that the "composite" denotation, implying that the "high school would do everything for everyone," should be dropped (1). [The number in the bracket indicates the interview from which the quote was taken.] The International Baccalaureate (IB) program, one of only four such programs offered by district high schools, was one reflection of this academic orientation. Another was the approximately two to one ratio of enrolment in the academic Mathematics 10-20-30 stream to enrolment in the Mathematics 13-23-33 stream (Tilson 5). (See Apppendix D for a description of these courses.) A third reflection of its academic orientation was its "rank" of third in the district (out of thirteen public system high schools, behind the officially designated "academic" high school and one other school) in the Mathematics 30 "blended" Diploma examination and class results for the year in which the research took place, as officially reported in a local newspaper in April, 1990.

Student enrolment at Fairfield had been gradually increasing for some time. Currently it was approximately 1200, a number larger than that for which it was originally designed. Students came from all parts of the city; "less than half of [the] students are from the surrounding area" (Coleman 1). These were interpreted as signs that the school was perceived by parents and students as a good school to attend. Many of the students came because of the school's academic reputation; the IB program was particularly significant (Tilson 1). Coleman suggested that even though other high schools in the district may have offered equally good academic programs, the perception of Fairfield as better academically than most was strong in the community. Parents had "the impression that we offer a good, sound academic program here, and as a result, that's what most people are looking for" (Coleman 1).

The success of its art and music programs, and its high profile sports teams were also factors in the perception of Fairfield as a good school to attend. Other factors included its limited Industrial Arts facilities (Coleman) (implying that students most interested in this area would tend to go to other schools), its medium size and its status as one of the very few city high schools located some distance from a major shopping centre or "mall" (a factor Coleman and Tilson independently identified as significant for parents).

Most students also believed that Fairfield was among the more academically oriented high schools in the district, and had a positive reputation. For example, Gordon, in response to the question of where the school appeared to place its emphasis, replied, "the school really stresses - high marks" as evidenced, for example, by the presence of the IB program, and "they [also] seem to like good, good phys. ed stuff." Even though Gordon (3) said he was not one of those achieving the high marks, the school's positive academic (and sports) reputation among the city's students meant one could be proud of it (also Darren 3).

A second student, Darren, described some of the other characteristics in interview #3 that marked Fairfield as an academic school from his perspective:

> "...you're not afraid to do homework during lunch..."
>
> "Here you're never ashamed to get a high mark."
>
> "...here, ah - I don't know, it's like -- higher marks - people don't look down on them. Not saying that they <u>reward</u> you at all, like - Well, if they're your friends I suppose they would, but, you're never looked down on for trying to do better on your academic sort of studies, you know."
>
> "People here <u>want</u> to succeed, it seems.... Like, they're thinking ahead, whereas at other schools, they're there for that day, and, they're not thinking too far beyond that."

All of the student participants generally spoke positively of Fairfield. Jan, perhaps the school's biggest supporter, described it as "a fantastic high school," having a "history of nothing but the best," in keeping with the school motto (3). Marie, who was active in the school's sports program, believed that the members of Fairfield's teams were more dedicated than those on the teams of many other high schools: "this is a school that has quite a bit of ... athletic --- self-confidence, self-esteem - does well" (Marie 2). [In interview quotes, "..." indicates some speech text has been removed, "-," "--," "---," etc. indicate pauses in speech (and their relative duration), and "/" indicates an abrupt change in speech, or a cut off by another speaker.]

School Vision

There was no explicit statement in the 1988-89 Students' Handbook describing the school's vision of itself as an educational institution. Certainly, however, the academic "thrust" (Tilson) was a major aspect of any such vision.

Mr. Tilson provided another component of the school's (and his) perspective toward education:

> We are trying to produce the best students we can to function in whatever aspect of society they function in when they leave here. We try to foster an attitude - not only in high academics, but in attitude. Work, and responsibility; they're given a lot of freedom, all we ask of them is a little bit of responsibility. (Tilson 1)

Len Coleman remarked: "One of the great emphases we have here is that we try to present a good academic program with courses which will fit almost all the students we have" (1). He elaborated in Interview #4:

> In order to get the best out of a student, you have to set up the proper environment. And, ah, I think the emphasis in this place is on trying to get the kid to do as well as he can.... You know, math, we've got the four different streams, and, ah, our objective is to get the student in the right program, and then, to succeed in the program that he's in. And if we do that, then we've succeeded. (Coleman 4)

There were things that Len would liked to have changed at Fairfield, but he was generally "quite happy" with the school's academic orientation and philosophy towards young people.

> I don't like schools where there's a great individual freedom to do whatever you like. I think these students are not adults yet, they need a fair amount of direction, and they need a fair amount of control. If the school ever went away from that philosophy, I think I'd leave. But it hasn't, and so I'm quite happy here. (Coleman 1)

One does not see in the school perspective of these two teachers the kind of devalued view of the educational process described by Sedlak et al. (1985) and others in their discussions of the teacher-student negotiation process.

Teachers

Backgrounds

The two teachers in the study, Frank Tilson and Len Coleman, had similar backgrounds in many respects. They both obtained B.Sc. degrees in mathematics in the 1960s and then entered After Degree education programs. They both had university advanced (graduate) Diplomas in Education. Early in their careers Frank and Len took positions at Fairfield, and had been teaching at the school for more than twenty years. During that time, each had taught mathematics almost exclusively. Len had been Mathematics Department Head for a number of years; Frank was Department Head at the time of the research.

Both teachers were academically active at Fairfield: Coleman had for some years been responsible for administering various mathematics contests held at the school, while Tilson assumed the position of school International Baccalaureate (IB) Coordinator in 1988-89. Frank (4) and Len (4) stated that at the time of the development and introduction of the IB program in the school district, they played a major role in defining the district-wide structure and content of the mathematics program to meet both IB and provincial requirements.

Teaching Assignments

At the time of the field research in the first semester of the school year, Frank Tilson's teaching assignments were one Mathematics 20 IB and two Mathematics 30 classes (see Appendix D). These were all one semester courses. Classes were held six times per week; each period was sixty-four minutes long. Tilson's teaching amounted to approximately 75% of the scheduled weekly periods. His six weekly "spare" periods were for preparation and administration responsibilities.

Len Coleman's teaching assignment during the research semester consisted of one semester Mathematics 20 and 31 classes and full year Mathematics 10 IB, 31 IB, and 30 classes (see Appendix D). In the full year courses, three sixty-four minute classes were held each week. Len had three "spare" periods per week.

Perspectives on Mathematics

With their university backgrounds in mathematics, both teachers expressed confidence in their mathematics abilities. Both had always enjoyed mathematics; there was no recollection of any "turning point." Frank, for example, described it as a "born ability" (1). From an early school age he had been able to grasp the subject quickly, and had had considerable success in school and university, often helping other students in the process.

Asked what particularly appealed to them about mathematics, the two teachers spoke of its logical, non-subjective character. The following passages reveal the personal appeal:

(i) Tilson:

I: What was rewarding about [math]?

Tilson: Just a feeling. I don't know. A feeling of accomplishment, when you/ Maybe this is it: When you logically go from point A to point B, and you find a solution, or you find that there is no solution, it's the inner feeling that you get. "Aha." (1)

(ii) Coleman:

I: ...What is it about math that catches you, or/

Coleman: Oh, well, there'a nothing very subjective about it. It's orderly, and probably that's a reflection of myself as well. An orderly, methodical sort of person - and it all ties together nicely, there are no loose ends. There's very little in the subject matter that requires debate, and tossing a coin to decide on a right answer. (laugh). So that's probably the same sort of person that I am.

I: Right. Do you ever see it as sort of a challenge, you like to do problems, --?

Coleman: Oh, yes, I always like a good problem. There's a certain amount of satisfaction when it's solved. You know, a certain problem, when it's different, challenging in nature. (1)

In addition to its ordered, objective nature, Len saw mathematics as

> in a way ... almost like a, ah/ like a second language.... can think of it as existing, you know, on its own. It's got it's own rules, and laws, and relationships, and whatever else. - Sort of a second language which is almost universal. (Coleman 5)

School mathematics consisted primarily of developing the concepts, laws, and patterns - the "basic skills" or "building blocks" of mathematics - with "the actual application in a wide variety of situations ... very limited" (Coleman 5). Some areas, such as algebra basics, did not lend themselves to concrete application. Unlike the "very abstract mathematics" which one might find in advanced studies of the subject, school mathematics was marked by a finality to its "situations" or problems - a "fixed" or single answer - although there may be a number of means to arrive at this end result (Coleman 5).

Frank Tilson (5) interpreted school mathematics as a "language" for present and potential future use by students as a "tool." For example, mathematics was a language for science, and students who ventured on in a scientific field would make extensive use of mathematics. This was, however, in some sense a "prostitution" of the subject, for at its higher levels, mathematics was "an art in itself."

Teacher Perspectives on Grade Twelve Mathematics Courses

Mathematics 30

Tilson and Coleman both taught Mathematics 30. Its requirement for an Advanced Diploma had led, said the teachers, to students with a wide range of mathematical abilities and interests enrolling in the class.

The importance of the Diploma examination mark (i) in determining the final Mathematics 30 grade, and (ii) in student, teacher, and school/school district comparisons (Coleman 5; Tilson 3) had led to a focus on "covering the objectives" and "teaching to the examination" (e.g., Tilson 5; Coleman 5). Other objectives for students, such as those outlined by the school board regarding personal and social development, and those in the curriculum guide which promoted problem solving and an appreciation of mathematics, were also part of what the teacher of mathematics was charged with (Tilson 5). These aims were secondary, however, to the principal aim of examination success; development in these areas hopefully would occur while students learned the basic course content.

Both teachers were in favour of the Diploma examination, but they claimed that Department requirements and the examination meant that there was no time to do anything beyond the required course curriculum (Tilson 5; Coleman 1). The content-oriented Diploma examination, which included little in the way of non-routine problem solving (Tilson 5), reinforced this view of the nature of Mathematics 30. The two teachers generally accepted the situation, but were not entirely satisfied.

Mathematics 31

Len Coleman taught this course during the research period. His expectation of students was that they would generally have more mathematics ability than many of those in Mathematics 30 - at least, there would be fewer poor students. Many of the students would likely have some interest in mathematics itself. The pace of instruction was faster than that in Mathematics 30, and "If you have a good class, you can do some interesting things with them" (Coleman 1).

Still, more students with lower qualifications were registering for the course because of its value or requirement in post-secondary study (Coleman 5). This was leading (as it did with the research Mathematics 31 class) to an increased number of drop-outs in the course. Coleman's view of this trend was "Let them try it, and if they can't hack it, fine, they can quit. At least they've had their opportunity to try" (5).

International Baccalaureate Mathematics (IB)

IB classes were not observed in the research, and there were no active mathematics IB students in the study. However, because it was an important program for the teachers and the participating students who had been in mathematics IB previously, I have discussed it here.

Both Tilson and Coleman taught IB mathematics courses; Frank was the school IB coordinator. They had been significantly involved in the development of the mathematics IB school district program.

Frank believed the IB program was a good one, and stated he was "strongly committed to it."

> We're finally giving the student of high ability a challenge. We're not boring them, we're making them work, we're showing - well, some of them do it in spite of our efforts - but some of them need the right atmosphere, the right environment, push, to challenge their abilities, and we're doing that. (Tilson 1)

The mathematics IB program covered more material and the pace was faster than the regular Mathematics 10-20-30-31 sequence. Students were expected to do more independent study. In Mathematics 30 IB, Frank said, the students studied some of the course units on their own (4).

Of course, they could discuss in class any questions they had regarding these topics. Tilson claimed that his Mathematics 30 IB classes had always had an average mark of at least 80% on the Diploma examination, compared with the typical 65-70% class average for regular Mathematics 30 classes (4,3).

Given Tilson's background and interest in mathematics, the lack of time to do much else besides prepare academic stream students for the final examination seemed to represent a strong limitation on his opportunities for doing more than the minimum in mathematics. The IB program provided that opportunity, and to attempt more would be largely futile, he claimed (5).

Students who did well in the mathematics IB program could receive advance standing in first year post-secondary mathematics, but for Coleman, the program's real strength lay in the mathematics background it provided students as they prepared to enter university. In this regard, he considered this international program to be better than many high school honours mathematics programs. Not only did it go into depth in some topics, but it also included topics not often discussed, even in some of these other enrichment courses (1).

Perspectives on Mathematics Teaching

General Views

It was earlier stated that both teachers felt confident in their mathematics skills. This was an essential characteristic of all secondary mathematics teachers for Len Coleman (1) and Frank Tilson: "Isn't that why you want math teachers teaching math? So that they will then have their students excel in math?" (5).

In addition to the necessary competence in mathematics, one needed to be able to "impart" this knowledge to the students, and to establish "an environment which [was] conducive to learning" (Coleman 1). The degree of freedom the teacher granted to the class was very much a contextual decision. The teaching approach to mathematics needed to recognize the essential logical, "continuity-related" nature of school mathematics (Tilson 1; Coleman 5,4):

> ...mathematics is a cumulative subject, um, its very structured, and, you're always building on something which you already had in the past. Everything that we do is based on something that, they

should know. And it's just a matter of, ah, pointing them in the right direction and directing them in a certain way, and, away you go.

But, yes, ... they're expected to be able to follow along and understand what it is that we're doing at any particular time. And what we're doing/ All we're doing really is integrating new things in with the old. So, it's a building process, and they've got to have the foundation, and, you assume they have it once they're in the class. (Coleman 4)

Both teachers involved the students in the lesson through a developmental question and answer instructional approach; "mathematics can't be a passive sort of thing," said Len Coleman (4). But there were clearly limits to the amount of independent learning they expected of the students in Mathematics 30. A considerable degree of direction or "spoonfeeding" was necessary, according to Frank Tilson, compared to Mathematics 30 IB, for example.

Tilson: ...These people are so used to being spoonfed that you'd have a ... revolution on your hands.

I: [Overlap with last of previous] But do you consider that what you're doing in Math 30 is spoonfeeding them?

Tilson: A lot of it, sure. You go away from spoonfeeding them a bit, and you'll see right away, "Oh, I don't understand this," "I don't understand that."

I: Yes.

Tilson: But yet, if you outline everything - you say "These steps - there's one, two, three, four, five - remember this" - no problem at all. You know, they'll sit down and memorize the steps - they may not necessarily know what the heck they're doing, but they can give you an answer, given certain conditions in the problem.

I: Yes.

Tilson: And so, what are you doing? Are you teaching them math, or are you teaching them how to pass the course? Or a little bit of both? (4)

In the IB program students were required to do a substantial amount of study on their own, according to the participants who had been involved in the program. Most high school students, however, had experienced a history of having been "spoonfed" in mathematics, and, as some students in the study stated, they had come to expect this instructional approach from teachers. Given this, coupled with the diverse range of students in Mathematics 30 and the importance of the Diploma exam, Frank believed that it would be inappropriate to change. One had to be "realistic," Coleman and Tilson said, in terms of what one could do and still provide the students with a successful experience in the time available. (e.g., Tilson 4,5; Coleman 4,5).

Teacher Frank Tilson

Frank preferred to see himself as a teacher with a good mathematics background, and a strong interest in the subject, who taught people, not mathematics (1). He claimed no preference in teaching Mathematics 30 students or Mathematics 30 IB students, for example. There were, of course, differences in the courses. The pace of instruction was faster in the IB class. The content also differed between these two programs (and the others), but it was always somewhere within the spectrum of mathematics. One adjusted to the content and the perceived ability levels of the students.

Tilson was clear about his principal Mathematics 30 objective: "getting them all eventually to a point where they're able to write a decent [Diploma] exam" (1). During the semester he made frequent reference to the importance of the exam, and what was likely to be on it. He encouraged students to buy the Edge booklet, a commercially available booklet of past Mathematics 30 Diploma examinations. He structured his lessons so that he finished covering the course material early to allow considerable class time for final exam review. Still, in "going to the ... slow to middle ability student" (4), Tilson did not consider his pace in Mathematics 30 to be particularly fast (although it was faster than that in Mathematics 33, for example). (Adam complained in the group interview that this focus on the lower student impeded the progress in the course of those who were more capable. The best educational arrangement "should be that each could learn at their own ability level.")

Pedagogically, interacting with the students and acting decisively to ensure they continually paid attention to him and the current discussion were features of Frank Tilson's general teaching style, and critical aspects of his aim of preparing them for examinations. The interactions with students in the classroom made teaching interesting for him (1). Frank enjoyed probing a student's understanding of a concept or technique, or problem, to determine where the individual was having difficulties. Observations in the class supported his claim. His homework reviews were sometimes extensive, for as long as students had questions, he appeared prepared to deal with them. Questioning, some of which drew upon past years' studies, was also an integral part of his development of a new topic. "Well, of course. That's all I do. That's why we're here" (5), he said of his eagerness to question, and to solicit student questions.

While Frank liked to quip with the students occasionally during class instruction time, one of the few things he strongly and explicitly demanded of the students in the large Mathematics 30 classes (more than thirty students in each) was that they paid attention to him, or to any other speaker, during an instructional presentation or discussion. He was quick to chastise a student who talked, even briefly, to another student, or who appeared not to be paying attention. The call to pay attention was a frequent admonishment (e.g., when reviewing test results and identifying student errors) as a general preparation for the final examination. Student reaction to Frank Tilson's disciplinary approach was mixed. Some felt he sometimes overreacted (e.g., Adam, Yee), while others felt his response was appropriate (e.g., Gordon).

There was usually ample time during the period for students to work at their desks on their assignments. Tilson relaxed his demand for silence at this time, and often several small groups of students collaborated more or less on the problems.

The student participants in Frank's mathematics classes - Marie, Adam, and Yee in Mathematics 30A, and Sarita and Gordon in Mathematics 30B - all identified Frank as a good mathematics teacher. Gordon said he was "the best [mathematics teacher] I've had" (3). They found him approachable, and they liked his willingness to answer their questions. They appreciated the amount of time they had for Diploma preparation at the end of the course. Marie (5) and Gordon (3) said they liked his instructional pace: not so fast that they were lost but fast enough that the course was challenging, and left ample time for review. Two repeating students who had completed Tilson's Mathematics 30 IB the previous year, Sarita and Yee, found the pace much slower and his expectations lower in this regular course, but even though Yee said the course was boring, this was not made as a personal negative reflection on Frank Tilson.

Students such as Marie (5) also appreciated those moments when Tilson went beyond what she called mathematics teachers' "Here's the formulas that you use" type of instruction, when he connected the mathematics to the world around her (e.g., series and sequences), or developed a more extensive approach to a formula or procedure (e.g., in conics). While other students would question why she would make notes on something she would not need for the test, she found it interesting or intriguing, and helpful in answering the question "Why?"

Teacher Len Coleman

Len's Mathematics 30 and 31 classes both had approximately twenty students in them. In the first months of the field research, the students in these classes seemed particularly quiet. Usually a substantial portion of the period was devoted to individual work on textbook and assignment sheet exercises, and students tended to work very much on their own, even though this was not a requirement set by Len. While students did engage in greater conversation in small groups in later months, particularly in Mathematics 31, for whatever reasons, these were students who generally appeared to prefer to work alone.

Coleman's teaching style was direct but low key. The analogy he drew between the nature of mathematics - orderly, methodical, and having few loose ends - and his own personality seemed appropriate in describing his approach to mathematics teaching. His statement in a later interview that "my job is to give them the best possible math course I can teach" (3) also is instructive. The school mathematics at hand was almost always the focus of class talk. With little extra conversation, he began the period by a review of the previous period's assignment. During the lesson and examples following the review, Len frequently involved students through questioning. There was a definite tone of expectation in his question to a student, as Coleman acknowledged in the following passage:

> I: I have a real sense that comes through of, ah - There's a strong expectation - almost a taken-for-granted expectation - you know, [that] student X, Y, whatever, should be able to tell me.... Do you agree with that?

> Coleman: Oh yes. Definitely. Mathematics can't be a passive sort of thing. You can't just sit up there and talk without having them involved. And the more you get them involved in either setting up a

problem, or looking through a solution, or whatever else, um, the better it is for them.

I: Right.

Coleman: And, I don't know if you've noticed, but, there are certain students which I do not ask certain questions of. And other students where, you know, I could ask them anything.

I: Yes.

Coleman: Because, you want them to, to be able to answer. So, if I ask anybody a particular question ... then I do it with the assumption that they should know the answer. If they don't, then, there's something wrong, somewhere.

And --- some students -- aren't used to that sort of thing at the beginning of the year. But everybody gets asked questions on a fairly regular basis over the year, and it involves them in what's going on. (4).

Students tended to describe Len Coleman's teaching style as impersonal (e.g., Darren 3; Jan 3,5; or "assertive" (Jan 4), and some expressed a reluctance to ask him questions in class (e.g., Gordon 5; Yee 3). They found his response somewhat intimidating. One student in Mathematics 31, Yee, said she did not like his approach to mathematics teaching. However, Mr. Coleman was considered by most of the participating students in his classes (e.g., Darren, Jan, and Adam) to be a very competent mathematics teacher.

The two Mathematics 30 students participating in the study, Darren and Jan, in particular spoke highly of Mr. Coleman. Darren liked his teaching style which focused very much on the mathematics at hand, and "nothing else that's useless." He said he had no problems asking Mr. Coleman a question, because he gave a "direct answer" (1), and furthermore, "he answers it, and sort of looks to see if you understand how he arrived at that answer.... he cares enough to make sure that if you have a problem, you understand it when you're finished talking with him" (3). [It should be noted that Darren was not observed to ask Mr. Coleman many questions in the full class setting.] If Darren was to repeat Mathematics 30, he would be quite willing to have Mr. Coleman again as his teacher (5).

Jan did express reservations about Len Coleman's teaching style at times, and the way he sometimes responded to student questions (3). Nevertheless, she also said she was very grateful to have had him as a teacher, and "wouldn't trade him" (5). Mr. Coleman was "really good the way he teaches because he only gives about one concept a day, and, if you've been paying attention, you shouldn't have any problem with what you're doing" (4). "When he comes in, he knows what he wants to teach, and he knows what he needs to get across, and he just does it. And that's fine." Jan was also confident that Mr. Coleman would finish the course well before the Diploma examination was scheduled in June, and she was pleased with the opportunities for review that situation presented.

Adam (4) believed that Mr. Coleman had mathematics expectations of all students in Mathematics 31, but greater expectations of some than others. It was a course requiring some mathematics ability; those who were apparently limited in this regard ran the risk of not meeting minimal course standards. While Mr. Coleman was concerned for these people, it was ultimately up to the student. It was, Adam seemed to believe of Mr. Coleman, essentially (and agreeably) a personal test as to whether or not the student should be in the course.

The Students

Introduction

As noted in Chapter 3, there were a significant number of grade 12 students at Fairfield repeating a course or courses to improve their grade, or returning to take additional courses to improve their diploma level. Len Coleman referred to this as the "fourth year syndrome" (5). This syndrome is evident in the participating students, four of whom were repeating Mathematics 30, and one who was returning to improve her diploma level (see Table 2). Each student's mathematics status is briefly described below.

Individual Profiles

Jan

Jan had graduated from high school the previous year, and had returned to take such courses as Mathematics 30, Social Studies 30, and others in order to obtain an Advanced High School Diploma. She had begun Mathematics 30 the previous year, but dropped the course after approximately two weeks. It had thus been over a year since she took Mathematics 20.

The table and the subsequent profiles are arranged according to the mathematics class(es) the students were in, to facilitate the discussion. Jan and Darren were in Len Coleman's Mathematics 30 class, Sarita and Gordon were in Frank Tilson's Mathematics 30B class, Marie was in Tilson's Mathematics 30A class, and Adam and Yee were students in Tilson's Mathematics 30A and Coleman's Mathematics 31 classes.

Student	Repeating Math 30?	Former IB Student?	Comments
Jan	No	No	4th year student, graduated last year with General Diploma
Darren	No	No	
Sarita	Yes	Math 30 IB last year	Repeating math to improve grade
Gordon	Yes	No	Repeating math to improve grade
Marie	No	No	
Adam	Yes	Yes, but not math	Repeating math to improve grade
Yee	Yes	Math 30 IB last year	Repeating math to improve grade

Participating Students' Recent Mathematics History
Table 2

Jan had done well in junior high school mathematics, but the transition to grade ten had been decidely problematic. She believed that grade nine teachers had instilled the wrong message about high school - very negative - in their students. In Mathematics 10, she did not like her teacher's style of teaching, and, while she did pass the course, she came to dread attending class. The Mathematics 20 teacher's approach was more to her liking. This teacher seemed more comfortable with students, appeared to have a greater concern for students' problems with mathematics, and provided a comprehensive, structured set of notes, with additional teacher-created practice worksheets, which Jan considered extremely helpful to students, many of whom she considered were not strong in mathematics (1).

In Coleman's Mathematics 30 class she sat right up in the front row by herself; she wanted to be able to see and hear the teacher at all times - and get his attention more easily. She occasionally asked Mr. Coleman questions in class; she said (4) that while she cared what other students thought of her asking questions, her desire to know, and be clear about some point, was stronger. Besides, she reasoned, other students may well benefit from the teacher's explanations.

Jan considered mathematics to be repetitious, and not of much importance to her (5). Still, she also believed that she was a "Good" student in mathematics. Reflecting on the question of the basis for her self-evaluation, she remarked that in Mathematics 20 - even though she liked the teacher's instructional approach - she would have graded herself as only "Fair." She believed that she always had the mathematics ability. The difference was in her own attitude to the effort she was currently willing to devote to preparing for and doing well on tests. In the fall of the school year, she stated, "I'm shooting for 100s on my tests now, not 80s. 100s. I want them, and I think that I can get them if I work hard enough" (1).

She claimed (3) she was a perfectionist in many of the things she did. Pressure to succeed was not imposed upon her by her parents, for example, she believed, but by her own sense of self.

During the course of the research Jan's marks were typically in the mid-70s, not at the high level she was "shooting for." Grade twelve mathematics was, however, relatively enjoyable, especially compared to grade ten, "because it's clear, and seems a lot more logical ....I don't feel lost" (5). She still believed realistic goal setting was important (5); it provided her with an incentive to move forward, to apply herself, without being overwhelmed.

Jan had enjoyed high school at Fairfield; she said she loved to learn (1). Upgrading her high school diploma by returning to school for a fourth year would permit her greater access to post-secondary study to pursue her learning. She had a variety of interests, and at the time of the interviews she had not decided upon a particular field of further study.

In addition to the traditional academic high school studies, Jan was very involved at school and outside school with music: band, choir, and piano studies. Indeed, in general the extracurricular and social side of high school was an important aspect of school for Jan. She believed that the school needed to promote its clubs, services, and social activities, and students needed a balance of the academic and the social in their school lives.

Darren

Darren was also a student in Len Coleman's Mathematics 30 class, in his third year at Fairfield. Like Jan, he was interested in the extracurricular aspects of Fairfield, particularly athletics and the football program. He played on the team which had won the city championship the previous year.

Darren's pattern of success and difficulty in mathematics was similar to that of Jan, with the exception that he was in his third year of high school and had not skipped a year of mathematics. Darren had difficulty in Mathematics 10, and for similar reasons to Jan: he did not like the teacher's style. He completed the course with a low passing grade. In his grade eleven year he took Mathematics 20, and had much greater success. He found the teacher very helpful; he also believed he had matured somewhat mentally, and that, too, had aided his understanding of mathematics. Darren did well during the year, but slipped in t' final examination. He stated his grade for the year was 67%.

Grade twelve was a particularly important year, and he wanted to be well prepared to write the Diploma examination in mathematics at the end of the year. Marks were very important for improving one's post-secondary opportunities. For that reason, Darren was appreciative of Coleman's approach to teaching. For the same reason, he was critical of his physics teacher, who, Darren said, "wasted" too much class time discussing things of philosophical or "human interest" value only that were not related to the required, tested, physics content (1).

Like Jan, he generally appeared attentive to Mr. Coleman in class (but did not ask as many questions). During individual seatwork time, like many of the other students, Darren tended to work alone while consulting with those around him from time to time.

Notwithstanding his praise for Mr. Coleman, and the firm stance he took on the importance of marks and post-secondary education, Darren's relation to senior mathematics did appear somewhat problematic. In Mathematics 30, Darren's test grades varied extensively over the period of the field research (36% to 85%). When the research began, he was just passing the course. His average grade later improved, but by the end of the research period he said he was back in the 50% - 60% range.

Excellent students were 90% students, Darren said (2), and he was not one of those people. However, if he applied himself, he would be an "Above Average" student in mathematics, getting marks in the "75 to 80 range." He was above average because he believed that he understood some of the concepts better than did some of his peers, but he seemed plagued by a lack of achieving to his potential. What separated him, he thought, from those who regularly demonstrated above average or even excellent achievement - those who consistently received high marks - was his level of commitment. Darren was often critical of himself for just this problem - not committing himself more to the work.

He questioned his long-term memory. He said mathematics tests made him tense. He disliked the practice of beginning new material before the unit test on the previous topic was over and done with. Still, he believed that if he better prepared himself, and read the test questions more carefully, he would do better. What was problematic was his lack of a consistent commitment to do so.

Darren's personal achievement goals also seemed "flexible" or unclear. The 75% to 80% achievement goal with commitment mentioned above became a 65% to 70% range later in the same October interview (#2).

During the early interviews, Darren expressed a strong interest in entering entering the local university's Faculty of Business. Entrance to the accounting program was quite competitive, requiring a high average grade for entrance. Darren felt he knew his limitations, and while he was trying to do well in his courses, he accepted the possibility of pursuing options: (i) entering the university transfer program of a local two-year college, and (ii) returning to Fairfield the following year to try to improve his grades.

In the final interview, Darren stated that he would very likely be returning to Fairfield in the fall. His desire to pursue accounting and Business was not quite as strong, and another of his interests, playing and instructing in the guitar, surfaced as a career option. Still, the long term major aim of formal education for Darren was a financially lucrative career, and a career in music might not be as secure as he would wish.

Sarita

Sarita had completed Mathematics 30 IB the previous year with Frank Tilson, and she had returned to regular Mathematics 30 (30B) to improve her grade. She had done well on the Diploma examination (88%) the previous year, but her IB class mark was lower than she was willing to accept (69%). In repeating the regular Mathematics 30, therefore, she was concentrating on doing well on class tests. She did not rewrite the Diploma exam. Her final class mark was 94%, for a final "blended" grade of 91% in Mathematics 30. Sarita later enrolled in Len Coleman's second semester Mathematics 31 course.

In class, Sarita was a quiet student who worked alone much of the time. She was attentive to Tilson's class presentations, and devoted the individual seatwork time to working on the assigned exercises. She seldom spoke with other students. Her mathematics study was usually confined to class periods (2,3), but, she claimed, she was capable of concentrated learning on her own when she felt it was necessary (e.g., in studying for the Mathematics 30 Diploma examination the previous year) (1,3).

Sarita was not interested in the extracurricular and social aspects of Fairfield school life. She had not joined any clubs or service groups, and at the end of November she commented, "Like, I didn't even know we [football team] were winning, or something. I never knew we had good teams out this year ... we won so many championships, and I didn't know" (3). Sarita was also not interested in much of the ceremonial side of school life, such as attending awards night: "I just don't bother going, right, and - just pick up my award at the office" (3).

The academic aspect of school was clearly where Sarita's interests lay, but even this had its limits. In grade ten Sarita was in the full IB program. In grade eleven she dropped some IB courses, but remained in others, such as Mathematics 20 IB and Mathematics 30 IB. In grade twelve, she was taking no IB courses. Sarita and her family saw school primarily as a stepping stone to post-secondary study, with good grades the major means of gaining access to this study. IB courses, while they were academically challenging, presented the risk of low(er) grades and having to repeat a course. In consultation with her family, Sarita had decided to try IB courses for two years, and evaluate her position at that time. Taking these courses would provide some challenge, and might help her develop study skills - which they did, Sarita noted (2). Since Mathematics 30 IB was a grade eleven course, she could take Mathematics 30 in grade twelve if necessary without extending her time at Fairfield. She claimed she decided early in Mathematics 30 IB that she would repeat the course (1).

Sarita had always done very well in school mathematics, especially in elementary and junior high school. She evaluated herself as "Good" in secondary school mathematics. Her Mathematics 30 grade average was 89% at the time of this statement, but she believed she was capable of even better grades. She also did not want to compare herself to those "excellent" students whom she had seen in IB mathematics.

She stated that she had had some difficulty in grade ten mathematics because of the "pressure, pressure, pressure" of the IB program (2). Relying on her ability to learn school mathematics with ease, Sarita had tended to devote most of her study time to other subjects. She was relieved in grade twelve to have withdrawn from IB, and she was doing quite well in all her subjects during the research (1). Because her father and younger brother (in grade ten IB during the study) also appeared very competent in mathematics, she conjectured that her mathematics ability was inherited (5).

While Sarita found mathematics "easy" and therefore a source of good marks, the subject did not interest her as a field of human knowledge.

> I like it because it's an easy course. I can do whatever I want in it, and still get good marks. But ... I'm not really enthusiastic about it.... because it's not me. I don't apply it anywhere else [than the math classroom] in my life.... To me math is just a course.... I've taken [Mathematics 30] twice.... It's over with. I finished the course, got a good mark, that's it. (Sarita 5)

Sarita was interested in the sciences, especially biology, and even though she would be required to study some mathematics in university, that seemed to have little impact on the significance of the subject for her as a high school student.

Gordon

Gordon was repeating Mathematics 30 (30B), first taken in grade eleven, to improve upon the grade of 51% he originally received. During the research, his test marks ranged from approximately 40% (his one failing mark) to 85%, and his final "blended" Mathematics 30 grade was 74%. He was considering rewriting the Diploma examination at the end of the school year. Like Sarita, he enrolled in Len Coleman's second semester Mathematics 31 course.

School mathematics was a subject Gordon generally liked, but his preferred subject was computer science, and it was his hope to follow in his older brother's footsteps and study computer programming at the local university. This was a major reason for his repeating Mathematics 30, and a source of personal pressure. His brother did very well in high school, and was doing well in university. Gordon accepted that he was not getting the grades that his brother did, but he did want to do well enough to get admitted to university; he did not want to go to the local technical college (3).

Gordon considered himself "close to excellent" in mathematics (1). Like the other students, he claimed to have done well in elementary and junior high school mathematics, but found the transition to high school difficult. In grade ten especially and in grade eleven he struggled and his marks were low. He felt he was always one step behind; he began to understand a topic at the time the teacher was reviewing the test in the area, but by then it was too late (1). He passed Mathematics 10 and Mathematics 20, but "... I was always that sort of step behind and, I don't know, I sort of feel it was unfair in a way. Because I knew I was good, but it just wasn't showing or anything" (1).

Being near excellent meant being able to solve problems involving a series or multiplicity of logical steps. Such problems would likely leave many others lost. What perhaps separated Gordon from the fully excellent was speed. He considered himself to be slower, and more methodical, than some. He believed also that he had not seen anyone in a mathematics class who he could genuinely say was excellent in mathematics; always there were some topics in which a student would be less successful than in others. Gordon, too, found some mathematics topics easier in which to achieve success.

In class, Gordon was attentive to Mr. Tilson during instructional times (as Frank demanded from all students). He worked on the mathematics assignment during individual seatwork time, but frequently spoke to those around him while doing it. I asked him about these conversations:

I: Is there some of that discussion to do with math?

Gordon: Well, like some is, and some is not. I also feel like, you should have fun.... That way --- you can/ also fun, and you can enjoy going to math class. Otherwise, like, you go to math class and its strictly math, you know, math is/ math is all right, but, that way you can have fun too.

...

I: ...when you are talking about math, what's the point, or, why are you talking?

Gordon: Well, usually ... about a question or something.... Because, like, they sort of ... can have the same problems as you.... that way you get it from them, and ... if they got it, ... they know what/ sort of, what's hard about it. Where, like, the teacher's done it ... hundreds of times, and ... he might forget what was hard about it.... You know, sometimes it's good when the teacher explains it, but like, other times, sort of like, isn't. (3)

In Interview #4, Gordon elaborated on his "strictly math" comments above: mathematics was not monotonous, and

> I like certain areas of it, but other areas ... where I find hard ... then [talking to neighbours about non-mathematics matters]... sort of relieves the tension, in a way. But for areas I like ... which are quite a few, ... I find that fun to do" (Gordon 4).

Gordon was finding grade twelve in general to be his best year at Fairfield. He had some difficulty "fitting in" in grade ten, but now felt that he had achieved that social status. He did not participate in extracurricular activities at school, but was involved with outside hockey. This was also his graduating year, and he was looking beyond the school to post-secondary study and a career. School, and some school subjects, such as mathematics, would, he believed, have a significant impact on his future, but at the present time this was something he thought very little about, so that school and school subjects seemed presently to be rather unimportant.

<u>Marie</u>

Marie's marks in Mathematics 30 (30A) during the field research varied from 64% to 98%. Her fall report card grade was 76%, about which she emphatically stated, "I just don't like it at all! ... I'm really disappointed in myself" (2). The previous year in grade eleven, she finished with a grade of 80% in Mathematics 20, and was an honours student overall. When the research first started, she again had an average of just over 80%. Marie's experience with mathematics over her years of schooling was that as long as she kept up with her studies, she was capable of consistently achieving a grade in the 80 percent range (1). Thus, she was disappointed with herself for letting her grade slip, but at the same time she believed she was capable of improving it (2). She did: at the end of the course she received a class grade of 83% and a Diploma mark of 82%. At the end of grade twelve she was an honours student, as officially reported by the school board in a local newspaper.

In terms of mathematics ability, Marie considered herself to be a "little bit" over "Good" (1). As indicated earlier, to do well in school mathematics Marie said she needed to study:

> ...when I do very bad, I like to learn it so that I'll do it over and over until I know it. I can't skip things over, I have to know why something is, and I have to be able to get every question. So, I'm always striving for, like, the 'excellent' rating, but then, I can't put myself there because I still make my mistakes, and certain things don't come to me very quickly, and I struggle with certain things. But ... I'm good at math, too, so I'd put myself a little bit over. (Marie 1)

Mathematics, and many of the other subjects, presented a challenge to her. She was striving for the 100% test, she said, but seldom achieved it.

In class, Marie paid attention to Tilson's reviews and lessons, believing she had to in order to maintain the level of success on tests that she had attained. However, school mathematics was repetitious and monotonous (3), and she preferred subjects such as English. She found mathematics teachers, including Mr. Tilson, who was a good, respected mathematics teacher (5), were very similar in their mode of teaching. She described being a mathematics student as "...coming into class, and sitting down, and taking notes, and then you do the assignment.... you started wondering, 'Is this how it's always going to be?'.... It's almost like they're restricted to give us our notes" (1). Two occasions on which the teacher (including Frank Tilson) used videotapes to introduce a topic were highlights of her high school mathematics experiences (1).

Staying attentive in mathematics class was a struggle at times. Like Gordon, during the seatwork periods Marie frequently felt a need to talk to neighbours, sometimes about mathematics, sometimes not: "...it's almost like I have to just sit and take a few minutes to - or else I go crazy, just doing the same stuff over when I'm doing something I don't like to do. So, it's almost a way to, to relieve myself, you know" (3).

Marie was active athletically at school, and was a member of the senior girls volleyball team. It was her busy schedule with this team to which she attributed the slip during the fall in her Mathematics 30 grade. Like Jan, Marie seemed generally to feel strongly positive about the extracurricular and social features of Fairfield.

Adam

Adam was in his fourth year at Fairfield, however, he was there for the first semester only. It was his first time taking Mathematics 31, but he was repeating Mathematics 30 (30A) to improve his grade of 55%, which was "not really a mark that reflects what [he] can do" (1). He downplayed this reason, and stated he was retaking the course because he wished to learn the mathematics (2). His first Mathematics 30 teacher could not teach, Adam said, and he "basically shut [him]self off from whatever [the teacher] was trying to teach and tried to learn on [his] own" (1).

Adam's test marks in Mathematics 30 and 31 varied significantly during the course of the research: from approximately 55% to 90% in Mathematics 30, for example. Regarding Mathematics 31 he commented: "That's a funny course. We've had four [major] exams in calculus, and I blew the first one, aced the second one, blew the third, aced the fourth.... It was just, going up and down like a roller coaster" (5). (Coleman described Adam's performance in Mathematics 31 with a similar analogy: the yo-yo (2).) The fifth and last interview was held just before Adam wrote the final exams in the courses, so there are no final marks to report.

His mathematics ability, he said, was "Excellent" at the time of the research, and his performances on tests, in general good, demonstrated significant levels of achievement. Nevertheless, Adam had a difficult time with the notion of excellence as it might typically be considered in a school context. In this context, marks were generally seen as the fundamental measure of academic excellence, but to Adam marks were "abstract things" that really did not truly represent anything (1), except perhaps to the extent that they could be said to be a reflection of the influence of the physical and social environment on the student, and an indicator of his or her psychological state at test time. For example, during the previous year when the teacher "couldn't teach [him] anything" (1), his marks were not good. Still, he believed, "My ability was ... I'd have to say, excellent, but what I could produce was poor because of the teacher himself" (1). "I judge myself in ways of more than just my marks.... it's just my way of knowing myself" (5), he concluded.

Throughout the research, Adam stressed that marks personally meant little to him, but because they were deemed important by other elements of society (universities, employers, etc.), they were important, and marks therefore held some significance. In order to discuss his personal academic accomplishments, however, he found he had to talk in terms of marks. Thus, while he tried to disassociate marks from the process of personally "knowing" himself, he needed, or at least used, marks to help define himself to others.

Adam began grade ten at Fairfield in a partial IB program. The program included courses such as mathematics, English, and computer science. He and his Mathematics 10 IB teacher "didn't get along," he said (1), and in grade eleven, the following year, he dropped IB mathematics. Although he continued in some IB subjects in grade twelve (e.g., English 30 IB), he questioned the IB program. First, his early expectations of IB students were not fully met: "what I considered an IB student was somebody who was good at everything, but was not somebody who was a bookworm, not somebody who went home and studied six hours a night to get the marks. It was somebody who had natural ability to do things" (1). He considered himself as someone with this natural ability, someone who did not have to study to be successful in terms of marks, someone who wanted to learn more. His expectation that most IB students would be like himself "turned out to be wrong" (1).

A second reservation about the IB program was its perceived value for the student. Subsidiary level IB courses, for example, "might teach you a little bit more, but [they don't] do you any good, like, as far as advance placement or anything else" (1). (In contrast, recall Len Coleman's comment on mathematics IB that its value lay primarily in the additional mathematics grounding a student received, not in a potential advance post-secondary placement.)

Notwithstanding his negative interpretations of the IB program, Adam was still thankful for its existence at Fairfield. In a regular academic course such as Mathematics 30, one was very apt to find several students who were not academically oriented struggling just to pass.

> I figure that the IB is the only thing that sort of kept my marks up because ... there were a few other people in there that were like me, who thought the way I did, ... that IB should be for the people who are naturally intelligent.... I don't think my mark would have lasted if I would have been in, like, a regular class all these years. My attitude would just have gone down.... I needed that kind of protection.... keep me away from all the lower students because, at the time, my marks were still down really low, and I hadn't had things sorted out yet, and, if I would have been in a regular course, I probably would have developed an 'I don't care' attitude.... Which I <u>did</u> develop, but not to the same extent. (Adam 4)

It is clear from the above passages that Adam believed he was endowed with ability in a variety of academic fields of study, and that he seemed to take some exception to certain types of students being permitted to enroll in the IB program. It is clear also that Adam had a view of schooling that generally suggested greater streaming of students as a natural extension of individual differences in ability. The following excerpt began in the context of a discussion of Mathematics 31, but soon became generalized:

> ...you always have some people in courses that are sort of taking it for the credits, or the prestige of taking it, and stuff, and barely pass it.... And, like, those students don't belong. Like ... even other students sometimes look down upon them; things like that. So, I don't think it's unnatural [for a teacher to apparently care for some students more than others]. It's like, you don't belong, and one knows it, sort of thing.... It's not really an elitist thing, though. It's just something like, <u>the</u> way it is.... They don't belong, because they can't do it. Guess it is [elitist]. It is, but it's not like, with the prejudice attached to it. (Adam 4)

Adam would have preferred a school structure which permitted students to "learn at their own ability levels." Courses seemed to be designed for a mid-range of abilities: Those of higher ability got bored, and those of lower ability in the subject got frustrated, and held up the progress of the whole class. Why should those people who cannot understand the material, and who may not want to be there in class, have to be there, he wondered (G).

Adam saw himself as academically distinct from much of the Fairfield student body. On the other hand, he appeared not to want to be socially distinct, and this, too, seemed to influence his negative view of those students in the IB program who worked very hard to succeed. He appeared pleased that, in the earlier secondary grades, many of his school friends who put down "stereotypical" IB students for getting high marks, studying all the time, having no fun, and being "square" did not know that he was in IB, and were "shocked" when they did find out. He saw these people, some of his friends, as generally judging others by appearances. He felt he was able to judge and accept people more deeply, "for what they [had] within them" (5).

In class, Adam was attentive to both teachers. During seatwork time he maintained a collegial relationship with the students in his immediate vicinity. In Mathematics 30, this included two or three youths whose mathematics achievement was approximately the same as his, and another young man whose marks were generally much lower, and who, he said, they occasionally teased good naturedly with the apparent aim of "encouraging him to do better" (5). In Mathematics 31, one of those with whom he conversed frequently (particularly as the semester went on) was Yee, who we will meet next.

<u>Yee</u>

Yee was also repeating Mathematics 30 (30A) to improve her grade. The previous year, in grade eleven, she had completed Mathematics 30 IB with a mark of approximately 85%. This was not high enough in her opinion, because she wanted to attend university in the United States, and the competition for admission there was great. Yee believed she could substantially improve her mark by repeating the course at the "regular" level, and she did: Her final Mathematics 30 "blended" grade was 94%. Her final mark in Mathematics 31 was 89%.

Yee had arrived in Canada from an Asian country in 1979 and started school in this province at the grade four level. She found her mathematics skills were well beyond those of Canadian children, and claimed that it was not until she reached high school that she really began to learn new mathematics. It was her belief that the educational system in her native country, and in Asia generally, was "really much harder" (1,5). Unlike Jan, who had advocated that Fairfield, and schools in general, should place a greater emphasis on a balance between the academic and extracurricular/social aspects of schooling, Yee believed that

> ...the school should, at least reduce all this stuff [clubs, teams, "easy" option courses, and so on], or maybe eliminate everything.... After [the students are] done with school, they can do all this stuff. Outside school time. I think school time they should just/especially for schoolwork. (Yee 5)

Also unlike Jan, who said she felt no pressure from home, Yee felt a great deal of pressure from family, especially her father. He had very high expectations of her: "He's so intelligent ... he wants me to be just like him" (3). Yee's entrance application essay to a U.S. university dealt with the topic of pressure derived from her father's high expectations of her.

Yee held diverse views on mathematics. On the one hand, it had no importance for her, she said, beyond the necessity of basic mathematics for everyday living (1). She wished to study engineering, and she acknowledged that mathematics did, therefore, have future significance for her, but beyond this potential value, "some of the stuff we learn in math is really dumb, is really useless.... Mainly I think everything is useless.... what do you do with math - nothing.... But I guess math can't be like that. You can't do that in math." (5). Mathematics education should be more relevant (G - Group Interview). Second, mathematics was not interesting, she said (1), in a statement that was apparently related to mathematics' unimportance. On the other hand, this outlook did not dampen her enthusiasm for the subject: "If it's something with numbers in it, I like it." It was "fun" and "challenging" (1). Yee had difficulty with English, social studies, and biology, but "I really do like math much better than the others. I have the knack to follow through everything, to understand the stuff much better" (1).

Her views on Asian/Canadian education, and her fondness for mathematics were reflected in her views of Fairfield's mathematics programs and the enrolled students. Yee liked the challenge of the fast pace, depth and breadth of content, and the difficult questions of IB (1). She was impressed by the mathematics ability of some of the IB students (e.g., 3). In contrast, she repeatedly remarked in the interviews how bored she was in the "regular" Mathematics 30 class - "I feel I'm dead in that class!" (1). Not only was she restudying (some of) last year's mathematics, but the pace was slow, and the students in the class often seemed to have difficulty understanding simple mathematics questions: "Sometimes it's so easy. I think to myself, 'Oh my god, can't you do that?' And sometimes I get kind of angry at myself for judging people like that" (1).

The problem of students in Mathematics 30 was compounded by the attitude of some of them who seemed not to care. In particular, Yee criticized some of the girls who sat near her as "wild" and "childish" in their "dumb" conversations (3). She moved away from them and sat on the other side of the room. She seldom spoke with other students in the class.

In contrast, in Mathematics 31 Yee frequently talked with other students, including Adam, especially in the later months of the course. Observation suggested these discussions were often about mathematics problems. Other students nearby turned to her for assistance. The Mathematics 31 environment did not replicate that of the IB program, but here at least some of the mathematics was new (and not studied in Mathematics 30 IB), and the students "seem[ed] normal to me.... same as [the] way I am" (3).

Getting approximately 70% on a Mathematics 31 test was "horrible" (3), but she seldom received marks this low. She considered herself to be "above Good," but not excellent. She knew people who were "really smart in math," who had very good mathematics "thinking skills," in her opinion. Her marks were good, her own ability to "reason [problems] out" was better than many students, but she was not quite on a par with the excellent mathematics students.

Yee could get high marks in regular mathematics courses, but the real distinctions between herself and those she considered to be excellent appeared in IB mathematics, where the pace was faster, and the tests more difficult. In the IB class also, she was not prepared to push herself too hard to achieve very high marks. This, too, separated her from some of the excellent mathematics students.

Comment

There were seven students in the research, four females and three males. Some had been in IB mathematics in earlier grades, while some were repeating grade twelve and/or Mathematics 30. Their achievement levels varied, although several did quite well in mathematics, and they all perceived themselves to be better than the average secondary student in achievement (and/or ability) in the subject. As can be seen from the biographical snapshots, their backgrounds, their experiences in school, and their views on schooling, are diverse. In the next section, these students' beliefs about the nature of school mathematics are described, as a companion piece to the teachers' views on mathematics and mathematics teaching dscribed previously. The chapter closes with a short section on both teachers' and students' beliefs about the purposes and value of mathematics study in school. These last two sections help provide a basis for interpretations of excellence taken up in Chapters 5 and 6.

Student Perspectives on School Mathematics

A Finite System of Numbers and Logical Procedures

School mathematics, for the participating students, existed largely as "a closed system" (Darren 5; also Marie 4), as essentially "finite" (Jan 4), as "math is just math" (Yee 2), as "just there ... got to learn it" (Sarita 5). Its principal focus was "numbers" (sometimes modified to "equations" (e.g., Gordon 5)), and the formulas and algorithms - methods or procedures - applied in questions and problems with which to manipulate the numbers and determine an answer. This view of school mathematics is evident in the following interview excerpt:

I: What is it about --- numbers you particularly like? [referring to an Int. 1 Yee comment] ... What is mathematics for you?

Yee: It's numbers.... Steps.... Organized. You follow through. Methods.

I: Methods.

Yee: Yes. Methods. You follow through each step. You follow the steps. Method.

...

I: ...what if there's no obvious method-?

Yee: ...Well, I just, work the whole thing out. Just try and work it out. But, still use method. Just follow it through, orderly.... In my mind I say, "Yes, that's where you go," and so, the next step, and so on. (2)

Darren described mathematics as involving "problem solving techniques.... You're faced with a problem, and they'll give you some theories: 'This is one way to solve this kind of problem.' Then they'll vary the question, and you use parts of this theory" (5).

The mathematical processes were "systematic," "organized," and "logical" (Marie G; Gordon 1; Adam G; Yee 5). Gordon explained:

> ...with math and numbers ... it's all logical, and when it's logical, you can, like, figure that 'this' and 'this' is going to balance with 'that.' ... everything is just logical. You just have to use a procedure to figure it out.... just figure out the answer. (Gordon 1)

This procedure could be metaphorically likened to purposeful, careful travel: "If you just keep going ... on a ... correct trail, you'll come out with the correct answer" (Gordon 5).

In contrast to a subject like English, which was "all a matter of interpretation" (Adam 4), where questions were often open to a variety of acceptable responses (a "grey" subject therefore), mathematics was standardized, and "black and white" (Gordon 5) in terms of permissible answers to its problems. There was "one answer" (Adam 4), and thus one was either "right or wrong" (Jan 4).

The procedures were typically provided by the teacher and the textbook. This is a critical point; in the interviews all of the students were clear about their heavy reliance on the teacher for learning the mathematics. As Sarita expressed it somewhat colourfully: "[Mathematics], it's basically numbers.... They're all in jumbles, and then the teacher teaches you how to put them together, and you just - follow what the teacher says" (5; also Yee 5). The students usually spoke of this in terms of "one way" to solve a problem, but not always, as Gordon, for example, claimed

> there's probably many approaches to it, but you sort of find the approach that fits your style the best.... how you feel, you know.... that way you get your own sort of personal math, and you just keep developing on that. (Gordon 5)

However, this could be problematic when it led to such rigidity that "you don't want to look at other ways" (Gordon 5).

A Concrete Mathematics

The essential ideas and concepts of mathematics were abstract, some students argued (e.g., Darren 4; Adam G), because "there's no concrete view of it in nature" (Adam G). Nevertheless, mathematics as it was experienced in the high school classroom was explicitly perceived by several of the students as concrete; more concrete than English, for example. The following passage is from the group interview with Marie, Adam, and Yee.

Adam: Math is logical, like, it has a concrete answer, whereas, English is something that doesn't.

Marie: Uh-huh.

Adam: There is not a right or wrong answer, necessarily [in English]....

I: O.K. Well, does everybody see math as sort of/ a question of, ah, being right or wrong answers? Is that what math is?

Marie: (Yes-?) (in background).

Adam: It's sort of like, you can get only one sort of answer to a question, you can't get, like, 'Well, maybe it's this, and then, maybe it's not....

Marie: It's not abstract....

Adam: Well, if you make it abstract, they sort of yell at you anyway.

Marie: Yes (laugh).

I: It's not abstract, you don't think?

Marie: No. Not from what we study, you know.

Yee: I don't think math is abstract.

Marie: No.... Most of it's a formula. Or something like that.

...

I: ...Interesting.... I mean, in some ways mathematics is considered to be one of the most abstract things around.

Marie: Well, I think in the cl/ the stuff that we're taught, though, isn't.

Yee: Well, I think (it will-?) always be.

Adam: Well, it's abstract in a different sense though. It's abstract in the sense that there's no concrete view of it in nature, or something, but it follows a pattern of set regulations, sort of thing. It's not very abstract.

Yee: So, it's concrete.

Adam: Yes. But it's an abstract concept.
(G)

Experienced as formulas and set procedures, and one and only one answer problems, school mathematics was thus perceived to be quite concrete for many students. To do so required an acceptance of these formulas and methods as "just there," as real. For student Darren, the ideas of mathematics appeared to predominate, and they did so as abstractions, with "no concrete foundation" (4). Especially in his earlier secondary years, this created problems of understanding and relevance for him. On the other hand, Darren was very well aware that success in school mathematics was rooted in correctly using the procedures taught in each topic. For that reason he wanted teachers to focus directly on describing and demonstrating the use of these routines. In other words, it was the teacher's task to make concrete the otherwise somewhat elusive mathematical algorithms.

Darren's understanding of the concreteness of mathematics was in terms of its applications (4). Like all the other student participants, however, he considered the applications of the current high school mathematics to be quite limited.

Order and Relationships

Jan described mathematics as a "man-made" way of relating through the use of number. "We need numbers not only for physical objects, but people-type relationships too" (5). In the group interview Marie agreed with the view of school mathematics as concrete. In her last interview she began to reflect on those remarks. She reaffirmed her position that school mathematics as formulas was essentially closed, and concrete. But in school mathematics they got just "glimpses of little bits of units" of mathematics (5). Marie spoke, somewhat speculatively, of an expanded notion of mathematics, and described it as "an explanation to me of a lot of things in the world. Like, just, how everything is so ordered, and fits into certain - [sentence left unfinished]" (5). It was more than just "formulas they're trying to drive in your head," and more than just the basic mathematics needed to function in everyday life (5). One would have to study mathematics beyond high school to better realize how it more fully related to life.

The Purposes and Values of School Mathematics Study

One reason students studied mathematics, of course, was because the Department of Education required that they did in order to graduate with an Advanced Diploma. But this did not address the question of what teachers saw as the purpose(s) for this requirement.

Teachers' Views

Teachers described potential future use as a major purpose of high school mathematics study. Schooling, including school mathematics, was a preparation for something else. It was a preparation for coping with life, and for whatever students may do if they went on to post-secondary education. At the high school level, mathematics was essentially taught to the students as a "tool" (Tilson 1,5).

Both teachers agreed and accepted that, notwithstanding their need to enroll in and pass courses such as Mathematics 30, many students did not enjoy mathematics, did not find it interesting, and would not require it after high school. Still, Len Coleman noted, students seldom knew for certain what they would be doing in their later years. They may very well require mathematics in some capacity. Since school mathematics could not be geared to specific careers, one had "to cover the broad spectrum, and ... expose the kids to the mathematics ... so that they can make a rational judgement down the road" (Coleman 1). Finally, Len pointed out, unless students were exposed to the field, they would never know if they might have enjoyed mathematics.

Tilson and Coleman also identified a "gatekeeper" function of school mathematics. Frequently

> the higher education institutions use mathematics as an entrance exam.... You know, the first thing they look at is, "What did you do in Math 30?" Regardless of whether math is even required.... I suppose they see math as being something sort of opposite to the language art skills ... which they can use as another measure of just ability.... (Coleman 1)

Frank made it clear that the first priority was to prepare the students for class examinations, the Diploma examination, and for some, the IB examination. Important by-products of this preparation also had to be recognized. These included "teaching [students] how to do problem solving" and "to think," and "teaching them to become better people" by "teaching them responsibility" (5).

> I'm showing them what happens if they don't work, I'm showing them responsibility towards their fellow students by making sure they don't come late, I'm showing the effects of not being there at all by frequent tests. They right away see their mark - their mark goes up, their mark goes down, because of work, because of not being absent, that sort of thing. (Tilson 5)

Coleman believed that mathematics, as a "structured," "continuity-related" or cumulative subject, was particularly well suited to developing self-discipline. "It's required of the individual that he master something before he continues, and so, I think you probably do need much more self-discipline [than in other less continuity-related subject areas]" (5).

Students' Views

Like the teachers, one major purpose of mathematics study, and indeed, a major purpose of school itself for the students, was to prepare academic students for post-secondary study and eventually for a good career. Mathematics was identified as a university prerequisite, so students enrolled in Mathematics 30.

The development of self-discipline was also seen by student Jan as a value of mathematics study. As a student who was not interested in mathematics she saw little personal value in it's possible future uses, but it's study in school required the persistence to solve questions of the same type repeatedly until one had learned how to apply the method. If one got stuck, one had to discipline oneself to keep working at the question until it was done correctly. The mathematics content may pass from memory with time, but the self-discipline developed to maintain a good average in a monotonous subject would remain (4).

Jan expressed regret that mathematics was unlikely to figure in her future. In general, students believed that mathematics had little current value, and were uncertain about its future potential. The relevance of mathematics study could be enhanced by incorporating such things as mathematics labs and mathematics field trips into courses. For example, visiting buildings and construction sites where mathematics was needed, she suggested, could lead to practical mathematics problems for the students.

Other students, Sarita and Yee for example, also claimed mathematics had little importance for them, even though their achievement levels were high. Their post-secondary interests in biology and engineering would require mathematics, but in their status as high school students even this acknowledgement was limited.

Students such as Gordon, Marie, and Darren believed mathematics did have future value, even though they were uncertain what that would be. Gordon explained:

> I'm not really sure, like, the purpose now, I'm sort of looking for the future, again. Like, I'm sure sometime it'll be useful. Where, where some people sort of go, "Well, I can't see use to it, therefore I don't like it," where, I think there <u>will</u> be a use for it. Like, I can see some usage for it. But I'm not really clear on what they are. (Gordon 3)

Darren took a somewhat more global position on the importance of mathematics, believing that given the place of technology in contemporary society, "there's no way we could survive" without mathematics (4). This general state had much significance for business and accounting, his personal career interests.

Another significant value of mathematics study, according to some of the students, was its development of the mind (e.g., Darren 4). Regardless of it's future use value, in school it was "working one's brain" (Marie 4). "It's a mental exercise," said Jan, "[which] <u>is</u> going to help you develop your mind, which will help you study anything" (5). High school mathematics "train[ed] your mind to learn" (Jan 3).

Learning school mathematics certainly is a mental activity, but whether the process of learning mathematics leads to logical thinking skills transferable to non-mathematical, or non-quantitative situations, is seriously open to question, as was discussed in Chapter 2. Furthermore, as Dorfler and McLone (1986) and Goodlad (1984) point out, even in quantitative contexts the nature of the students' mathematical learning experiences is a very significant aspect of the development of logical thinkers.

Summary

In this chapter the school, the two mathematics teachers, and the seven senior mathematics student participants have been introduced. Their views on mathematics, and mathematics teaching have been described. The two teachers have very similar academic and teaching backgrounds. Teaching styles are similar, but there are also differences. The students are all in grade twelve, and several of them are repeating Mathematics 30 and/or the full grade. The importance of successful school academic study in terms of providing opportunities for further study, and ultimately a career, is clearly significant for the students. Some have been in the IB mathematics program. The students' backgrounds are diverse and among the seven there is a range of views on schooling, and mathematics, especially its personal significance. There is substantial commonality in terms of beliefs about what school mathematics is.

In Chapter 5 we first explore the question of the possible excellence of the school, Fairfield, and the teachers, based on the views of the teachers and students themselves. Chapter 5 then looks at the question, What does it mean to be an excellent student at Fairfield in mathematics? The interpretations the nine participants give to this question are described. The knowledge of the teachers and students offered in this present chapter provides a substantial background against which we may better understand the beliefs of, and the positions taken by, the participants as described and interpreted in the following chapters.

CHAPTER 5
PARTICIPANT INTERPRETATIONS OF EXCELLENCE AT FAIRFIELD

Introduction

The significant meanings that teachers and students gave to the notion of excellence in the context of school mathematics at Fairfield are described in this chapter. Such interpretations principally take the form of characteristics of excellent students.

Prior to considering student excellence in the mathematics classroom, teacher and student perspectives on the general nature and degree of excellence at Fairfield school are presented. This is followed by a description of the achievements of the mathematics program as interpreted by the participants. This includes an exploration of what is required of individual students to be consistently successful in senior mathematics, and a consideration of what participants believe reasonably indicates the success and excellence of the Fairfield mathematics program.

The nature and degree of excellence of the participant mathematics teachers is then described, based on student perceptions and teacher descriptions of their teaching goals. It should be pointed out that the teachers did not talk about their own "excellence" per se. A framework of "instrumental goodness" is used to infer from participant discussions the character of teacher excellence.

These interpretations are presented first in order to establish a context, or a "school matrix," in which to embed the participant views of what constitutes excellence for a student in the mathematics classroom. Three major categories of student excellence are described. A consideration of the potential for excellence closes out the chapter.

The School: Teacher and Student Considerations of its Possible Excellence

Fairfield's academic orientation as perceived by teachers and students was described in Chapter 4. The school focused particularly on successful academic study - English, mathematics, the sciences, social studies, and other knowledge-intensive (as opposed to skill or practice-intensive) subjects. As a particular mark of its academic status, Fairfield offered the IB program for the more academically oriented and/or gifted students. At the same time, it served students of widely ranging interests and abilities through subject streams.

Given this latter context, schooling at Fairfield was not about excellence if by that one meant "trying to get everyone to be excellent" in terms of high achievement levels (Coleman 4; Tilson 5). The aim instead was to get students working to the best of their ability. The question then arises, How is one to decide that students are consistently working to such levels? Len Coleman addressed the question at the program and school levels. Among the external indicators were the favourable results of the Diploma and IB examinations, which answered the question, How well did Fairfield students do in comparison to others writing the tests? The positive perceptions of the parents and students were also important factors. Critical internal indicators included professional teacher judgements of student classroom and course performance (Coleman 5). The general academic emphasis of Fairfield aided this teacher endeavour by providing the proper environment "to get the best out of [the] student" (Coleman 4).

These factors were wedded to create a generally positive response to Len Coleman's own question regarding school excellence: "What does the place <u>do</u> which is <u>beyond</u> what is the basic requirement?" (5). With some reservation, he allowed that in a context of educational excellence, Fairfield was "basically" excellent.

The students also acknowledged Fairfield as being academic in orientation, and those whose achievements were noteworthy were often recognized in some way. Teachers usually made brief encouraging or congratulatory comments on the report cards of those who did well. The list of honours students was posted. The name of the top academic student in each grade for the year was engraved on a plaque in the main hallway. A year end awards night honoured those who had done well in a variety of curricular and extracurricular fields. The school had "high standards" (Darren 3) and seemed to "stress high marks" (Gordon 3), a comment which appeared to be based in part on the presence of the IB program. As described in Chapter 4, the "stigma of excellence" (Posner, 1976) did not appear to be a critical factor amongst the Fairfield academically-inclined students in their endeavour to achieve good grades.

There were some dissenting voices, however; in remarks reminiscent of Lyons' (1976) and Glazer's (1985) concern for the devaluation of excellence, Adam (G) believed that Honours awards at Fairfield were becoming less meaningful. He felt that too many students were achieving grades of 80% or more, and making the Honour Roll. While this might be interpreted as a sign of a good school, it meant those who were truly outstanding - and in this he was supported by Yee - were not getting the recognition they deserved.

Some participants believed that student recognition was not fairly balanced. Those in sports - especially the football team - tended to receive much more recognition than the high academic achievers and students in other extracurricular activities, such as debating and the arts (Jan 3; Marie 3; Sarita 3; Yee 3).

Announcements of student accomplishments were made in daily news bulletins and school newsletters, but these were met with mixed reaction by the students. Jan noted that the school "was proud of their students, and they push that" (3). In contrast, Sarita (3) noted that many students did not pay much attention to these announcements, and Darren referred to these types of school promotion statements as "propaganda" for which there was often "no call" (3).

A consideration of the school's possible excellence should include the teachers, who, for all students were the critical representatives of the school. Questions related to the nature of the school were often addressed at the teacher level. Most of these senior students believed that school-level expectations and pressures were not a factor for them. On the other hand, good teaching was very important to their success (e.g., Darren 4). The students appeared to believe that more than most high schools, Fairfield seemed to have "a lot of good teachers who really want to help you ... do the best that you can" (Yee 3).

Whether this meant that the teachers actively encouraged one to excel was another matter. Sarita (5) interpreted the help teachers provided in preparing students for tests (e.g., final examinations) as encouraging achievement excellence. In general, students did not feel this way. Excellence was principally understood as high achievement, and many students were not capable of such grades. What Yee meant by her remark regarding Fairfield's good teachers was that teachers had a sense of what students were generally capable of achieving, and did not want to see them fall much below that level.

Some students (e.g., Darren 5 and Adam 5) believed that the will to strive for excellence was personal, and no amount of encouragement from teachers (or other adults) would stir some students if they did not wish to be moved. Jan (5) believed that personal teacher-student connections were very important, and most if not all teachers had "so many students, and so many classes" that they simply had no time for such personal encouragement. Marie (5) further suggested that "I don't know if they put that much emphasis on challenging yourself ... so much that you improve. Maybe it's fear that everyone will fail, because lots of kids don't have the same drive." Yee (5) felt similarly.

The participant students and teachers agreed that many students could not achieve excellence when conceived as consistently high test grades. In addition, most of the students believed that the school and its teachers did not encourage students to strive for high grades, and thus, for achievement excellence. Still, both groups believed that amongst many of the members of Fairfield there was a desire for general academic success. To the extent that Fairfield was meeting this goal, the school was achieving some degree of educational excellence.

The School Mathematics Program: Teacher and Student Considerations of its Possible Excellence

Introduction

Two key aspects of the mathematics program at Fairfield are considered. In the first major subsection, the teachers' and students' interpretations of what is required to achieve success in mathematics are described. This leads to a focus on the mathematics test, its dominant and secondary characteristics, and the knowledge and skill levels students believe are necessary to consistently be successful on these tests.

After examining the assessment measures, the general "success" or excellence of the Fairfield mathematics program is considered in the second major subsection ("The Success of the School Mathematics Program"). Teachers' and students' perceptions are again described.

Achieving Personal Academic Success in School Mathematics

The Assessment Measure: Achievement Tests

The class tests and Diploma examination constituted the measures of Mathematics 30 achievement. As Frank Tilson and Len Coleman have stated, the Diploma examination established the focus of the course, and influenced the form of class evaluation. In Mathematics 31, the final examination was set by the teacher. The students' descriptions of school mathematics in the last chapter were based on experiences with teacher instruction, textbook and teacher-created exercises and problems, and the tests. It was a view principally of a mathematics developed around concrete formulas and algorithms.

A: Primary Characteristics of Tests

(i) Dominant Question Types

Except for those students repeating Mathematics 30, the Diploma exam was largely an unknown quantity until the class began to review for it at the end of the course. The class tests were the ongoing objects of students' attention. All of the participating students described these tests as predominantly "just like how we did our exercises" (Sarita 2). "They test what you've already been taught" (Marie 5). These test questions were closely patterned after the classroom teacher and textbook questions, with the "numbers" changed (e.g., Marie 2; Yee 5). The teachers' views of the tests they created were in agreement with those of the students. Predominantly the tests consisted of textbook-like questions designed to "cover the objectives" of the course curriculum guides (Tilson 2).

(ii) The Principal Aims of Testing

What one principally tested for in courses such as Mathematics 30 and 31 was

> to see whether or not they really have mastered the basic fundamentals.... you do a <u>certain</u> amount of testing on <u>applying</u> material, but ... on the whole, you're testing primarily the basic concepts ... to see whether or not they have mastered the building blocks of the course which you're trying to teach. (Coleman 5)

Mathematics exams were designed to test the achievement of students in learning the concepts and skills related to the topics covered by the test. Except to the extent that a person with very limited mathematics ability would likely do poorly on the tests, ability was difficult to test for, and was not the object of the tests (Coleman 5). Achievement testing was where the mathematics teacher's real responsibility lay, according to Len Coleman (5). On the district senior secondary report card (Appendix F), for example, a grade of 80% or better was officially described as "outstanding." This was to be interpreted as a comment on the student's achievement in the course, not on the person as human being, nor, necessarily, on the student's ability in the subject (Tilson 3). Frank Tilson (4) believed that a student with only moderate mathematics ability and time to devote to the course should have been able to meet the official criterion for outstanding achievement in Mathematics 30. Some students, such as Adam (G), also made it clear that they saw test marks as representative only of what one was currently doing, and not representative of ability in mathematics.

(iii) Judgements of Success

Given the dominant characteristic of classroom tests, doing well on them meant getting the right answer using a correct procedure or algorithm. While the work had to be correct, its quality or "elegance" was usually not a major consideration for the teachers in the formal evaluation. For example, Tilson marked the tests rapidly, looking first to see if the answer was correct:

> Basically I look at the answer, if it's right I just quickly glance at the work. If it has the same ideas that they should have, I give them full marks.
>
> But if somebody is not doing well, then I of course look at the answer and then I go through the things step-by-step. So I can tell you more about the people who are not doing well than the people who are doing well. I haven't got the time to. (Tilson 2)

The principal criterion, then, was correctness; a significant focus of attention (not inappropriately) was incorrectness.

There was some correlation, Coleman noted (2), between grade and quality of workmanship: Those whose work was "awfully sloppy" were more prone to making errors than those who did things "orderly and systematically." Informally these differences were a mark of differences in quality of mathematics work.

B: Content and Process Knowledge Necessary for Success in the Dominant Mode

(i) Knowledge

To be successful one had to know the appropriate "concrete" formula (Yee 4) or "certain operation" (Marie 4) that described the relevant relations in the problem at hand, and how to use it. Because high school mathematics was interpreted to be a closed subject, one did not need to draw upon past experiences outside of the mathematics class, or read in areas beyond the mathematics course textbooks and teacher notes and handouts, according to the student participants. But because school mathematics was also cumulative in nature, one did need to draw upon the mathematical knowledge hopefully learned in past mathematics courses. According to Marie (5), this knowledge included such "basics" of school mathematics as the four operations of addition, subtraction, multiplication, and division, reducing fractions, factoring, and so on which reappear in many mathematics topics, and together with knowledge of the current operation, should enable one to well on tests.

(ii) Gaining the Necessary Knowledge: The Process and Place of "Thinking"

The place of "thinking" in the process of gaining this knowledge and becoming test-successful was significant for students. Some who did very well on tests considered that compared to mathematics

> other courses [such as English and social studies] need a lot more thinking. -- For example, one has to think of things, where to <u>apply</u> it, but math is - you have concrete information, right. So you have, how to use formulas. - It's just concrete, just right there. You apply it.
>
> But, like social [studies], bio[logy], English - you have to think. You have to go, "O.K., how do things/" You have to give ideas, and opinions, all these sorts of things. (Yee 4)

This did not mean that there was no thinking involved in doing mathematics. Here is Gordon's description of his trying to understand a new topic:

Gordon: The first three problems ... in the text, I was really struggling on how to do it. And so, I kind of asked my brother [who was in university] ....It's like, when I finally got it, it's sort of like there's a pattern, and so, you just keep following the pattern....

I: So, once you saw a pattern, and you understood what the pattern was - routine-/

Gordon: Once you sort of, like, did the thinking, then you sort of did the thinking for that area.

I: O.K.

Gordon: And then you sort of understand the area. (Gordon 5)

The point at which the apparent patterns or relationships became routine was the point at which the need to "think" declined significantly. Test questions became relatively "straightforward" to answer correctly. For Marie, "the unit was [sometimes] challenging ... the actual classroom work before the test.... [But], if you do know your unit, and if you go in and write the test that's exactly questions from the unit, well, of course, they're not that challenging" (5). Recognizing and accepting the structured nature of school mathematics, with its "one ordered way of doing [a given type of problem]," was the foundation of success in the subject. If one could "look at it at that basic level," Marie stated, "it's quite simple" (5). The ability to consistently reach a point of seeing "what's behind it" was a strong confidence builder (Gordon 4).

The ability to recognize and to use the appropriate formula or procedure routinely and correctly was not necessarily a trivial matter: students who were not "comfortable with numbers" or equations often did not "get the sense of the question, and ... would ... get lost in the first step" (Gordon 4,5). Yee described some students she knew who "have problems, when they just look at a question. They don't understand what it means, or anything. I think being good in math means being able to figure out what it means, and how to do it" (4).

Adam (2) categorized as "pretty incompetent" those who could not do well on a test after the teacher had "drilled" the mathematics topic for a week or two, but students such as ("near excellent") Gordon and ("above average") Darren would not have agreed. In the November interview, Gordon expressed concern about an upcoming Mathematics 30 test because he had not yet reached the point where he was able to routinely solve the questions: "So I'm -- like, figuring out how to do the question that I'm on -- just trying to figure out every question, rather than understanding them and doing them" (2). Darren stated that school mathematics was not "easy": "I [have] got to think about it constantly, you know" (3). In school mathematics, "You're working with new, abstract ideas ... this is forcing you to think" (4). In Chapter

4, teacher Coleman and student Jan had noted the self-discipline that was required for many students to practice and study to be able consistently to "take that one little equation, and flip it around all its different ways" (Jan 5). Darren was frequently self-critical for not consistently "applying" himself.

C: Secondary Characteristics of Tests: "Conceptual Questions" (Above and Beyond the Call of Duty)

The majority of the questions on any test were questions on basic concepts and skills like those in the text and worksheets. In addition, there were on most tests a limited number of questions "which you have to think about. And it really confuses you, so there's ... no chance of trying to get everything.... You get stumped" (Sarita 2).

Sometimes what was most required to solve these questions correctly was a careful reading (e.g., Tilson 2). At other times they seemed to go a little beyond this level, as Darren described:

> there'll always be that one question that you've never seen anything about it, and you must apply the steps that you've been taught. You know, maybe a little differently. You have to apply new knowledge into solving the equation.... even sometimes it's just a bonus question.... They want to see if you <u>understand</u> the whole concept, so that you can ... try new ideas ... they're testing you for understanding.... Not that you can recall what they're showing you, but you understand how it works. (Darren 2)

Jan described these latter problems as "conceptual questions" (2). She accepted that these were important questions that teachers should ask students, but she believed that teachers must be fair and prepare students for them, either through the adequate study of such problems in class prior to the test, or in a further quiz after the original test review in class. Any approach where students were not given sufficient exposure to these questions before final testing was unfair, and harmful to their marks, which were vital.

Len Coleman commented on the bonus question:

> ...I would say that about one-third of my tests always have a bonus-type question on them which ... deals with something which is an extension of what they've learnt. So, it still deals with the topic, but it's an extension which we haven't delved into, which, if they have the ability, and they've done the work, then they can show or demonstrate that they really know what they're doing. That's something extra, something a little above and beyond the call of duty. (Coleman 5)

The bonus question was appreciated by some (e.g., Gordon, Jan, Yee) because failure to answer the question correctly did not harm one's mark, while answering it increased one's mark, and, as Jan stated in comments similar to those of Coleman, "that's neat. That's like saying, 'This kid's done above and beyond the call of duty in class, therefore we will give him a bonus,' because they took it farther than they had to" (2; also Darren 5 - "Beyond the call of duty"). Yee considered the bonus question to be more challenging, and similar to the Mathematics 30 IB questions she regularly experienced the previous year (5).

In contrast, Sarita stated that she rarely tried the bonus problem, preferring instead to check the other questions. Although she also had been in Mathematics 30 IB, and was doing very well in repeating Mathematics 30, she could do what she had been taught, but she could not "come up with new formulas, new ideas, and do other things," she claimed (5). And, although Darren acknowledged that conceptual/bonus questions were more likely to require an understanding of "why something works," their secondary, and sometimes optional, value meant the explanations required in the classroom were largely a waste of time to him.

> ...right now you don't want to know why something works, you just want to know that it does work, and that's what I'm going to use.... [I]f you're just a student who ... you know, you're not shooting for the 100 percents, or the 99 percents, you're shooting for 75 to 80 range, all you want to know is that it does work.... Don't spend an hour teaching me how they arrived at this theory, or whatever. (Darren 5)

By far the major portion of most tests was composed of routine questions designed to test knowledge and comprehension of "the basic concepts" (Coleman 5). To consistently do very well on mathematics tests, however, the student also had to have learned the material well enough to be reasonably successful with these "thinking" or "conceptual" questions, especially those in the regular body of the test.

D: The Potential for "Careless" Errors

The "logical," procedural, rule-based nature of school mathematics test questions meant they were susceptible to the "silly mistake." These were typically errors of, for example, neglecting to change a sign (e.g., $-(4x - 6x) = -2x$), adding instead of multiplying (e.g., $2 \times 3 = 5$), and so on. These mistakes were also the result of having failed to read the question carefully enough, and thereby having made a simple error in logic, or provided an incomplete answer. These errors were seldom a major problem, but <u>every</u> participating student made them at times, and <u>all</u> the students were critical of themselves for having done so. The students knew how to perform the (usually elementary) operation correctly, but in the particular instance, did not.

Mathematics is a subject in which the potential for making such mistakes seemed particularly high, and the students acknowledged that "careful reading" (Sarita 5), "paying careful attention to [the] little details" (Yee 2), and learning to "proofread" (Darren 4) were essential personal qualities for consistent high achievement on school mathematics tests. (On the other hand, identifying one's specific mistakes - silly or otherwise - in mathematics was much easier than in a subject such as English (Jan 4).)

<u>The Success of the School Mathematics Program</u>

In order to discuss interpretations of the success of the mathematics program, it was first necessary to describe what students and teachers believed one had to accomplish in order to succeed, in terms of marks, in the mathematics course. Such interpretations have significance for beliefs and perceptions about general program success. Program success, however, is not fully dependent on individual student success, as the following discussion makes clear.

At the beginning of the chapter it was noted how the mathematics teachers interpreted the aims of schooling at Fairfield not to be about excellence <u>if</u> by that one meant having everyone achieve at levels of at least 80% in mathematics. Many students were not going to achieve the kind of consistent test success described in the previous section. Everyone was not going to be a mathematician. The aim, instead, for the mathematics teacher was to get everyone working to the best of their ability in terms of "pushing for success" on examinations (Tilson 5). Of course, this meant expecting at least some of the class, especially in the academic courses, to achieve Honours level marks. If the teacher felt that the students were in large measure accomplishing what each of them was capable of in the course, then the teacher and the program were succeeding.

This is illustrated in the following interview excerpt with Frank:

I: So, there's one part of me that says - and you can challenge this all you like - but there's one part of me that says your expectation of Math 30 students is not particularly high.

Tilson: --- Well/

I: There's another part of me that says ... there is an expectation from these kids ... that they put an effort/

Tilson: That's right.

I: into things. And so that there's kind of a split ...

Tilson: [overlap with last of previous] Yes, you're saying it seems like there's a contradiction, is what you're saying. ---

I: Yes, well, I guess/

Tilson: See, what your mistake is is that you think that I expect an 80 from every student. I expect an 80 from a student who's capable of doing an 80, I expect a 60 from a student who's only capable of doing a 60. I'm willing to accept them at their own level. And try and bring them up. See, that way, you might think that my expectations of a student in [Math] 30 are not very high. But yet I'm disappointed with every one of them that don't get 80. OK. But I'm realistic enough to realize that we all have different abilities. (Tilson 5)

One had to accept the students as they apparently were; to expect more from them than they appeared capable of doing would be too frustrating for them and the teacher (Tilson 5). Excellence in the mathematics program was measured in terms of the degree to which students were successfully achieving to the full extent of their apparent ability. The earlier teacher remarks about school performance - the presence of the IB courses, levels of success on major examinations, parent and student perceptions, for example - also applied to the mathematics program, and suggested to the teachers, and the students, that the Fairfield mathematics program was successful. Under these criteria, such success implied general programmatic excellence.

The Mathematics Teachers: Demonstrating Instrumental Goodness

One approach to interpreting the degree of excellence of teachers is in terms of their instrumental goodness (von Wright, 1963), that is, the extent to which they are deemed to have fulfilled their professional purpose in society. Here, informal criteria introduced by the teachers and students themselves are used to locate the nature and extent of personal prespectives of instrumental goodness.

Frank Tilso[illegible]man spoke of the professionalism of the teacher. They re[illegible]ed on the professionalism of previous teachers to have taught and evaluated the students appropriately in preparation for the present mathematics class (Tilson 3; Coleman 4). Given the wide range of mathematics abilities and interests of students in the school, the requirements of the provincial Department of Education, and the mathematics streams available at Fairfield, it was important that teachers provided appropriate guidance to students, even if they and their parents did not always heed it (Coleman 4). The teachers spoke of the Diploma examination as providing a check on the professionalism of mathematics teachers in the province by helping to prevent inflated teacher grades, and by reducing the harm some teachers may do to students by not teaching the specified curriculum (Tilson 3; Coleman 5).

Tilson and Coleman interpreted their roles as high school mathematics teachers as essentially preparatory in nature. Mathematics was a part of high school, and

> ...high school is a preparation for university, or [local post-secondary technical institute] or what have you, in terms of earning a living, right. So mathematics just forms part of it. Hopefully we catch the few people that really have an interest in it, and nurture that interest so that they can follow it up, do whatever they have potential to do. (Tilson 1)

Coleman (3) interpreted his role as teacher as providing the students with the best mathematics course he was capable of, and having them achieve to the best of their ability in the course, in order not to put them at a disadvantage in any future endeavours which may require mathematics. Both Frank and Len believed that in this educational process, students would also (continue to) learn to take responsibility for their actions, and develop good work habits (Tilson 2; Coleman 3), both beneficial life skills.

Thus, the teachers saw themselves as primarily preparing students for entry into post-secondary institutions, and the work world. Providing students with an adequate mathematics background and attempting to enable them to achieve to the best of their ability on official tests were very major aspects of their perceived societal purpose as mathematics teachers, and a dominant component of any self-evaluation as a professional teacher. For example, seeing his students do well on the IB mathematics test (Tilson 4) and on the Diploma examination (Tilson 3) were significant indicators to Frank that he was "doing [his] job." To the extent, then, that students did do well on these examinations, these teachers demonstrated instrumental goodness.

Almost all the students also perceived the two teachers to be succeeding in these tasks of providing mathematics instruction, and preparing them for the major grade twelve examinations. Although Yee questioned Len Coleman's teaching style, she was equally clear in stating her need to learn from a teacher, and she did very well in the Mathematics 31 course. The competent teaching, the curricular focus in the course on what was necessary for exam success, and the completion of the planned curriculum in time to provide substantial opportunity for review were seen by the Mathematics 30 students in all participating classes as signs that the teachers were concerned for the success of the students. These, too, were signs of the instrumental goodness of Frank Tilson and Len Coleman as mathematics teachers.

The students did qualify their positive assessment of the teachers. While striving to excel was certainly not discouraged, neither was it encouraged, in the minds of most students. The comments made in the previous "School" section regarding the limits of teacher encouragement also applied to Coleman and Tilson. The exception to this was the IB program. Both Sarita (4) and Yee (3, 4) spoke of the high expectations that Mr. Tilson had for the Mathematics 30 IB students, and his apparent lower Mathematics 30 expectations stood out in contrast. It was Tilson's position that the two programs were very different: the abilities of the students were different, and the intent of the programs was different.

This particular qualification of the students' positive assessment of Frank Tilson and Len Coleman was of limited importance when weighed against the other qualities of these two teachers. The teachers appeared to be doing as well as they believed they could in preparing students for the high school reality of class tests and the Diploma examination; anything more in terms of striving to achieve high grades was speculative, and would have to come from individual students.

<u>The Students: Identifying Groups of Students Excellent-as</u>

In the preceding sections, a graduated look at participant interpretations of excellence was provided, beginning with the school, followed by the mathematics program, and concluding with the participating teachers. This has helped to provide a sense of context for a consideration of participant interpretations of student excellence in the Tilson and Coleman senior mathematics classrooms.

Introduction

John W. Gardner's statement that excellence is a powerful word that "means different things to different people" (1984, p. 10) was echoed by some of the participants. Student Darren remarked: "Everyone has their own opinion of excellence.... It's personal" (5).

Teacher Tilson stated, when he thought I was pressing for a single definition of an excellent student, "I don't want you to pinpoint; the word excellence means different things to different people" (3).

Teacher Coleman, in a similar reaction, said

> I don't know trying to get at, ah, a one specific set of characteristics of, of an excellent student. You know, I think there are different meanings to the word, and you can have many different types of students, all of which would be considered to be excellent, but being really nothing like each other. (Coleman 4)

Three general categories or groups of students excellent-as were distinguished in the teachers' descriptions. These were (i) the student excellent-in-mathematics (SEM), (ii) the student excellent-as-such (SEAS), and (iii) the student excellent-as-human being (SEHB). While there were sufficient distinctions to identify such groups, they were not completely discrete categories of "student." A student excellent-in-mathematics, for example, may demonstrate many characteristics of students excellent-as-such.

This teacher focus is significant; the teacher's understanding of students in his class was fundamental to these ways of describing students. Thus, they were very much derived from personal teaching experiences, and reflected his interpretation of his primary responsibilities as a public high school mathematics teacher.

The participating students tended to identify excellence in mathematics students in ways similar to those of the teachers, although there was some diversity in identifying the significance or meaningfulness of these perspectives of excellence. None of the participating students themselves claimed to be in any of the three student collectivities, nor did they identify other research participant class colleagues as members.

Before the categories of students excellent-as are described, the question of the authority of these teachers and students to interpret standards of excellence must be addressed. First, the teachers were part of the school mathematics community. Second, it was the teachers who either set the official assessment measure - class tests - or who had the authority and the expertise to prepare the students for official evaluation in Diploma and IB examinations. In the case of class tests, it was the teacher who evaluated the students' performance. Further, time and tradition had officially established that grades of 80% or better were usually signs of excellent achievement. In addition, these experienced teachers had also come to establish informal standards of excellence based on perceptions of student understanding of mathematics, and behaviour that was considered necessary or desirable to consistently perform well on tests.

The students in the study may not have been members of the three collectivities, and therefore the full elucidation of the particular insights that only an acknowledged member might provide may not be possible. However, many of the participants did exhibit at least some of the characteristics of members of these groups. In some instances a teacher did place a student within one of the categories. Second, and perhaps most important, the student participants were obviously experienced members of the larger community of high school students to which all students belonged, and the smaller but still extensive group of students studying school mathematics. As such, they had experienced evaluation by the same official measures as those who were members of "excellent" groupings, and they were knowledgeable of official standards of excellence according to these measures. In addition, these longtime observers of fellow students had also come to establish informal standards of excellence in the subject based on perceptions of student knowledge and classroom behaviour. Some of the students (e.g., Sarita 5; Gordon 3; Yee 3) explicitly used themselves as a reference standard by which to judge the possible mathematics excellence of their classmates.

Having established the basis for teachers' and students' interpretations of student excellence, I will now describe these interpretations. The three broad forms of student excellence were (i) the student excellent-in-mathematics, (ii) the student excellent-as-such, and (iii) the student excellent-as-human being. The first was marked particularly by strong evidence of ability in mathematics. The second was marked by performance in school mathematics, and "good work habits." The student excellent-as-human being was not as clearly defined as the others. It has two sub-categories, the characteristics of which are described in later sections.

The Student Excellent-in-Mathematics (SEM)

A: Some Identifying Characteristics

(i) Introduction: Technical Goodness and Beyond

Consistent success on tests meant success in school mathematics, and one can say, following von Wright (1963), that the formulas and methods which students had to learn, to the extent that they signified effective and efficient ways to do school mathematical things, possessed instrumental goodness. In turn, students who learned them well enough to excel consistently on class achievement tests demonstrated technical goodness in school mathematics. The students excellent-in-mathematics were certainly technically excellent.

In many cases, however, in the eyes of teachers and other students these students appeared to possess other qualities that placed them at levels beyond that of technical goodness. These are the students who others identified as having substantial "natural ability" in mathematics. There was a range of mathematically excellent students, marked at the "very, very top" by the

> superb, top, one half of one percent sort of thing, they are the ones that can grasp a concept very easily, and follow through with it, and, apply it, very quickly....
>
> Somebody, who, you explain a concept to him once, and he's got it, and he can take it forward from there, apply it. You know, he doesn't have to struggle with it in terms of what's it actually mean. (Coleman 4)

Teachers and students alike sometimes spoke in awed tones when describing what some of these excellent students appeared capable of mathematically. This tone was apparent in Sarita's description of a student in Len Coleman's second semester Mathematics 31 class (which was not observed):

> There is this girl in our Math 31 class, and ... [Coleman] told us something about the course, and he goes, "OK, you guys -" and there was this girl who knew the answer. You should have seen everybody's face. We were just like, "How did she get that?" [tone of amazement]. Like, she does math contests, she loves math contests, and here I'm just like, "Oh my god!" She's good in physics too, and in chemistry. And that's all math. And it was like, "How did you know that?" [tone of amazement]. Everybody was saying, "How did she know that?" We were just, like - all of us were stunned.
>
> And/ and it's like, you can see that she has math ability. She can figure out problems and do them ten million ways. Like one problem she'll do three million different ways. But us, we learn it one way, and we do it one way. (Sarita 5)

Frank Tilson described a recent IB student in his class in the following way:

> ...he -- always had his work done. You knew darn well that he was a step ahead of you. He challenged you, ah, - not if you made a mistake, but he challenged you to do better in terms of going further on into explanations in terms of doing proofs and that sort of thing. And yet he was tolerant when you did actually make a mistake. Because he understood, that it isn't that you're/ that you're dumb, it's, ah, just any human being. So, he had this deeper understanding, ah, of, of what mathematics was all about. And his marks were just fantastic.... top IB student in the school, as far as math goes. (Tilson 5)

There is in the content and tone of these descriptions a recognition of difference. Within the limitations implicit in the context of high school mathematics, these particular students demonstrate aspects of "master" - master student in mathematics. They certainly are able to pass the achievement tests which identify them as technically good. The descriptions acknowledge their position at a level beyond the limits assessed by such standard school measures. Not all students in the "excellent-in-mathematics" community appear to warrant such identification, but certain of those at the "very, very top" do.

(ii) Identifying General Attributes

The general view of the student excellent-in-mathematics (SEM) has been briefly elucidated. A more extensive description of the SEM includes such attributes as:

(i) achieving consistently high test marks (see opposing view later);

(ii) a strong, competitive concern for marks (Jan 3; Darren 4);

(iii) an apparent ability to learn mathematics on one's own, for example, by reading ahead in the textbook at home, before the teacher began the lesson (Yee 2,3; Jan 3,5);
(iv) answering teacher questions on mathematics which other students could not; discussing in class or staying after class to discuss with the teacher mathematics about which other students seemed at most to know very little (Jan 3; Sarita 5; Yee 3);
(v) "never get[ting] extremely tired or bored" of mathematics (Jan 1);
(vi) an apparent <u>limited need</u> to devote extra time to the study of the material in order to be very successful on tests in most circumstances (Jan 1; Darren 3; Sarita 5; Adam G);
(vii) (related to (vi)), an apparent ability to "understand everything," or to quickly "reason out" any problem (Darren 3; Sarita 5; Marie 3; Adam 5; Yee 1);
(viii) (related to (vii)), an apparent ability to "absorb things like a sponge, ... speculate on them, expand on them" (Adam 5);
(ix) an interest in solving, or at least the apparent ability to solve problems using a variety of approaches (Sarita 5);
(x) reading "extra math textbooks for enjoyment [and] university material, [and studying] concepts that were come up with centuries ago and that have still stuck around" (Jan 1);
(xi) (related to (x)), curiosity; a desire "to want to understand the relationships between numbers, between objects, between sizes, between -- things" (Jan 5);
(xii) an interest in entering mathematics contests (Sarita 5).

The student excellent-in-mathematics was unlikely to be a composite of all of the above attributes. As Len Coleman (4) stated, there were different types of excellent students, none of which were alike; the "interaction of ability and personality" was important. For example, not all students who did consistently well on school mathematics tests did well on, or even participated in, mathematics competitions (a feature which Sarita, for one, saw as particularly characteristic of those who demonstrated strong interest and abilities in mathematics). Indeed, a student may have demonstrated none of these mathematics-related characteristics except the ability to achieve high marks while doing no studying. It was possible to identify a number of "types" of students excellent-in-mathematics within the larger collectivity of SEMs.

The characteristics cited above were made by individual students based upon their personal experiences in mathematics classes. One feature of the interpretations of the student excellent-in-mathematics was the lack of detailed attention to the actual mathematics work of the student. As Jan (4) noted, students in class seldom had access to the work of other students, because mathematics had not been a subject where people shared their work with others. Therefore, they assessed the mathematical excellence of other students by what was known of their marks, and by their behaviour in class, especially during exceptional moments.

The teachers, of course, had access to students' work (especially tests) but did not dwell on the detail of the quality of the work, except to the extent that it was correct, and usually systematically done. The questions on tests which did require close reading, and perhaps recall of earlier mathematics, were, however, of particular value in revealing those with possibly greater ability, those who had paid attention in class, and perhaps those who had studied more extensively (e.g., Tilson 2; Coleman 2).

B: Some Qualified or Dissenting Interpretations

Not all the participating students claimed to have had experiences of such excellent mathematics students (e.g., Gordon), and among those who did, their interpretations sometimes varied. Darren's principal criterion of excellence in mathematics (or any subject) was marks (3), and he almost certainly would have interpreted as mathematically excellent anyone who consistently achieved high grades in the subject. However, he was contemptuous of highly competitive, extremely mark conscious students: these people (often ex-IB students, he believed) were "immature," "mark mongers" (4).

Some students held opposing beliefs about measures of excellence in mathematics. For example, Adam frequently and consistently argued that marks were rather meaningless in terms of gauging excellence in mathematics: the 50% student may well have had more ability than the 80%

student, and ability was the critical criterion of excellence. Influences which apparently had nothing to do with one's ability, such as the student's like or dislike of the teacher, the degree of interest in the particular topic, and other events in the student's life on the day of the test could easily have affected the student's performance on any given exam (e.g., Adam 1,2,5). The student who got 80% may have been average or below average in ability and had just spent many hours studying; the student with 50% may have had excellent mathematics ability, but disliked the teacher (Adam 5).

The criterion of marks was very questionable for Adam because it was only an external indicator the interpretation of which was subject to many variables, and for the same reason, he was cautious in identifying other class behaviours as markers of excellent ability in mathematics. One had to know much more about particular students' habits (4), "and know a lot about ... what they do on the inside" (5). He had known some excellent mathematics students in the IB class, but this type of person was "very rare."

The Student Excellent-as-Such (SEAS)

A: The Student Excellent-as-Such MAY also be Excellent-in-Mathematics

The student excellent-in-mathematics was an uncommon individual. The second category, "students excellent-as-such," occurred more frequently. Two major characteristics of the SEAS were good grades indicating consistently successful performance on mathematics tests, and "good work habits." This was a student acknowledged as excellent more explicitly by the participating teachers than the students. More will be said of this later.

The student excellent-in-mathematics, that is, the person who was particularly distinguished by his or her apparent mathematics ability, may also, but need not have been, an student excellent-as-such. The key to identification with this latter group of students lay in what Len Coleman called the "necessary or desirable qualities of a <u>student</u> [emphasis added]" (4).

Coleman: ...you might want to distinguish between, what is - an, ah, excellent <u>student</u>, as such, and a student with excellent ability.

I: Uh-huh.

Coleman: Because, ... there's a difference between those two types as well.

I: Yes.

Coleman: I've got a kid in my 31 IB class who, ah, does extremely little.... he never, ever - or hardly ever - shows any sort of enthusiasm at all. But in terms of ability, he's probably one of my best two or three students. But, as, as a student as such, he's terrible. You know, in terms of the normally associated qualities that we think of in terms of good students.

I: Right.

Coleman: Ah, his work habit sort of gets - his, his neatness is non-existent, ah, he - appears to do nothing at all in class. Not interested/ doesn't exhibit any great deal of interest.

I: Uh-huh.

Coleman: But, he, ah, is in the top one or two in the class, because of just straight sheer ability.

I: Yes. Is this a student who, ah, -- doesn't sound/ maybe I'm misreading it here, but it doesn't sound to me like this is actually a student who, who is really interested in the subject. Or is that a misreading?

Coleman: Umm, -- he probably is. He probably is interested in, in the subject area, and, ah, I think it comes so easy to him that he/ he's basically lazy, and he doesn't have to work, so why should he.

I: Umm. OK, right.

Coleman: When/ When he gets/

I: But he doesn't exhibit any kind of, ah, sort of extra interest in, oh, "What can you offer me that's more challenging?", or something?

Coleman: [Some overlap with previous] Every, every once in a while -- Every once in a while he gets into an interesting problem, ah, he might spend some extra time on it. And if he seems to be making progress then, fine, he'll continue on, but if he's not making any progress he'll quit.

I: Right. Yes. He's got a low level of, of, ah, --

Coleman: Persistence.
So, in terms of looking at him as a student and the necessary or desirable qualities of a student, he would be very, very, low.

I: Yes.

Coleman: Ability-wise, he's good.

I: Yes. So that on the report card --

Coleman: Oh sure.

I: the kid goes home with a 95 or something.

Coleman: He's tops. Sure.

I: And I would take it that, if we pick up on last time this would still have to be a kid you would call excellent. Yes.

Coleman: Well, in that definition, or that sense of the word, yes. (Coleman 4) discussion illuminated the characteristics of <u>one</u> (type of) stud excellent-in-mathematics. He passed the major standard of excellence, that is, a consistently high level of performance on class tests, in this case, IB class tests. But this discussion also revealed much about the student excellent-as-such, which the student in the discussion was definitely not. The "as such" student was an individual who first of all was attentive in class and who "worked," or applied him- or herself to the task of learning what was expected. It was often <u>necessary</u> for these students to apply themselves in order to do well, for consistently good mathematics test performance was also an important aspect of the "as such" student (e.g., Coleman 3,4; Tilson 4).

B: The Importance of Good Work Habits and Attitude

Good work habits such as neatness and persistence, and a demonstration of some enthusiasm and interest for the matter at hand in the class, were characteristic aspects of the student excellent-as-such. Effective use of one's time in class was another, especially important, standard by which the excellent student as such was judged. Student Richard, for example, in Tilson's Mathematics 30A class was such a student. His test marks placed him as one of the top students in the class. In Interview #1, Frank remarked, "He works hard, he asks questions, he's a pleasant personality to deal with...." In Interview #2, during a discussion of a Mathematics 30A and 30B test the students had written the day before, and on which Richard had received the top mark, (and Adam had a mark of 89%), I asked if there was something in the way they answered the questions that revealed aspects of their ability, that set them apart. Frank turned to the students' work habits:

Tilson: Well, it shows in their work.

I: In terms of, "...they can do it. [emphatic]"

Tilson: They can do it right in class.

I: Yes.

Tilson: They, ah, I can give an assignment to - the rest of the class takes a full period, he'll be finished ten, fifteen minutes early, and asking if he can go get his physics or whatever.

I: Yes.

Tilson: So, the kid has learned to work, and to use his time effectively. Sometimes they get a little tired of working and they fool around. Well, that's OK.
(Tilson 2)

Frank described another student in his second semester course who also fit his criteria for an student excellent-as-such:

> I've got a girl in Math 30, her [report card] mark is now 98.... she's constantly working, and working and working.... she's always ahead, and if she finishes her Math 30, she's working on Math 31, and, ah, you never hear a peep out of her. If she has a question, she'll come and get it done. Back to her desk. Efficiently independent, but yet when she needs help, she knows where to get it. Also helps the people around, if they get stuck. (Tilson 5)

This student may well have also been an excellent student of mathematics, with her high grades. Performance on tests was clearly an important standard for the "as such" student, but grades at this high level were not necessary. For example, in the first interview Tilson described Marie as an student excellent-as-such: Her mark was in the low 80% range. He explained: "Basically what I'm looking for is not necessarily the 80s, but the ability to work hard, the desire to work hard. See a goal, and make the goal" (1). The student who worked extremely hard to achieve a "low honours mark" was also an excellent student to teacher Coleman, although not as a student of mathematics (3).

C: The Significance of Context in Naming the Student Excellent-as-Such

The context of achievement was very important. Working to one's ability, and achieving well within the context of the particular course meant, for example, that students in Mathematics 10, 13, and 15 could all be considered as students excellent-as-such.

Coleman: It's not illogical to talk about an excellent Math 15 student.

I: What would it mean in that case?

Coleman: Because he can handle the curriculum of the Math 15 course. He's doing very well at it, and works hard, and gets good marks in it.... He's an excellent student in that course.
(Coleman 3)

The significance of context and and relative ability were major factors in understanding the meaning of the "as such" student. It meant, for example, that a Mathematics 33 student achieving grades in the 80% range could be excellent, while an IB mathematics student achieving grades in the same range might very well not be considered a student excellent-as-such if it was evident from observing classroom work habits that this individual was not applying him- or herself to the fullest (e.g., Tilson 4).

D: The Ideal of Ability AND Good Work Habits

Ability and work habits were essential for post-secondary success in mathematics (Coleman). The student who relied on ability alone for high school success may find that she or he was ill- prepared for university study. The student who was inconsistent in his or her effort - that is, the person whose grade fluctuated with the amount of study - was also more likely to experience difficulty. Furthermore, the student who might be described as being at the lower end of the scale of students excellent-as-such, the very hard working individual with limited ability who reached a level in the low 80% range, may also experience difficulty with university mathematics because of a lack of ability. The ideal student excellent-as-such, the person with at least reasonably good mathematics ability and good work habits, was the individual most likely to succeed n post-secondary mathematics study.

E: Student Views of the Student Excellent-as-Such: Uncommon, but Consistent, Committed, and Achievement Oriented

Students were less inclined to explicitly identify strong work habits as a sign of excellence, although some did. The idea of a person being an excellent <u>student</u> seemed primarily to be a teacher construct. Getting consistently high test marks was for most student participants the major standard, and this usually implied the student had mathematics ability, and demonstrated at least some characteristics of the student excellent-in-mathematics. Consistency was important (as it was for the teachers), and it was in this context that positive work habits had significance.

Darren described those individuals who were excellent in his Mathematics 30 class as "committed" (3), always apparently putting their studies ahead of other activities. Such students set goals for themselves, and remained committed to meeting them (5). Even if they were not interested in the subject to start with, they "forced" themselves to take an interest, thus improving their chances for success. Sarita referred to the "effort" of the top IB students she had known, and "looked up at," in the previous year's class (4,5). It was an effort sufficient to maintain a high average in the course. Sarita and Darren both cited their own relative lack of consistent effort and commitment as reasons they were not faring better (although Sarita especially was doing very well on tests).

IB students were, in fact, sometimes described as the group in which one found many of the students excellent-as-such (e.g., Tilson 3). Jan commented,

> I said that an excellent student was someone who was curious, and desiring to learn. Someone that had self-discipline. And those are exactly the characteristics that the IB students are cultivating, or have cultivated to a greater extent in order to accept that reponsibility, and stick with it. (Jan 5)

This committed preparation for university while still in high school was a sign of the students' maturity. These people were representatives of the notion of the "ideal student" - who combined ability and good work habits - described above.

As noted before, Adam provided a dissenting voice, primarily because he did not recognize such work habits as the ability to study for long hours as demonstrating student excellence in a field of study, and that, after all, was what one did at school - learn about various disciplines. IB students should be known for their natural ability, not for long hours of study, yet many of the IB students he had known had achieved their test success by studying extensively at home. However, if the notion is accepted of a student excellent-as-such, defined in part by virtue of work habits, then Adam had certainly implicitly acknowledged that in the IB program there were such students.

F: A Willingness and Ability to Assist Others

As Frank Tilson noted previously, another factor in identifying the student excellent-as-such for some participants was the ability and willingness to help other students. Marie (4,5) spoke of student Clayton in her Mathematics 30A class whom she had sometimes turned to for help. He seemed to be able to quickly understand the mathematics, and he had the ability to explain the question, or concept, at a level she was able to understand without being condescending. If necessary, he was able adjust his level of explanation. Yee (in Mathematics 31), Jan (in biology), and Marie herself (in Mathematics 30) were sometimes turned to by others for help. It was a sign of trust and confidence in one's abilities, and apparent willingness to assist, and made one feel good about oneself (Jan 4; Marie 4). Although this factor was not a necessary one for the student excellent-as-such, it does underline the greater emphasis on personality and the person as one moves from the "mathematics" to the "as such" excellent student.

The Student Excellent-as-Human Being (SEHB)

A: The General Importance of Context

Context played a major role in the process of identifying students as excellent in some way. Students excellent-in-mathematics and students excellent-as-such were excellent according to the teacher because in his class these people had demonstrated consistently high to very high achievement on their tests, and in the case of the "as such" students, good work habits also. There could be considerable overlap between the two categories of "mathematics" and "as such" students.

The context of particular mathematics classrooms was also significant in understanding the third form of student "excellent-as." The student members of this third group were not achieving at high levels in the teacher's mathematics class. Thus, while students in the first two collectivities (SEM and SEAS) could, in some context, potentially also be considered excellent human beings (clearly the possibility exists), in the present context these groups were distinct from the third (SEHB). This third type of student category was also a somewhat more speculative grouping, with human actions or developments beyond the mathematics classroom sometimes being considered.

Given the particular contextual nature of this third grouping construct, and given that students tended to interpret mathematics classroom-related forms of excellence as tied to achievement, few people identified this category as it is described and delimited here. Throughout, the question of excellence was directed toward the mathematics classroom, and not to general ways in which students as human beings might exhibit excellence. By its nature, then, the SEHB construct was primarily a teacher creation.

B: Limited Achievement Levels and Focused Work Habits: Toward the Mathematics Class

One view of this individual was as the person who "works hard," but whose achievement level on tests was not high. The student was demonstrating worthwhile human characteristics in the particular course. Tilson described one conception of this person in the following passage that begins as a discussion of marking procedures and marks:

I: So correct answers, correct work,/

Tilson: Leading to marks.

I: leads to marks, and if they're high marks, then we can talk about maybe they're excelling, and of course there's a range/

Tilson: [overlap with last of previous] Well, they're working within, ah, their ability/

I: Their, their ability. OK.

Tilson: OK, so, they could be excelling by being average, as well.

I: Yes, OK.

Tilson: So -.

I: How/ What do you/ I know we've gone through this before, but, ah -

Tilson: Well, if somebody comes in to you out of, say, a Math 33 class, and they really struggled in there, and worked hard, and passed, and they are coming in with really basically a low ability level, and they're working like dogs in Math 30, and they're getting 50. They're working well within their/ maybe even above their ability level.

I: Right.

Tilson: There you go. There's, ah, ah - Not an excellent student as such -

I: Not excellent mathematically.

Tilson: Not excellent in mathematics, but an excellent human being, an excellent person,

I: OK.

Tilson: in terms of that course.

I: Good qualities.

Tilson: Yes, right.

I: Demonstrating personal qualities.

Tilson: [some overlap with previous] Demonstrating some of the other things that we're trying to teach them. (Tilson 5)

This person demonstrated what the teacher considered excellent work habits in class, high among them being perseverance in order to pass the course. However, this person could not be a student excellent-as-such because achievement levels were simply too low. For the same reason, both Tilson (3) and Coleman (3) believed that the "An excellent student" comment on the report card (Appendix F) given by another teacher to a student with a 52% average in Mathematics 30 was inappropriate. If the remark meant that the student had been working hard, then that should have been the comment made. Thus, while this group of students did not and could not overlap the group of "as such" students in terms of membership, the members of both did share qualities of work habits.

C: High Achievement Levels but Focused Work Habits: Away from the Mathematics Class

A second perspective of SEHB was somewhat more speculative, and, in terms of the mathematics class in question, less positive. Identification with this category also included students with the ability to perform well on mathematics tests but who, because of commitments to other apparently worthwhile school or outside of school activities, did not devote the necessary attention to the mathematics study at hand. Thus, the individual was in some sense an excellent human because of these other activities, but was not an excellent student in the particular class in question.

This mathematics classroom-related SEHB identification is best illustrated with the example of an actual student, Marie, in Frank Tilson's Mathematics 30A class. In Interview #1 in October, Tilson described Marie as a student excellent-as-such because of her positive general work ethic and her mathematics ability to achieve honours level grades when she applied herself. In October and November Marie was heavily involved with a school sports team, missing some class time according to Frank (3), and not devoting the necessary time to mathematics. Her grades dropped to 76% on her fall report card, while Tilson believed she had the ability to have maintained an honours level grade (and so did Marie).

> She's a student of good ability ... Although she might be an excellent all-round person, I wouldn't classify her as an excellent student, for that reason. Because to my mind, she's not applying herself to <u>my</u> course as well as she could be, <u>even</u> though she might be a better person for what she's doing, you know. (Tilson 3)

One can see that identification with this category is fluid. Students who have the ability to perform well on mathematics tests but who are not doing so because of other commitments to which they are devoting their attention, can, if they wish, improve their mathematics test performances and thus (unknowingly) remove themselves from SEHB. This peculiar and negative sounding action results from the fact that the view is that of the teacher from the mathematics classroom. The teacher may, in turn, identify the person as a student excellent-in-mathematics, or as a student excellent-as-such.

Coleman did not explicitly speak of such a student. However, there was in his Mathematics 31 class a student who "should [have been] an honours student" but who was not achieving this level on her tests (mid-70s instead). Her performance was disappointing to Coleman (2) because she was apparently not doing "enough preparation," spending too much time away from class in dancing competitions. This student's outside-class interests and Len's view of her in-class Mathematics 31 performance and his reasons for its inadequacy, bore a close resemblance to Marie's interests and Frank's discussion of her Mathematics 30 performance. For this reason, Len may have also assigned her "excellent as person" status.

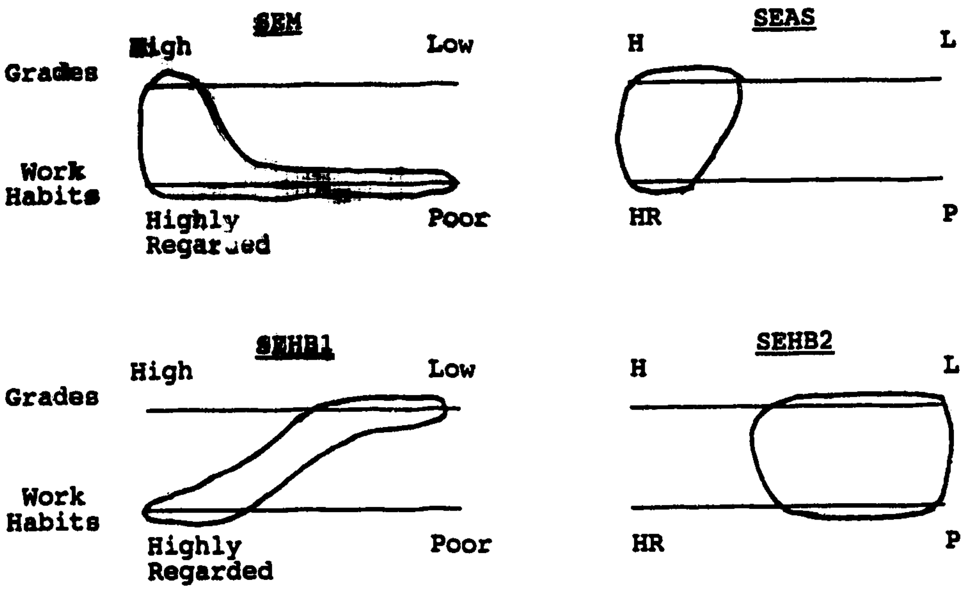
The category of student excellent-as-human being has value beyond that of marking a third informal group of students which the teachers identify as excellent in some way. It is more than just another category of student excellence.

The SEHB provides a clearer view of how the teachers see personal qualities (perseverance, self-discipline, etc) in relation to the mathematics qualities/abilities of the student. It does suggest, in the case of the student who is working hard and attaining only modest success, that the teacher admires the "human" qualities of the individual. At the same time, if those qualities are not, apparently, pressed to the fullest in the name of his course, then that student loses something in the eyes of the teacher.

Second, the SEHB has additional research value insofar as it helps to establish the classroom limits of what the teachers see as excellent. One can say, "Here are the limits of what teachers see as excellent in students, from their perspective as mathematics teachers of these students."

The Potential for Excellence

What potential was there for student excellence in terms of the three categories of students? Broadly put, there is in the shift from the student excellent-in-mathematics to the student excellent-as-such to the student excellent-as-human being a shift in critical characteristics from mathematics ability, to ability and work habits, to work habits or personal qualities (Figure 2).



NOTES:

1.) SEM: Students-Excellent-in-Mathematics
SEAS: Students-Excellent-as-Such
SEHB1: Students-Excellent-as-Human Beings (Focus toward the mathematics class)
SEHB2: Students-Excellent-as-Human Beings (Focus away from the mathematics class)

2.) Grade Scale:
a) "High" may be interpreted as 100% but no particular numerical scale of grades is implied.
b) "Low" may be interpreted as some failing grade (below 50%).

3.) There is no positive correlation implied between Grade and Work Habits within any particular category. That is, for example, it should not be inferred that those with higher grades within a category are also those with the better work habits within that category.

4.) The space between the Grade and Work Habits graphs has no category meaning.

Relationship of Grades, Work Habits, and Groups of Students Excellent-as

Figure 2

The teachers believed that students possessed a wide range of mathematics abilities. Only a few had the potential to be students excellent-in-mathematics. As apparent innate ability in mathematics became less a factor in defining classification, an increasing number of students could potentially be included. The aim of the school, the teachers stated, was to get every student working to the best of their ability in the appropriate stream. To the extent that this was achieved, then, every student had the potential to be identified with some excellence grouping.

Darren had an interesting perspective on this potentiality. He had strongly argued that marks were the criterion of excellence, primarily in terms of their significance for career possibilities. If you don't have the marks, he said, "most times ... the system squeezes you out and you're never heard of again" (4). Like teacher Frank Tilson, Darren believed that given a moderate amount of ability in mathematics, with hard work a student could excel in the subject (4). Thus, many students had the potential to become students excellent-as-such. A distinguishing characteristic of these students was their ability to set and meet academic goals. Even if they were not initially interested in the subject, they had "forced" themselves to become sufficiently interested to do well (Darren 5).

Darren did have qualifications to this typical picture of the "as such" student. First, his respect for this student was not universal. Some of those he had known in his school experiences had been quite "stupid" in doing the practical things in life (for example, having difficulty "crossing the road without getting hit" (4)). (Is this a sign of the "stigma of excellence"?) It has already been noted that those students who appeared to be excessively concerned about every mark "made [him] sick" (4). This first point may be interpreted as representing a tension between the "as such" student and the "excellent-as-human being" student who had competing interests outside of academic study. In contrast to the teachers with their classroom focus, the "as such" individual was not rated more highly by Darren.

Second, in elaborating on goal setting, Darren described it as a significant aspect of a personal vision of excelling, and to the extent that it was personal, grades in the 65% to 75% range became acceptable (5). This stood in contrast to his general concern for high marks as the criterion for excellence. The range he cited was what he expected of himself, but he did not consider himself to be excellent in mathematics, only above average. Nevertheless, this personal vision of excelling was an important aspect of the broad potentiality for student excellence. It raises the interesting matter of the distinction between individual excellence based on external criteria as determined by some larger group, and individual excellence based on personal criteria. (Recall the description of the two grade eight "excellent" students in the Prologue.)

Third, the instrumental, preparatory nature of high school for further study and a career was important in determining the ultimate meaningfulness of the short term excellence of good marks. Marks were the significant products of school meant to secure a good, profitable future for the person. Good marks may produce scholarships. Still, if one had a good mark in mathematics, for example, but "dropped out of university," or otherwise got "side-tracked," and did not end up with the "huge job," then what long term value was there in having attained short term excellence in school mathematics? This long term value may well be the "ultimate form of excellence" in school, he concluded (Darren 5).

This point might be extended beyond excellence based on marks to excellence based at least partly on character qualities. One might ask, "To what extent do these qualities lead to more and better career and 'life' opportunities?" Ultimate excellence might be taken to mean that these opportunities, whether offered or personally created, were taken up, proved "successful," and contributed to further personal growth.

It is also worth recalling Len Coleman's view of the "ideal" student excellent-as-such: an individual who combined both substantial ability (and thus had good marks) and personal qualities such as good work habits. Although the focus of discussion was on success in post-secondary study, one implication might be that this student was more likely to achieve Darren's "ultimate form of excellence."

One other point on the potential for excellence: Excellence exists based on perceived "difference." In the opening description of the student excellent-in-mathematics as "master," there was a definite sense of profound difference, of distance between that individual and almost all others. As the shift from SEM through SEAS to SEHB occurs, the qualities of difference also change. No longer is there an element of master; difference becomes more mundane, more potentially attainable by a greater number of students. The teacher does recognize character qualities which signify difference from those whose efforts appear to be lacking in some way, and these qualities may stand the student in very good stead throughout life, as we noted above. One wonders, however, how the "hard working" student in the teacher-defined SEHB category feels about his or her limited success in the subject. Does that person experience a "difference"? What is the quality of the experience as student excellent-as-human being? What is there about which one may take ownership?

Summary

In this chapter the nature of the possible excellence of the school, Fairfield, the senior mathematics program (especially the academic program), and the participant mathematics teachers was first explored, based on the perceptions of the students and teachers themselves. Excellence was typically interpreted as success, based on the achievements of the students and the instrumental goodness of the teachers. This examination was undertaken to help establish the context for a consideration of personal student excellence within a (regular academic) mathematics program. This was again essentially a description of teacher and student interpretations of student excellence.

The teachers had informally created three broad categories of "students excellent-as-" in their classrooms, and the students' understanding of what it was to be excellent in the context of a subject and a class supported some of these constructs. Two principal modes of evaluation were basic to being "placed" in one of the groupings. These evaluations were made on the basis of formal measures of performance levels in the form of tests and informal measures of classroom/personal study performance. In the case of the SEAS, and especially the SEM, consistent, high test performance was almost unanimously accepted as critical. In the case of the third, the SEHB, marks based on tests were important because they prevented students from being assigned to either of the first two categories.

Performance on the informal measures of excellence was judged in the classroom - efficient work habits were foremost signs of the student excellent-as-such - but other actions - interest in the class and subject, participation in class discussion and review, and so on were also important. Classroom actions such as demonstrating an interest in mathematics, and discussing mathematics with the teacher at a level beyond that of most other students were among the very significant informal signs of the student excellent-in-mathematics who was also excellent-as-such.

In Chapter 2 communities of people were described as sharing common interests and standards. The categories of students SEM, SEAS, and SEHB are just that - categories, not communities. They represent the informal, mental "slots" created by teachers, and to some extent by students, to describe individuals in the classroom who reveal certain personal characteristics, skills and abilities through their mathematics-related performances. The students themselves lack a sense of, and do not participate in the development of, a mathematics classroom community in any real, substantive way in the (regular) academic classroom. This theme will be pursued following Chapter 6.

CHAPTER 6
INTERPRETATIONS OF EDUCATION AND EXCELLENCE

Introduction: Conceptions of Education and Educational Excellence

Prakash and Waks (1985) identified four conceptions of education - the technical, rational, personal, and social - and their respective standards of excellence - mental proficiency, disciplinary initiation, self-actualization, and social responsibility. What follows is an interpretation of the teachers' and students' understandings of school, school mathematics, and success in school mathematics in terms of these four conceptions and standards.

In general, educational perspectives which could collectively be described as technical were most common among the teachers and students. Some beliefs were indeed suggestive of the "rational" conception of education, but this conception was more evident in the beliefs of some participants than others. The personal vision of education, with its aim of self-actualization, was also evident, but to very limited degree. Again, it represented the views of some more than others. The strong concern for social responsibility, as espoused in the social conception of education, was essentially not present.

Regarding the Four Standards of Excellence

Excellence is an expression of exemplary qualities or performance; the interpretation of beliefs and actions as being consistent with a particular educational perspective does not necessarily imply educational excellence within that perspective. What might we expect to "see" in terms of qualities or performances that meet the four different standards?

Excellence as mental proficiency would be significantly marked by consistent success on tests such as were typically administered in Mathematics 30 and 31, and the Diploma Examination. Thus it was possible to achieve "technical" excellence in mathematics at Fairfield, and indeed, given the dominance of this conception of education, it could well be the most common form of student excellence in mathematics.

Excellence as disciplinary initiation would be signified by exemplary work on mathematics projects and presentations (the focus of which was the mathematics itself), on mathematical proof and problem solving (routine, and especially non-routine)), and achievement on mathematics examinations. These examinations would test for basic skills, knowledge, and routine understanding, but they would also extend substantially beyond this level to non-routine applications and problem solving. Again, other forms of assessment in addition to tests would figure significantly in the total formal evaluation of the student's initiation into the field of mathematics.

Some participants claimed that present tests do sometimes extend beyond basic skills and knowledge, but the number, and non-routine nature of these extensions is limited. In addition, these tests represent the sum total of graded forms of student evaluation.

Excellence as disciplinary initiation in mathematics would also be signified by student initiatives in independent study, by informed questioning and discussion with teachers and others regarding the nature of the mathematics at hand, and extensions of this mathematics, and by an interest in solving mathematical problems. Other qualities, such as regular enrollment and at least moderate success in mathematics competitions, and a willingness to help others in mathematics may also be evident in those meeting the standards of excellence in mathematics initiation.

This discussion has focussed on the individual in mathematics, and does not address the level of the mathematics course, or program. Without a program that reflects an academic rationalist view of education, the student is confronted by a significant barrier. As we have seen in Chapters 4 and 5, the structure and intent of even the Academic program (Mathematics 30 and 31) is not designed for initiation into the field of mathematics. Students are substantially on their own in such an endeavour. Based on participants' interpretations, the IB program appears to have been developed with these disciplinary interests more in mind, and judging from some of these interpretations, IB mathematics is likely where those who meet the standards of initiation will most commonly be found. These students are among those "excellent-in-mathematics."

Excellence as self-actualization cannot really be identified within the limits of mathematics. A possible exception is those students for whom mathematics is their central intellectual focus at this time in their personal growth. In this case "disciplinary initiation" is really the standard. Otherwise, the place of mathematics study must be seen in the broader context of students who are actively and earnestly engaged in activities leading to personal growth and in which mathematics' knowledge and skills are critical elements. Mathematics study is pursued in the name of goals other than gaining understanding of the field for its own sake.

Clarity of purpose and a strong sense of positive, personal direction would be markers of personal excellence. The relationship of mathematics study to personal goals and other studies or activities would be known and could be articulated. It could be argued that it is sufficient to have a general "sense" that mathematics study will be personally valuable in some as yet unclear way in the future - a position not unlike that taken by some students in the research. The unfocused character of (a) what mathematics is studied, and (b) why mathematics is studied is problematic for sustaining this view as completely consistent with personal relevance and self-actualization.

Excellence as social responsibility would be signified by exemplary "critical" work in mathematics study in ways suggested by Mellin-Olsen (1987) and Skovsmose (1985), for example - demonstrating critical competence, critical distance, and critical engagement. The latter would, and should, mean active participation in projects involving current, relevant (local) issues in which the use of mathematics as a tool for analysis and understanding (and potential resolution) of the situation is vital. Learning "basic" skills and knowledge would still be necessary, but the critical social contexts in which the students learned and gained ownership of the mathematics are vital to maintaining the integrity of this conception of education. Thus, mathematics tests, and success on them, might be a partial basis for ascribing excellence to the student, but far more significant would be the degree and nature of the personal and cooperative development and use of the mathematics "tools" in the service of actively addressing the social issue at hand.

As stated above, instances that are indicative of a particular conception of education certainly do not imply that the standards of excellence within that conception have therefore been met. Given the nature of school mathematics education at the Academic level, student opportunities for reaching the standards of excellence consistent with rational, personal, and social perspectives are very limited within the context of the formal educational program.

The IB program may offer some opportunities for students to demonstrate excellence in the process of disciplinary initiation, and perhaps, of self-development. Much depends, however, on how the students are evaluated and how the classes are structured, on the reasons why the student is in the program and in mathematics, and on what the student sees as the meaning of mathematics study in relation to other aspects of his/her life, present and future. This is particularly so if one is to feel that the individual is engaged in mathematics study in ways that reveal a well-developed sense of self, and self-in-community.

Markers of Conceptions of Education

The Dominance of the Technical Conception

In Chapter 4, teachers' and students' views and beliefs about school mathematics, mathematics teaching, and the purposes or values of studying mathematics were presented. Chapter 5 included an exploration of the prevailing measures of evaluating students' mathematics achievements - tests. I described what teachers and students perceived to hold true about the tests, and what was necessary to have consistent success on those tests.

In the sections that follow, I offer evidence suggestive of all four conceptions of education. However, markers of rational, personal, and social conceptions of education need to be understood as generally embedded in a dominant, technical educational matrix.

The system itself must be seen as predominantly technical in the Prakash and Waks (1985) sense of the word. The structure of senior high school, and senior mathematics, with its streaming, its attention to "basic skills," and its evaluation focus - is indicative primarily of this educational perspective. It has given rise to a view of mathematics as closed, as dominated by teacher and text presentations of "concrete" formulas and algorithms, and as a preparation for "something else" - principally post-secondary education/training and a career. Most students did not appear to take "possession" of, or appropriate, the mathematics knowledge as their own, and most of them acknowledged little responsibility for how that knowledge might be used or for how it might inform their lives. The meanings of mathematics study were often unclear for participants, and the Nash and Ducharme (1983) portrayal of education as essentially the accumulation of potentially marketable skills seems an appropriate description.

However, one sensed a desire on the part of a least some of the participants to see mathematics study as more than marketable skills. Sensitization to mathematics itself, and to learning and mind development through mathematics are examples of this desire. Nevertheless, these desires seemed to go substantially unfulfilled.

Some Markers of the Technical Perspective

Having remarked on the general preeminence of the "technical" education orientation, especially in terms of a vision of senior mathematics, I offer some specific instances of technically oriented secondary education. Some of these cases reveal that educators and students seldom hold views that place them entirely within a single educational interpretive framework.

A: Concerns for Losses in the Academic Program

Structural features of the educational program such as streaming and formal course content are beyond the control of the individual teacher. Over time, changes in these two aspects of the system had taken place about which the teachers personally expressed some concern. Still, their pragmatism led them to accept and adapt to the changes.

Those who hold to a conception of education consistent with the technical view have a concern for the quantity and rigour of content covered. As Slaughter (1985) notes, the more liberal rationalists also have a strong sense of disciplinary rigour and content. Concern for their "watering down," or dilution, in terms of depth and breadth of content, may be taken as an indication of the technical or rationalist perspective. One must understand why there is concern in order to see which perspective is favoured.

Streaming is essentially indicative of a technical view of education. This structure was considered necessary by the teachers in a public, composite, high school in which students with a wide variety of apparent mathematics abilities and interests were enrolled. With Fairfield having four mathematics program streams, it was the educator's objective "to get the student in the <u>right</u> program, and then, to succeed in the program that he's in" (Coleman 4). The mathematical abilities necessary for at least moderate success in each stream were substantially different, and the teachers had experience with students in the past who had done well at one level, and then had struggled badly at a higher academic level of mathematics.

The value of the streams apparently had been reduced somewhat by a weakening of standards for entrance, particularly to the Mathematics 10-20-30 stream. Students with seemingly minimal requirements for registration were in this stream. Tilson and Coleman were both practical, and claimed they governed the level of instruction according to the students in their classes because the principal objective was to get these people through the course (Coleman 5; Tilson 5). Still, as Len Coleman stated,

> I think there are far too many kids who are in [Mathematics 30] who shouldn't be in the course. My personal opinion of the way it <u>should</u> be is, is that there should be a clear distinction between streams of mathematics, and ... we should have far greater standards - which would allow the kids to register for the course. Basically, the way the situation is now, anyone can take Math 30 with very minimum accomplishments and prerequisites. This was never the intent when they set up the streams, but unfortunately, it's changed into that. (Coleman 5)

Len Coleman's statements indicate a concern for what he sees as the general academic decline of the Academic Mathematics stream: too many students of apparently limited interest or ability in mathematics meant a loss in the mathematics quality of the courses. Frank Tilson felt similarly. Although he generally supported the Diploma examination, its introduction and his feeling that the Department of Education was trying to make Mathematics 10-20-30 for everyone were at the root of Frank's concern. Time was now at a premium (5).

> Back [before the Diploma examination] ... we took much more material; we took complex numbers, we took probability, ah, we took combinations and permutations, and as the Diploma exam came along, they cut out more and more material.... Yes, of course it is [a disappointment]. (Tilson 5).

...you know what's happening over the years? It seems to me, the Department of Education is watering down the mathematics program more and more [at all secondary levels, including junior high] (Tilson 5).

...the Department of Education ....They're the ones that are pushing us towards - less academic excellence. (Tilson 5).

...Math 30 is the outcome of Math 10, 20 as well. So, if you're going to do more in 30 you have to give them a little bit better background further down.... You've got to go all the way back.... Instead of "going forward" and doing less and less, we should be doing more and more, somewhere along the line, I think.

Now, you see what they're trying to do with this less and less bit is, I think, they're trying to make ... mathematics for everybody. And, ah, if you go back to when we were educated, mathematics wasn't for everybody. See, so what we're doing is we're making that melting pot bigger and bigger and getting more people into it, and consequently the material that you can cover with most of them becomes lower and lower.... Whether that's good or bad, that's not for me to say. (Tilson 5).

These Coleman and Tilson passages signify aspects of a technical or rational educational perspective. What of these two possibilities? As rationalists they may have been concerned about the reduced possibility for a fuller engagement in the field of mathematics for any students, that is, now no students had an opportunity to explore the field in any depth in the Academic stream. On the other hand, as technically-oriented educators their concern would have been for the reduction in quantity of mathematics content covered and an implicit loss of distinctive standards in the academic streams. More and more students were enrolling - were being required to enroll - in Mathematics 30, and forcing the reduction.

Seldom do an educator's beliefs fall strictly within a single conception of education. Aspects of Tilson's and Coleman's outlooks or beliefs about the nature of the Academic mathematics program support a rational conception of education. However, the dominant tone of the teachers' concern for the loss of distinctiveness among the streams and the loss of content appeared more consistent with a technical orientation to education. The rational view is concerned with content, but more importantly, it is the nature of the engagement with that content that is critical. A desire to cover more content, or regret at the loss of content, does not necessarily signify a "rational" educational perspective. One senses the concern is primarily with a loss of mathematics content - fewer topics, less depth - and not with a reduction in teaching strategies and student activities. Furthermore, at the high school level, the intent of a liberal rationalist conception of education is to fully engage as many students as possible with mathematics, and is not supportive of general streaming.

B: Emphasizing the Instrumental, Utilitarian Value of School Mathematics

The technical view of high school education as a product with instrumental value, serving largely societal and personal economic ends, was implicitly or explicitly expressed by all participants. It was evident, for example, in Tilson's view of the general goal of school mathematics as a preparation, in Coleman's view that students may need to use their high school mathematics in some way in the future, and in all of the students' claims that having taken Mathematics 30 and 31 would increase their future study and career opportunities. Of course, the teachers also saw themselves as participants in the general education of youth, providing them with knowledge of an important field of human endeavour.

The instrumental value of a high school education to serve economic ends was particularly strong for some students, like Darren, whose dominant aim was to have a career in a high-paying, well-respected field. He speculated that the ultimate measure of short-term excellence as high marks may well be the extent to which these marks helped one realize long term career goals.

C: Emphasis on Marks

The technical perspective is marked by a concern for an efficient means-ends relationship between school processes and student outcomes. A major measure of success is high scores on achievement tests. At Fairfield, and the district, course grades were the principal item to be reported on district report cards (see Appendix F). Preparing students to achieve to the best of their ability on the Diploma examination was the expressed goal of the Mathematics 30 teachers, whether or not they were pleased with the apparent dominance of that goal. Consistently good performance on tests was, for all participants except Adam, a necessary mark of the student excellent-in-mathematics and the student excellent-as-such. IB students, as they were perceived by some participants (e.g., Jan, Darren, and Sarita), were exceptionally concerned about every percent of their grade. Marks were subject to student and teacher variables, but most students believed marks were meaningful indicators of what they knew of the tested topic.

All of the students, even those such as Jan and Yee who expressed an interest in learning as well as being successful on tests, and those such as Adam who questioned the meaningfulness of marks as a measure of excellence, desired high marks because they saw them as necessary to secure employment or to continue to post-secondary study. Adam spoke of this as signifying two levels of meaning for marks - ability and credentials - the second more meaningful for him than the first. Jan remarked that while good marks were required to gain admission to university, they were not necessarily a consistent predictor of strong performance in university. Students were not completely happy with the great reliance that had been placed on marks by others in society, but they saw no alternative at the present time (e.g. Jan 2; Darren 3; Sarita 3). The teachers felt the same way; until there was something better, marks were the only relatively objective way of labelling students across the province for comparison purposes (e.g., Tilson 5). At the same time, in their classes, marks represented a motivational "carrot," a reward for effort and hard work by students (Tilson 5).

The external significance of marks tended to place students in a position of tension. For example, on the one hand Marie (3) found mathematics repetitious and monotonous. It was a struggle to consistently study and practice mathematics. On the other hand, when she did study she had some success in the subject, and the good marks she received were a strong inducement to continue the struggle.

D: Limited Time, Diverse Abilities, and an Expectation of Teacher-Directed Learning

At Fairfield time was very much an element of the teachers' and students' school life. The daily routine of sixty-four minute periods was a major factor in structuring events and human actions. For example, as mathematics Department Head and IB Coordinator for the school, and with twenty-four out of thirty periods per week to teach, time was critical for Frank Tilson, and his day was highly structured.

The need to prepare students of diverse ability and interest for the Diploma examination, and leave substantial review time at the end of the course, also meant, according to Tilson and Coleman, that there was no time in Mathematics 30 for anything other than teaching and evaluating the "basic skills" defined in the curriculum objectives. In Mathematics 31, the students as a group tended to have greater mathematics ability and interest. Still, the increasing presence of students with marginal abilities limited the time available for doing "interesting things" beyond the content-oriented curriculum.

"Time" also influenced the nature of instruction. A common form of teaching - described by Frank as "spoonfeeding" - was considered to be quite efficient. It was also a style of mathematics teaching with which the students were very familiar. There was little time to adequately orient students to any other form, and to change was likely to court serious problems.

Students had come to expect mathematics instruction to take this particular form of direct instruction. They had also come to expect that mathematics evaluation would primarily take the form of test questions that mirrored the basic skills and concepts-oriented textbook questions. Learning the formulas and algorithms, and when to use them, would consistently yield success. For many of the students any desire to see classroom instruction and evaluation change to include more extensive, open-ended problem solving, for example, was limited because of the potential harm to their marks (e.g., Marie 2). Darren (e.g., 5) was adamant in his demand that teachers in a subject like mathematics not teach anything or in any way which would not be of direct value to his successful completion of the course. In Mathematics 30 students were pleased that the teachers were going to be able to provide ample time for review for the Diploma exam. They purchased the Edge booklet of past tests to help them prepare. The standardized Diploma examination itself was a major element in establishing the dominant technical perspective.

B: More Content, Fewer Curricular and Extracurricular Options

Yee's position (5) that the school should have devoted itself more exclusively to the academic aspects of education by reducing or eliminating the "easy" courses and the extracurricular and social features in the school, and that mathematics classes should have reduced the time devoted to individual seatwork, was largely, but not entirely, a technical educational outlook. These courses or activities reduced the time available for academic study or for covering content in class. They thus undermined curricular planning and instruction, and reduced students' proficiency in mathematics. These are features of education which figure more strongly within a conception of education that is technically oriented.

Still, although Yee yielded to the teacher as authority and believed that she could learn only through the direction of a teacher (a "technical" perspective), she wanted a more challenging Mathematics 30 (within limits), with a faster pace and questions and activities that tested one mathematically. Her position is similar to that of teachers Tilson and Coleman in their regret at the academic decline of Mathematics 30. Yee's vision of secondary <u>mathematics</u> education, therefore, is certainly shaped in part by a rationalist conception.

<u>F: Valuing Individualistic Competition</u>

Some competition among students occurred in all observed classes, although it appeared to be low-level in terms of intensity and involvement. Darren described the atmosphere in his Mathematics 30 class as "quietly competitive ... you're always trying to do better than anyone, but you're not letting them know that you're trying" (4). Some IB students seemed keen on marks competition, and this tendency was evident in former IB students Sarita and Adam in the Mathematics 30B and 30A classes. Sarita said that when another student taking the regular Mathematics 30 course for the first time received a higher test mark than her and a few of her friends who were repeating the course after having taken Mathematics 30 IB, it "drove [them] up the wall. It's almost like we can't take it" (4). They were shocked that they had "lost" to another, and spoke disdainfully of this person as though he or she was an interloper in the small circle of top students in the classes. They were the former IB students who were also studying the material in class for the second time; they should always do really well on tests. Still, Sarita said, they were unwilling to devote much of their own time to studying mathematics (4).

Adam considered it natural for human beings to want to compete (5). He described taking up a "friendly competition" with some of the students sitting around him in some classes in order to help alleviate the "boredom" (2). It amounted to comparing answers after tests and having the students with the better marks "rub it in" to those who did not do as well. In the Mathematics 30A class there were two other nearby students who appeared to be on a par with Adam in terms of ability and achievement, and among these students the competition seemed designed to help in a limited way maintain good marks. This was also how he described his competition with another student in biology (5).

Other students with apparently lower ability in the subject were sometimes involved:

> ... we have a girl who sits behind me [in physics] ... and she doesn't do as well as I do, but she beat me two exams ago, and she just rubbed it in. I always rubbed it in on her, and you know, it makes them feel better that they can beat somebody who has a higher mark than them.... But anyway, I killed her on the next exam. (Adam 2)

Adam spoke in a similar way about a student in the Mathematics 30A class who had difficulty passing and who was also included in the "friendly" "teasing" and "kidding" (5). Adam hoped that it would encourage this student to do better.

What appeared as condescending and elitist seemed a perfectly natural form of student relationship for Adam. Building relationships on perceived ability levels was a significant means of understanding one's fellow students. Adam also believed that teachers could not push students to strive for excellence, but students could follow the natural human tendency to compete and establish their own "excellence areas of competition" in their different courses (5).

The IB class was potentially a good place for this "team" effect to occur. If the class, or a group within the class, could stay together long enough for the students to get to know each other, and work together to promote personal striving through individual competition, then greater achievement exellence could occur. Because the IB students stayed together year after year, and given the academic orientation of these people, the potential for this competitively based excellence was greater in IB. The chemistry among the members of the group or class had to be right, however. This chemistry was not right in Adam's former class, he said (5), and so the competition was not as strong, and the general levels of achievement were not as high as he thought they could have been.

Closing Comments

Much about the educational system was beyond the direct control of the individual teacher and the students. It was not the teachers who established the mathematics system of courses, evaluation, and requirements, of course, and they were limited to working as well as they could within it. The streaming, and the standardization of curricula generally and of evaluation in Mathematics 30, were established by the province. The structured form of reporting student evaluations was established by the school district. The focus on marks was long established, and governed by factors such as the wants and needs of post-secondary institutions. The course requirements of the various educational programs were not set by the teachers or the school but by the province and educators at the tertiary level, and by IB personnel. These factors were accepted by the teachers, however, and many were supported.

The technical conception of education dominated in the mathematics program. Within this orientation, Fairfield was in many respects attaining success, even excellence, in terms of standards of mental proficiency. According to achievement standards within the district, the school was doing well in comparison to other schools. The teachers pointed to a number of factors - Diploma comparisons, IB comparisons, parent perceptions, for example - to support beliefs that their mathematics program was providing students with a variety of levels of streams to match their abilities and interests, and that within those streams students were generally achieving to the level of their perceived ability. Thus the school was achieving educational excellence in its mathematics program in a way similar to that which Driscoll (1987) describes as streaming the students, offering challenging, non-traditional courses (i.e., IB) to the top students, and traditional but still demanding courses to those students who are average or below.

The Rational Perspective

The rational view of education, with its standard of disciplinary initiation, was evident, but not strongly expressed. It was most evident in qualifications to a technical outlook toward education. Reference to the "mixed" perspectives of participants was made in the previous section, for example, in discussing Tilson's and Coleman's concerns regarding the declining academic character of Mathematics 30. The rational conception is discipline (field)-focused, and is most evident in teachers' views of the IB program and Mathematics 31. This conception leads to those individuals the teachers and other students see as exceptional mathematics students. It is evident, for example, in Frank's hope that "we catch the few people that really have an interest in [mathematics], and nurture that interest so that they can follow it up, do whatever they have potential to do" (1).

A: Opportunities for More Students

The reduction in mathematics content that teacher Frank Tilson spoke of can be interpreted as a Department of Education "liberal-oriented" desire or requirement that as many students as possible should experience the same (academic) curriculum. Thus, while the "technical" view was evident in the provincial mathematics streaming, the rational conception was also represented in Frank's interpretation of provincial mathematics aims. The apparent consequent reduction in content, and perhaps in rigour, for all students was however, a departure from the liberal, rationalist educational perspective.

B: IB - An Initiation to Mathematics

On the one hand, streaming has been identified as a technical characteristic of education, and the IB program must be considered part of this streaming. For example, one might question what effect the presence of this program has had on the regular academic stream, in which the heterogeneous student mix has been somewhat reduced.

On the other hand, the IB mathematics program must also be considered as the single most clear opportunity in high school to explore the field of mathematics, and to lead students to think mathematically. To the extent that it did, it represented an initiation to mathematics that even the Mathematics 10-20-30 did not. This latter program appeared to be viewed more as a means of entry to post-secondary study than as a study in mathematics. Perhaps at best the regular academic program presented mathematics as the language of algorithms, or, as Frank Tilson described it, as a "tool" for (possible) use by students.

For Frank, the IB program was the one which "finally" provided a cognitive challenge to students of high ability, by providing the "right atmosphere, the right environment" in which to pursue their interests in mathematics (1). The IB program also provided Tilson with an opportunity to teach mathematics content not found in other high school courses (5).

C: Supporting and Encouraging Mathematics Contests

Participation in mathematics contests was another indication of a rational conception of education, and Len's involvement was an indication of his interest in aiding students to participate in the greater challenges these examinations provided.

> For those that are really interested in math/ The IB kids primarily are the ones who take part in these things. The ones that are interested in math, they really enjoy it. They get in there, and after the exam is over they argue with each other ... who's right and who's wrong. They're really keen about finding the results right away. It gives them a different sort of problem which they can look at, rather than the ones out of the textbook which are content-oriented, whereas the math contest-type things are a lot of questions which require more mental agility rather than course content-related sort of things. So, it's a different type of question and they get a big kick out of it. It's fun. (Coleman 1)

Sarita (5) believed that contest examinations were real tests of performance in the field of mathematics. Unlike good performance on class tests or even the Diploma examination, success on contests clearly signified mathematics excellence.

D: Bonus and "Conceptual" Test Questions

Classroom mathematics tests were checks to see if one had done his or her homework, and had been paying attention in class (Sarita 5). However, some questions (some required, some bonus) on most tests did require more thought, as the teachers and most students acknowledged. To the extent that these were of a problem solving, non-routine nature they represented a shift to the rational perspective from the routine-oriented questions of the technical perspective.

Coleman described some of these questions as including "a step beyond ... a little bit of application, something they hadn't seen before. But it's still based upon achievement, things they've learned in the last section" (5). Gordon said he liked the bonus question the teachers sometimes put on the test: "...it's not like any of the other ones, but you can use the principle or whatever you're studying" (2). Jan referred to many of these questions, often including the bonus question, as "conceptual questions, things that took more than the textbook; that you had to sit down, draw yourself a diagram, and think it out" (2). These were the harder questions that were more likely to better test one's mathematics knowledge and skills, Yee (2) said.

Gordon (5) noted that one seldom stopped to look over and feel a sense of satisfaction from correctly answered routine test questions. One tended to look only at the errors and the loss of marks. In contrast, he thought, the satisfaction of answering conceptual or bonus questions might lead one to spend more time reflecting on the nature of the problems and what one did right.

This shift in educational perspective was limited, however. First, there were few such questions on most tests. Second, some of these questions tended to be "tricky" (Gordon 2), and were more significant for their need to be read carefully to avoid the "silly mistake" than for the mathematical problem solving challenge they represented (e.g., Tilson 2; Sarita 5). Third, the students viewed these questions as special, and most preferred to leave them with this status. While correctly answering these questions might produce a special feeling of satisfaction (Jan 2; Darren 4; Gordon 5), students generally did not want to see their use expanded, fearing that their marks would drop (e.g., Darren 5; Marie 2). Yee, who claimed that IB tests were more difficult and challenging, was one who did wish that regular Mathematics 30 examinations had tested a person's ability more fully by including far more "bonus-type" questions (5). But she, too, expressed some concern about a potential drop in marks. Some students speculated that teachers might also have the same fears.

E: Knowledge as well as Marks

A dominant image of education technically conceived is that of "getting through." Marks are an outstanding feature of such an educational vision. They were a concern for all students, and some, such as Darren, wanted the teacher to focus entirely on the Diploma examination requirements. Still, a secondary image of education, one rooted in a desire for knowledge, motivated some of the students (e.g., Marie 1; Gordon 3). This intrinsic valuing of education may be interpreted as compatible with a rational, "liberal" - and perhaps "personal" - view of education. It was Gordon's belief that

> I want to pass, but ... I want to do it for me. Like, for my knowledge.... so I can feel good about it, and I can feel I can do it, but I want to know it good enough so I can get high marks on it. Like, I'd say I'm more on the (part-?) for the knowledge. With the knowledge also comes marks, OK. I would think. (Gordon 3)

Students Adam and Jan were other examples. Adam claimed he was repeating Mathematics 30, in which he had received a mark of 55% the first time, not to improve the mark but to learn the mathematics (2). His first teacher could not teach, he said, so he did not learn (1). Jan was the student who most spoke of a desire to learn. When asked why she had returned to school for a fourth year to obtain an Advanced Diploma, she replied, "it's partially because I love learning, I just want to learn, I want to know things, I want to be able to go to university and take any course I want..." (1).

F: Mathematics Study as Mind Development

Some participants also valued high school mathematics study for its "mind development" qualitities. This represents a "development of cognitive processes curriculum orientation" (Eisner, 1985) that fits with a rationalist view. The participants' beliefs are the significant element here, and not the degree to which mathematics study does develop the mind, a claim which remains in question in the research.

This belief in the mind development ability of mathematics arose partly out of the perceived lack of concrete applications of high school mathematics, except as it may be necessary in later studies or a special career. Even if one was not going to actually make use of this mathematics later, its study still had personal, cognitive development value. This was a position that past teachers had put forward to the students as an explanation for having mathematics in school.

Darren, whose general educational perspective was largely technical in nature, stated, "I do think it's mind development, most of it. You're working with new abstract ideas ... this is ... forcing you to think. Some of the questions you're applying past knowledge, or ... new knowledge, or, anything like that" (4). Said Marie:

> I was told that ... maybe you won't ever use it again, but it just teaches you how to learn things, and, um, it works your brain. I really think it does ... and sure you won't maybe use it exactly how you used it in class, say, but I think somewhere down the line you're going to come in contact with it again somehow.... (Marie 4)

Jan expressed similar thoughts:

> I think the way the schools put it is, the reason they teach you all these things is to train your mind to learn. Not so much so that fifty years down the road you remember how to do conic sections, but so that fifty years down the road you will still have a desire to learn, you'll still have a desire to go to the library and read up on things, watch the news, watch what's going on, read scientific books or magazines, or whatever's out at the time, have intelligent conversations with your peers. That's what my teachers tell me anyway.... Yes [I accept that]. I like to learn. (Jan 3)

The extent to which school mathematics study actually contributes to this mind development is open to question, especially given the emphasis on routine methods and formulas that characterizes much of secondary mathematics.

Closing Comments

One can identify a number of isolated indicators of a rational educational perspective. These were limited in scope and in their expression, however, bound as they were within a generally technical conceptual framework of education. Some were quite speculative. The value statements may have been of a rational orientation, but a significant test of their fruition, the kinds of activities students engaged in, and the form of evaluation, was not met. Opportunities for mathematical thinking, as described by Driscoll (1987), Gordon (1978), Mason (1985), and Solomon (1986) were very limited in high school Mathematics 30 and 31. With the possible exception of some of the special test questions that involved "more thinking," mathematics evaluation was one of checking "mental proficiency." A program capable of having students achieve levels of excellent performance in terms of a standard of disciplinary initiation was incompatible with a high school system designed to match students to streams in an effort to get them through with some success and prepare them for some range of possible future opportunities.

The Personal Perspective

Signs of a personal conception of education and a standard of self-actualization were very limited. The structured, mandated nature of schooling was largely antithetical to this conception. As Bloom and Sosniak (1981) note, the high school curriculum "is intended to give all students a well rounded education" (p. 92). For example, schools are organized on the basis of a rotary system of closely scheduled courses, and are generally not structured for personal talent development. Schooling, and school mathematics, were interpreted as largely preparatory to an individual's personal development. The items that follow are often incidental to formal school structures and courses. In some cases, they represent an individual's attempt to personalize the impersonal education process.

A: Tentative, Limited Systemic Signs of the Personal

It may be argued that streaming, perhaps especially with the addition of the IB program, offered opportunities for the individual student to pursue his or her own personal interests, and there is some validity in this argument. However, the restraints on personal directions were considerable, illustrated, for example, by the requirement that one must pass Mathematics 30 (and Social Studies 30, and English 30) in order to obtain an Advanced Diploma, a highly desirable certificate if one wished to pursue post-secondary study. Continued success in mathematics was described by students as confidence boosting, but the liberating experience (Gordon, 1978) was not evident in those typical mathematics experiences even successful participant students had with the subject.

B: Seeking a Balance between the Academic and Social Aspects

Some isolated indications of a personal conception of education were evident, for example, with student Jan, who particularly liked to "learn." "The whole planet's an education system," she said, "it's not just the school" (5). Students whom she believed were capable of succeeding in the IB program did not enroll full time because that would have meant being unable to take part in other non-academic school and outside school activities. Jan (3) felt strongly that Fairfield should have stressed the extracurricular opportunities it provided (and offer more), as a balance to the emphasis on academic course study. (Note the contrast with Yee's vision of schooling.) Students should have been encouraged to participate in the clubs and programs, and in the school's special social activities. The following excerpt illustrated Jan's position:

Jan: You're trying to put a division between social activities and academics. You're saying/

I: And you're saying that there is no division. Is that what you're saying?

Jan: Well, I'm saying they should work hand in hand, they shouldn't/ You're saying that there's a conflict; I'm saying there should be a cooperation.

I: OK, but I/

Jan: I'm saying they should be related in a way where you're doing well in one area, you're doing well in the others. Not that it takes away.
(Jan 5)

The "personal" concept of education does not necessarily imply educational balance, and therefore Jan's call for a balance between the academic and the "social" - which included such extracurricular activities as choir, the chess club, and the debating club - was not completely compatible with this educational orientation. However, her position was taken within the limits imposed by the structure and requirements of school. The clear expression of a wide variety of endeavours being potentially equally valuable to the development of the student as person was certainly in keeping with standards of self-actualization.

Jan believed in the need for greater balance, but at the same time she acknowledged that at the high school level there was a great competition for the student's time and attention (5). Other students also spoke of the struggle they had in attempting to achieve this balance in their life (e.g., Darren 5; Gordon 5; Marie 2).

C: Personal Development in Mathematics, not Competition with Others

Another isolated example was Yee's claim that she did not care for competition with other students, but rather the aim was to "just do it as best as you can," as she said she told another student (4). But this statement has to be understood in the context of an individual who late in the term was exceedingly bored with the regular mathematics she was repeating. She had reached the point of claiming not to be interested in marks (although she said she "needed" marks, and she was still getting grades in the eighty to one hundred percent range). She felt she was being "bugged" to compare marks with a student who had also been in Mathematics 30 IB the previous year. She had been more competitive in the IB courses, she said (5).

Notwithstanding the above qualifications, the notion of striving to improve upon personal past achievements rather than the achievements of others is compatible with a conception of personal development and self-actualization, provided that the area of achievement was one which had substantial personal relevance of the individual. (One is reminded here of Aoki's (1990) call for a return to the original meaning of excellence, Branton's (1979) champion, and of the concern for such a vision of excellence expressed by Stanic and Reyes (1987).)

D: Personal Character Development

Some of the habits of students valued by mathematics teachers - persistonce, self-responsibility and self-discipline, setting and working to achieve a positive goal - were attributes which Greene (1984) describes as valuable to one's personal development. However, a goal of striving for marks for their instrumental value in terms of later opportunities was not a sign of being in touch with oneself, which is the mark of a good learner in a personal educational perspective. Nevertheless, if in the process of successfully getting through the mathematics course one enhanced one's personal qualities, and one became a better person for it, then it can be said that the mathematics course, and the standards for passing it set by the teacher, have contributed to personal character development.

Closing Comments

Teachers Frank Tilson and Len Coleman, in responding to the requirements of the Department of Education and their school district, and to the needs of the diverse students, believed they simply did not have the time to devote to extra nuturing of those with talent in mathematics beyond what they could provide in the class setting.

Within a personal relevance conception of education, disciplinary study is valued only insofar as it contributes to an individual's general development. Clearly the major focus of secondary public schooling, especially at a school like Fairfield which fostered the perception of being academic, was just that - disciplinary study. The school did offer elective study in art, music, industrial arts, and drama, for example, and it did offer a variety of extracurricular possibilities - sports, clubs, social activities - but relatively speaking the options were limited and the restrictions substantial in terms of the possibilities within this educational perspective.

Presently there is really very little opportunity to participate fully in an education that promotes self-actualization. The system is pre-personal; only in post-secondary education, or perhaps extra-secondary education contexts, are there significant possibilities for personal choice of endeavour. Some do not see secondary school as the place for extra-academic pursuits, while others see academic and extra-academic endeavours as distinct and necessary poles of life activity, competing for the students' time and interest, and needing to be balanced. The integrative link between these endeavours still appears tenuous; only in limited cases (e.g., Jan) are they seen to have real symbiotic potential.

The Social Perspective

There was no critical dimension to school mathematics as, for example, Frankenstein (1983), Gordon (1978), Mellin-Olsen (1987), or Skovsmose (1985) describe it. Mathematics knowledge itself was unquestioned. The focus was on the individual student making his or her way educationally, in terms of a career, and so on, with no visible evidence of a formal concern for "responsible social action" (Prakash & Waks, 1985) other than a general hope that students develop as productive citizens. A mark of much of high school mathematics was its apparent lack of application to everyday life, and the social world.

In the social conception of education, the instrumental value of mathematics is of considerable importance, and at Fairfield (and in the system as a whole) the instrumental value of mathematics as potentially useful was clear. School mathematics knowledge was identified as a "tool." However, the mathematics of the observed classrooms (and the system's intentions for mathematics) did not include its use as a "thinking tool" (Mellin-Olsen, 1987), as a "tool for analysis, understanding, and action" (Eisner, 1985). The basic skills orientation of school mathematics was not concerned with "controversial issues" (Eisner), or indeed any of the social issues of the day. (The various evaluation instruments also discouraged this focus.) The possible uses of mathematics as a tool were left to be established by the future needs of individual students. Therefore, any student critically applying his or her mathematics knowledge for purposes of social action would have to do so in an informal, extra-mathematics, extra-curricular, context.

A: Cooperative Support among some Students

The cooperative relation between some students, and the value it appeared to have for those involved, should be noted as personal responses to the nature of education in the school system. Competition was described earlier by some participants as a means of fostering excellence, and the literature has described the mathematics class as quite competitive. Jan and Marie provided two examples of mutually supportive relationships that could also foster achievement. Marie had a girlfriend with a similar achievement level who was also in grade twelve (but not in Mathematics 30A). They studied together when they could, they discussed courses and grades, and they provided support and encouragement for each other when results were not good, and congratulations when they were good (2).

Jan spoke of forming a Saturday morning partnership with another girl in her Mathematics 30 class in April to prepare for the June Diploma examination. They could work on problems together, and discuss any problem areas they had while reviewing (5).

One could speak of these cooperative unions as small examples of "individuals-in-community" (Nathanson, 1974). They were formed through the initiative of the students, however, and not in the formal context of the mathematics course. These actions were responses to the impersonal, individualistic nature of senior secondary education. These actions also have as their primary goal mutual support in the process of "getting through." Thus, while the interpersonal qualities of communicating and working with others are developed, the standard of socially responsible action met in the interests of the common good of the community cannot be invoked here. The interpretation of these actions as indicators of a "social" conception of education is therefore limited.

Closing Comments

The fact that the "social perspective" was not in evidence in any systemic way did not mean that the teachers did not care whether or not the students acted in a socially responsible way. On the contrary, the teachers hoped that in the process of studying for success on mathematics tests the students would learn valuable lessons in responsibility and self-discipline. Strong personal development is still important in the social educational conception, but it gains its importance in terms of the "individuals-in-community" (Nathanson, 1974), or in the "community of ends" (Prakash & Waks, 1985). It was evident that the teachers felt it was not part of their professional mandate to incorporate a social issue focus into their efforts to teach the content and skills necessary to meet course objectives, and prepare students to pass examinations. One result of this (traditional) approach was that students were generally passing the tests (and were happy for that), but felt little connection to mathematics or to its use in the broader community.

Summary

The school mathematics community of Fairfield can claim substantial success in achieving educational excellence within a technical conception. The structures of the district (and the provincial) public school system are oriented to this conception, and so to achieve some degree of programmatic (and school) excellence according to standards of mental proficiency implies that the school mathematics community has reached a valued position of esteem within the provincial educational community.

The achievement of excellence within this conception generally precludes excellence at the program level within the other conceptions, however. Individual students, through very significant personal accomplishment may reach excellence according to the various standards, but the structures of the program, the school, and the system are not generally supportive. Only some achievement in terms of disciplinary initiation in the context of the IB program seems possible. The regular academic courses, which are of principal importance in this study, are not intended to initiate students into the field, or to make students significantly aware of the social importance of mathematics. Those for whom mathematics is a meaningful area to pursue personally in greater depth may enrol in the IB program, but the general school structures are very restricting in terms of the freedom to pursue a wide range of personal interests.

The next chapter will examine the relationships between the interpretations of the conceptual orientations of education at Fairfield made in this chapter, and the teacher and student visions of what constitutes an excellent student in the mathematics classroom developed in Chapter 5. The individualistic character of the technical orientation will especially be considered.

CHAPTER 7
RENEWING EXCELLENCE

Introduction: Acknowledging Success in Context

In this chapter I reconsider the meanings of excellence that seem to dominate in a senior school mathematics academic classroom. I consider some of the tensions that exist in these meanings. I draw upon expanded conceptions of excellence in Chapter 2, especially the notion of "community," to discuss in general terms how education in the (mathematics) classroom might be different.

Some aspects of this chapter will appear as a critique of existing mathematics educational practices at Fairfield. It is very important to acknowledge the context of the school and its teachers and students. They are part of a system of secondary education which has largely defined the parameters that constitute success for students, and consequently, for teachers. Within this system, Fairfield, the teachers, and the students have achieved a significant degree of success and recognition for that success, and this must be acknowledged.

Excellence: A Difficult Notion, Grounded in Tension

"Excellence" in the school context seemed a somewhat elusive notion for the participants, and giving the term fullness in discussions was difficult. What did it mean? Perhaps Lightfoot (1987) was right - excellence had a history of restricted meaning, and therefore was too limited to use in the context of a high school - albeit academic - mathematics program. (The regular academic senior mathematics program will be the principal focus of the discussion in this chapter.) Perhaps it did not let enough in. What was it that the notion did not let in? No single definition was adequate. A "definition" would leave much out, yet it seemed difficult to describe what would be omitted.

Students

In the mathematics class the notion of excellence first brought to mind the question of achievement. What was meant by achievement? Typically it meant mathematics achievement on tests, signalled by correct procedures and answers, and resulting in high marks, but that alone apparently was too limiting. For the students, achievement was important, but the meaning of the term varied. Achievement levels (grades) might mean nothing unless one knew the context in which the tests were written. Or perhaps, in the case of personal goals, achievements below accepted "honours" levels might mean excellence if those goals were realistic, and consistently met. For others, excellence could only be reserved for those with the very highest grades - and there was always someone with higher grades - and thus they were never willing to put themselves in the "excellent" category. Perhaps in some restricted, or relative sense of the term, one could venture that one had personally reached some degree of achievement excellence. But was even this really legitimate? Was it honourable to declare oneself excellent? There were always qualifiers when it sounded like one was making a final statement about one's own state of perfection in school mathematics.

Excellence was a concept based upon comparison and the element of difference. One could claim that few others were excellent, and indeed, most others in the class seemed not to do as well as oneself when it came to doing mathematics, but the final step of stating, even modestly, that one was excellent, was difficult. (In any event, claiming personal excellence might lead to being challenged to prove that it was so.) Students, like others, do apply standards, and make moral judgements about themselves and others when it comes to mathematics excellence: consider, for example, Adam, who questioned the excellence of hard workers, the former mathematics IB girls Sarita and Yee, who could not justify personal excellence in light of having seen math-excellent IB students, and Darren, who identified excellence with marks, but who was disgusted with the "mark mongers."

Perhaps they all were right; perhaps none of the student participants was really excellent in mathematics. Still, the notion of "technically-oriented" excellence smacked of elitism and bragging if one applied it to oneself in the context of mainstream academic schooling. It was announcing that one was a "Somebody." It was perhaps better if someone else described you in those terms, but even in the context of an "academic" school like Fairfield, where students claimed that it was "O.K." to openly study for tests and get good marks, the "stigma of excellence" did seem to have a presence. Being "good at" mathematics meant being "able to do it" in class work and on tests, and that was personally reassuring and confidence boosting, but announcing even privately that one was excellent, which set one apart from the majority of students, was problematic.

Teachers

Teachers also found the notion of excellence restrictive, if it meant high achievement alone. Teachers cared about students as humans, and felt a need to informally honour them for things other than high marks. They created categories that expanded the scope of "fields of excellence." Human or personal qualities developed in the pursuit of achievement were important. One could grudgingly grant a student the label of "excellent" on the basis of consistent achievement when there was no interest or effort shown on the part of the student, but this was not personally rewarding for the teacher. Furthermore, high mathematics achievers in the regular academic mathematics stream were not that common. While preferring to limit excellence to include mathematics achievement in its meanings, teachers also wanted to acknowledge "studentness" in the notion of excellence.

What is more, distinctions between personal and program excellence in mathematics were important. Thus, as Len Coleman indicated, if excellence meant students attaining high achievement levels in mathematics (getting over 80%), that was not compatible with the notion of general secondary schooling, and was not what the mathematics program, including the academic stream, was about.

Programs such as IB mathematics were set up in part to provide opportunities for the development and demonstration of such personal mathematics excellence (the SEMs). It represented an attempt to shift from a technical to a rational educational orientation. But with its introduction it seemed to have heightened the sense of division within the educational structure: the increased focus on disciplinary initiation stood in contrast to the principal focus of "getting through" in other programs, where mental proficiency was the standard. The teachers appeared to believe that one could really only hope for mental proficiency in academic courses such as Mathematics 30, which were designed for the general student body. The existence of the IB program seemed to strengthen this belief.

If excellence had a place in the dominant provincial senior educational streams, it was (a) in programmatic terms a belief that a large proportion of students were working near, at, or even beyond personal ability levels, and thus the average class mark was good and (b) in personal (student) terms a belief that there were students performing excellently as students. Of these two, given the range of student abilities and interests, the programmatic view was the more practical to consider. Ability was an innate characteristic, and there was little that one could do to change that. The meaning of being a teacher, wherein lay one's instrumental goodness, was in feeling that one had done the best one could with the students one had been assigned; that is, the students were achieving "up to their ability."

Secondary mathematics teachers professionally define themselves largely in terms of their classroom. It is their world, through which hundreds of students pass. It is a transient world for students. Even those who "love to learn" are doing so in a fragmented school mathematics world. On the other hand, the students arrive with little direct input from the teachers regarding qualifications they need to have to be there. What is more, these qualifications seemed to be in some decline, in the minds of the teachers.

The formal curriculum in the form of guidelines is set beyond the classroom. The standard of the examination is also largely set beyond the classroom by local and provincial systems. For the most part, teachers only interpret and administer this standard. The mathematics, in a sense, has been somewhat removed from the teacher.

The prevailing interpretation of what "society" wanted was to have as many students as possible acquire "basic" mathematics knowledge and skills as preparation for whatever the student might do in the future. The teaching aim was to present the basic facts and routines of secondary mathematics such that even those with only modest ability could succeed in passing the tests and the course, by paying attention in class and persevering with the exercises to learn the procedures. It was thus evidence of good student work habits, in concert with at least some mathematics achievement, that best heightened one's sense of professional success (instrumental goodness), and it was therefore the students excellent-as-such who were the most rewarding to have in one's class, generally.

If some of these students had such apparent mathematics ability that they were also students excellent-in-mathematics, then so much the better. Those students excellent-as-human beings who were as such because of their classroom work habits also helped to substantiate one's instrumental goodness. Of course, all students as human beings were valued, but in terms of one's sense of professional goodness, those people who seemed the least engaged in what one had to offer as a teacher contributed least positively (although not necessarily the least) to that feeling.

Tensions: A Further Consideration

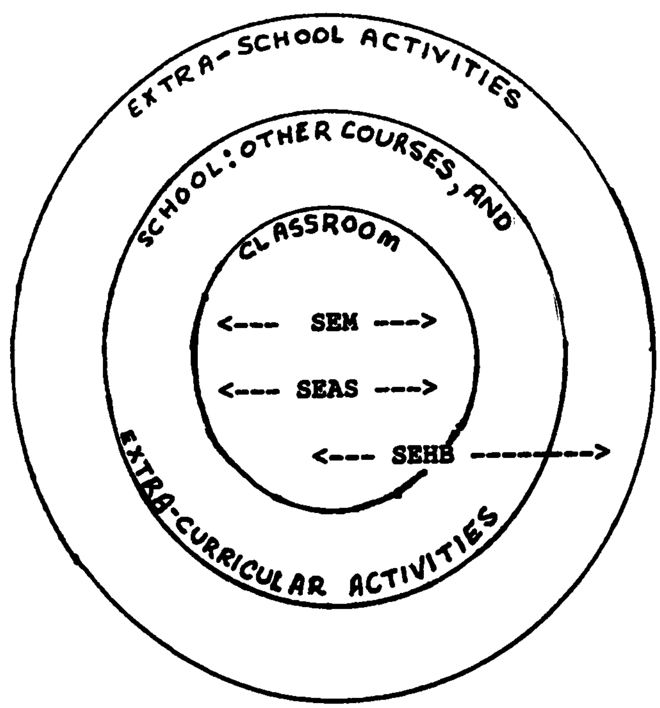
In the preceding section, tension appeared as an integral characteristic of excellence as experienced in the secondary mathematics classroom. This quality identified as "tension" has appeared at other times in the teachers' and especially the students' interpretations of their experiences of senior mathematics. For example, it was revealed: (i) in the desire to succeed in a subject perceived to be repetitious and monotonous; (ii) in the belief that mathematics helped build character qualities of perseverance and self-discipline while being a subject of little relevance; (iii) in the desire for greater challenge and knowledge, coupled with the fear of loss of marks; and (iv) in the belief that success in mathematics increased future opportunities, while the substantive or meaningful place of mathematics in those opportunities lacked almost all definition.

The exploration of tension in excellence (and the possibility of excellence) in the secondary mathematics classroom environment continues in the next sections. The teachers' world, the place of compliance, and the meaning of marks are considered.

A Clash of "Worlds"

The world of the teacher is the classroom. As we have seen, teachers define the achievements and qualities of students in terms of their performances in this classroom/"world." Figure 3 provides a simplified schematic look at realms in which the student is deemed to be excellent. The student excellent-in-mathematics (SEM), and the student excellent-as-such (SEAS) are considered excellent by virtue of the student's positive actions in the mathematics class. The student excellent-as-human being (SEHB), who works hard to attain modest achievement levels, is also "excellent" by virtue of his or her positive actions within the classroom.

The other student excellent-as-human being group has attained some notoriety in the mind of the teacher. The goals of the teacher (as the representative of the subject, and of the school), and the goals of the student are in conflict, producing tension between the two.



<u>Interpreting the "Worlds" of the Students "Excellent-as"</u>

Figure 3

The present structure of schooling promotes this tension. It promotes competition between the mathematics classroom and the outside world, including other classes, for the student's time and attention.

Students are put in a position of having to make decisions and set priorities. When worthwhile "excellent" activities compete for the student's time, there is little or no room in the school's structure for accomodation. The discord is not with the fundamental "worthwhileness" of the activities, for the teacher acknowledges that the potential growth of positive human skills and character qualities may be even greater with the "outside" activities, thus leading to greater "excellence of character." The dilemma, however, occurs because the limited educational/"math" world of the teacher in which are embedded certain notions of "studentness" has been (temporarily) devalued by its lack of congruence with the broader "life-world" of the student, revealed by declining student performance within the teacher's math-world. The location of the discord is thus a clash of "world" priorities.

SEAS: Excellence and Compliance

The tension between the "math-world" of the teacher and that of the outside world of the SEHB is clear. Less clear is the tension that exists within the mathematics classroom world of the SEAS. They are the students whose success the teacher feels he can most influence; they are among the students who see such success as based on personal decisions. The teacher would not disagree that performance is a personal student decision; the student might disagree that the teacher has any influence on performance.

Singleton (1979) wrote of the distinctions between excellence and compliance. Compliance was appropriate when the system "impos[ed] peculiar demands," thus restricting performance. Excellence was an appropriate description when the performance was "well beyond the average skilled performance; and the performer was deliberately seeking achievements to which most people [did] not aspire" (p. 9). I suggest that within an educational context shaped extensively by a "technical" perspective, students excellent-as-such, while exhibiting the personal self-discipline to succeed in the course, also exhibit a significant degree of compliance to the system of education in which they find themselves. It is implicit in the very "studentness" of being an SEAS. In contrast, one might postulate that the SEHB whose outside activities conflict with those in the math classroom is a case of excellence based on non-compliance.

The system most favours the teacher-defined students excellent-as-such as the exemplary products of schooling. The students do well in achievement in the subject, as defined by the system and the teacher, and they exhibit work habits most desirable to achieve success. The teacher judges the student's actions as positive, as "fully characteristic" (Wallace, 1974) of an SEAS. Student performance is critical. Furthermore, whether or not students consider themselves excellent in some way, they do derive some confidence and a sense of accomplishment from knowing that their consistent efforts produce results in the form of good tests, and consequently, good course grades. However, while learning is one aim for students, a greater aim for many, even in the regular academic stream, is to "get through." The SEAS label is also granted for the success students displayed in "getting through." Teachers themselves acknowledge this as a significant feature of education, not necessarily one they enthusiastically endorse, but one which they believe they must live with.

Fairfield was considered to be an academically oriented school, where success in academic study was accepted and supported. We have explored the nature of success in the school, particularly in the mathematics program. We have seen that as part of a larger system of education, Fairfield success was, in terms of the Prakash and Waks (1985) model, largely of a technically-oriented nature. In order to succeed, students' attention must be focused directly on the school work at hand. The teacher was at the centre of the classroom, given the mandate and responsibility to see that these senior students successfully completed the course, and students attended closely to what the teacher said and did. Students expected direct instruction (as "spoonfeeding") because that was the perception of how they had been principally taught throughout much of their elementary and secondary education.

Excellence understood in this way is a fragile achievement of grades and status. It is largely an excellence of dependency, based on a certain teacher-student relationship, i.e., a certain instructional framework shaped largely by a certain educational orientation. Students lack a sense of ownership of their mathematics education. The suggestion of doing what appears as more challenging work erodes many students' confidence, and raises concerns for a loss of marks. Excellence as "student excellent-as-such" within a technical conception of education carries within it the opposing notion of compliance. Furthermore, students could lose their SEAS status through a decline in grades and/or work habits without ever knowing they had been granted it by the teacher.

The concern fundamentally does not lie with the teacher, or with the student, for it is the system which has much to do with how they both believe they must function. The structures of education, including mathematics education, have strongly shaped what it is to be a good professional teacher, a "student excellent-as-such," and an "in-class student excellent-as-human being;" one might in fact see the SEAS as symbolic of the "just-right" principle. Programmatic educational excellence of the technical orientation kind places dominant, or common, notions of individual excellence within the realm of compliance, and seeking after normalcy.

Interpreting Marks

The Principal Product

The Question of Connectedness

According to Norton (1980), our contemporary problem of "excellence" lies in the attention society devotes to "product excellence." First, the range of products society honours is relatively limited, and second, we tend to dissociate the product from both the person/creator, and the person's labours in the creation of the product. Norton believes that we must re-attach the notion of excellence to the person. In this way, product excellence may still be recognized, but as a derivative of excellence of the person. What "products" are produced in the study of senior level school mathematics, and how are they interpreted?

Completed tests are one product which in turn serve as means to a more final end: the mark. We have seen in Chapter 6 how marks are one such very significant product. Marks are not, however, dissociated from the person, in the sense that the "creator" of the marks - the student - becomes separated from them, for the marks remain connected to the name. (It is perhaps more properly the case that the mark is a creation of both student and teacher, even in a technical sense. The student completed the test; the teacher, however, developed the test and the grading system, evaluated the student's work and assigned the mark.) Once beyond the classroom, however, marks may take the place of the person. They may be assigned meanings not fully appropriate in terms of the student's relationship to the subject.

Product/By-Product

One way of interpreting marks is in terms of a "product/by-product" duality: a product of the student's labours, a by-product of the teacher's. The mark is the end product of the test, of the reporting term, of the course, of the year, of high school. It is an end, but an end which has instrumental value, and is understood as the means - or barrier - to other ends. When education is viewed "technically," marks are valued principally for their potential utility and status. It is the mark that is publicly displayed to all those persons outside the classroom itself: parents, school and school board administrators, employers, college and university personnel. Marks are put out to make a statement about the student, but in fact, key qualities of the person - those, for example, that contribute significantly to being an excellent student - remain largely private, known only to a few.

Personal excellence as marks is categorized publicly as outstanding on report cards, plaques, and the like. Good marks are viewed as a sign of excellence of individual achievement, but ironically perhaps, this achievement is often seen as the attainment of good marks. That is, although marks may be interpreted as making a statement about the person, students are honoured for the marks they receive. Marks themselves may be interpreted as "fully characteristic" (Wallace, 1974) of excellence, whereas it is actually the person's <u>actions</u>, or labours - and not just the "actions" of receiving or getting the mark - that are fully characteristic.

The mark, although it is a quantitative value derived from teacher and provincial evaluation schemes, is interpreted as being produced by the student. Teachers interpret their course products to be the students, or more specifically, the perceived general level of success of the students in attaining the mathematics and personal goals the teacher has in mind for students. Thus, the students' product becomes an important factor in (self-)assessing the teacher's product. The collective mark of the student body is an important by-product of the teacher's efforts, upon which much of his or her instrumental goodness is based. Indeed, programmatic excellence in the academic stream is based significantly on this mark.

As a by-product, the mark has important value to the teacher as a sign that the student knows (or does not know), and can do (or cannot do), what he or she has been asked to know and do. The teacher has a vision of what constitutes an excellent student in the course. The teacher makes connections between work habits and success on tests and informally honours those members of the class whose actions appear to be "fully characteristic" of the SEM, SEAS, or SEHB. The mark symbolizes relative success, and as Frank Tilson suggested, is interpreted as the student having set a goal of working up to his or her ability, and apparently having reached it. In the case of the SEAS and SEHB, it means that good work habits are identified as excellence of character, and are associated with excellent "studentness." In the case of the SEMs, teachers (and students) recognize their strong mathematics abilities and achievements, and do honour their ability to produce the high mark.

Identifying with the Mark

For many "academic" students, it is the mark which gives most meaningfulness to mathematics study. From the (dis/ad)vantage point of their school environment, academic students look out to see that marks are the products of their education which carry the most public meaning, even if they feel marks misrepresent them and their capabilities. They therefore tend to define themselves in terms of their marks. Within the regular academic stream, the content and processes of mathematics are frequently secondary to grades, and even the classroom display of such personal characteristics as perseverance and self-discipline to be able to "do" the mathematics at hand seems mainly in the name of the mark.

Even though school mathematics is typically characterized as concrete, it is the mark that is the most tangible item that many students often take away from courses. (The secondary nature of the mathematics, and the primacy of the mark as an end product and a means to further ends can perhaps best be recalled in Darren's candid discussion of long-term excellence, and the final goal of career/financial success in the "huge job.")

Drawing Interpretations of Personal Competence from the Mark

In addition to this long-term instrumental meaning of marks, they carry short term intrinsic meaning as signs of personal competence, and mathematics worthiness. Indeed, student's interpretations of marks appear to fall between the bi-poles of "getting through" (negotiating his or her way past the current mathematics to the end of the course, or to the opportunities beyond) and "competency and understanding," but with "getting through" generally dominant.

Students draw various meanings from the mark regarding mathematics and their capabilities in the subject. Achieving consistently high marks is said to signify excellence; it signifies being "good at" mathematics in terms of certain technical skills. To determine the student's actions as "fully characteristic" of excellence, one must inquire into how the student interpreted the mark. It is necessary to ask if there is a sense of aspiration, and if so, to what does the individual aspire?

In some instances, the personal actions and attitudes of a student may, for example, be considered as fully characteristic of standards of disciplinary initiation and/or self-actualization. Embedded as the course is within a technical orientation, such an outlook is difficult to fully sustain. Since school opportunities to explore and interpret the place of mathematics in "personal" and "social" orientations are limited, the student is much less likely to interpret his or her mathematics study in these ways.

In contrast to the possible personal meanings students may draw from high marks, when the "statement" a (low) mark makes is in conflict with personal beliefs about mathematics ability, students may try to distance themselves from the mark as an inappropriate measure of who they are. Rationales are developed to explain the distinctions between self and mark. One problem occurs because students are asked to perform on demand, which may be incompatible with student readiness. This, of course, is another characteristic of (and problem for) the dissonant student excellent-as-human being whose attention is directed to interests outside the mathematics class.

<u>Marks as Masks</u>

We tend to assume we know the meaning of marks in terms of the subject area, and take comfort in the implied scholarship in a student's grade of 90%, for example. Marks are interpreted by others as making a statement about those who achieve the marks; they are "good in math." Students also define themselves to others in terms of their test or report card grade. In various ways, we formally recognize those who achieve a mark of 80% or more. We assume the marks are based on some types of tests for technical goodness, and imply the students have some mathematics skills in, or are "good at," the major portion of the mathematics they were taught. High marks at whatever level of course - Academic, General, or Basic (Mathematics 10, [illegible], and [illegible] for example) - indicate excellence of achievement. But beyond serving as a marker that tests were consistently well and correctly answered, what can be said about the student's performance? How is excellence of test achievement as signified by high marks related to reflecting credit on the agent, and to actions which are "fully characteristic" of excellence, and connected to the labours of the person, and the person him/herself?

The common use of marks, while a concern, is not the principal focus here. The educational context of their use is very important; both the assessment basis for the marks, and the relative emphasis assigned to the mark may vary given different educational frameworks. Thus, the primary concern is (a) the limited basis for the derivation of the marks, as was described in Chapter 5 and, equally important, (b) the emphasis that is placed on the mark by students and others at the expense of celebrating the students' relationship with the subject. Marks are not separated from students - they remain linked, numbers to names; but they are a product which stands apart from, and hides the nature of the students' labours, except insofar as they are a cumulative sign of the students' test achievements.

Beyond the level of the immediate classroom, only high marks are honoured. Even the recognition of qualities of character the teacher informally identified in students excellent-as-human beings is lost in the formal documentation that is passed beyond the classroom (although one might assume the student will retain those qualities). Teachers acknowledge the dilemma, the tension that exists between the informality of the classroom, and the formal structures and procedures of the system. They ask, "Are we teaching math, or are we teaching the students how to pass the course?"

The academic level course Mathematics 30 has become principally a marks/credential course. The mark tells us nothing about the content focus for the student, or about the nature of the student's engagement with the subject. And, among those students who do have a strong work ethic, a serious concern is the question of the "pride of work" in mathematics. Here the focus is not limited to the individual student's personal engagement in the subject for the sake of mathematics itself, but also considers the relationship of mathematics to other aspects of the person's life. The senior student has learned mathematics which may support further mathematics studies, but what is there in the mark for the student to share, or give to others, that speaks to the nature and extent of "becoming what one is not yet," of personally growing?

Secondary school mathematics, and perhaps academic subjects generally, have this peculiar quality, especially within a technical educational perspective. It is the mark that is primarily honoured. In many other areas of human endeavour, other products (still a restricted view of excellence) and qualities are often created and/or visible. Even in areas where quantitative measures of technical goodness (von Wright, 1963) are major measures of achievement, such as track and field, and swimming, for example, the person, and the "labours" of the person are highly visible for evaluation, and appreciation by others. Mathematics tests are considered highly personal, and generally known only to the student and the teacher. Following Norton (1980), I suggest that we refocus our public attention on the person - the student.

Community, Ownership, Pride of Work, and the Creation of Self

The concept of "community" is a unifying notion. Current education is problematic because many students appear to lack a sense of community, except, generally, in the broadest terms as members of a school community. There are other exceptions; for example, those who are members of a "special" group such as a sports team, a school band, or perhaps an active school club. Students in "special" programs such as IB, or shop areas may also have a greater sense of community but many of those in "regular" programs such as the senior level Academic stream lack this feeling of community in their classes.

The collectivities, or groups of students identified in Chapter 5 were principally loose-knit creations. These were not categories explicitly taken up in class (and rightfully so). The mathematics students themselves had a vision of the student "community" that was very individualistic. They did not see themselves as a community of mathematics learners, as a community caring for each other, and caring for the mathematics. Even though they were in class together, the students were not a community because they did not act as a community, and they did not perceive themselves to be a community. They recognized standards of high marks, but there was little sense of community within fields and subject areas.

Students in the same course with the same teacher are being taught the same content, and some learn more thoroughly and deeply than others. What most marks a community, however, is the spirit with which one enters it. In the context of the subject, in this case mathematics, students tend to see themselves as isolated individuals. Many students enter that classroom because of system structures and requirements. Once there, the focus continues to centre on the individual student and getting through.

The technical educational emphasis provides a major barrier to the development of a greater sense of community. The potential for community exists, but it is by-and-large not fulfilled. Academic program students often lacked a deep sense of why mathematics was studied by the mass of students. Some believed senior mathematics study had future value, and some expressed the view that it aided mind development, but these really were rather unfocussed beliefs, which seemed not to have a significant relationship to the mathematics that was being studied. Mathematically, then, many students appeared to experience an emptiness of significant purpose. Even teachers see the possibility of students attaching significant meaning to their mathematics, and being meaningful to students in future, as little more than a hope. One catches in the teachers a sense of regret at the loss of meaningfulness, even at academic program levels, in senior mathematics, and a desire to capture it where they can: in the IB program; through hoping to maintain the interest of those (few) students interested in the subject; by exposing students to mathematics because just maybe they will find they like it.

One difficulty with the technical conception of academic education is that the context of learning - Why learn?, for example - tends to become artificial, "made up," in order to support continued study. As was discussed in an earlier section (Interpreting Marks), the "aspirational basis" for success in mathematics is often not the mathematics itself but the desire to "get through." As meaningful as the development of the human qualities to get through (self-discipline, perseverance, and so on) may be, there is little relationship between them and the mathematics content and processes which are being taught. This is not to say that mathematics concepts and skills are not considered important, but it is a question of emphasis. It is a question of greatest meaning for a teacher - students who are apparently applying themselves to the best of their ability - and, for a student - getting good grades.

Excellence derives from a sense of community. Communities have an internal cohesion; they are created by those who share a common interest in some activity or range of related activities, such as a craft, athletic endeavour, or academic discipline. Members of the community also share common skills and knowledge. They share a sense of purposefulness, of meaningfulness in the performance of characteristic community-related actions. Standards are established by those within the community. Not all members are excellent according to these standards - indeed few are likely to be - but as excellence emerges from the nature of the standards, there may be opportunities for a variety of forms of excellence within the community, both skill and character related.

Community is about taking ownership of what is learned, of seeing the activities as meaningful, of assuming personal and collective authority for knowing, and of sharing responsibility for understanding (Wilcox, Schram, Lappan, and Lanier, 1991). Community within the mathematics "classroom" needs to be seen in terms of Nathanson's (1974) "individuals-in-community." It allows for individual excellence but acknowledges a shared world. To truly be a member of the classroom community is to be involved in the process of prizing and creating, or discovering the self, while at the same time realizing that everyone is engaged in the same process, at different stages, and that the relationship among members is most properly a mutually supportive one. Excellence is a journey, a process of achieving "desirable individuality" in which we implicitly recognize and honour that we are the relations that we grow through. The work ethic as a sign of compliance is replaced by a wholesome pride in the quality of one's own labours, and a respect and a caring for other course-colleagues and their labour. To be a member of the community concerned with excellence, as Greene (1989) noted, is to make the community standards one's own, "to decide to live and work with what they take them to mean" (p. 10). If we re[illegible] excellence to the person, as Norton (1980) suggests, then the co[illegible]nity of the classroom (and education in general) must consider it part of the social task to support each person in their endeavour (over time) to discover their "loved work," that work which will lead to the development of personal excellences (<u>aretai</u>) and the "creation of self" (Nathanson, 1974).

What does this mean in terms of the senior mathematics classroom? It is unrealistic to claim mathematics as the "loved work" for large groups of adolescents in high school. It is also unrealistic, and inappropriate, to state that mathematics is a field of little importance for many students, and therefore they need not engage in its study. So, how can excellence encompassing notions of "creating the self," "becoming," "loved work," and "pride of work" be incorporated into mathematics, and lead to a more genuine sense of community in the mathematics classroom? With the mark, based on limited forms of evaluation, as the major product of schooling signifying excellence, this clearly leaves many students (notwithstanding Adam's group interview complaint that too many students at Fairfield received Honours awards for their marks) with little visible or apparent opportunity to experience excellence in the (mathematics) classroom. This fits well with Norton's (1980, p. 285) assertion that many people (students) perceive themselves to be "irredeemably ordinary" (in school mathematics).

The mathematics classroom, indeed the school, must be interpreted as providing an environment which facilitates students in their long-term aspiration to their work of choice. This implies a restructuring of the school to see a far greater integrated approach among subject-area teachers. The view that the classroom is the teacher's classroom, and the mathematics is the teacher's mathematics, also has to change. The self-discovery process is certainly complex, and not one (likely) to be completed during the time of a mathematics course, a year of school, or even the entire period of secondary school. But mathematics education must be seen as integral to this process, as a valuable aspect of the journey of "becoming." Excellence in a mathematics classroom context means a deep engagement in the process of becoming a "better person," in the sense in which those such as Greene (1984) and Aoki (1990) mean by "better person" - excellences of mind, excellences of character.

In the mathematics classroom this means developing mathematics experiences for the students that encourage seeing the subject as a human endeavour having a range of values, from the intrinsic to the instrumental. As long as mathematics is taught in isolated, rigidly scheduled, fixed blocks of time, and understood by students primarily to be a set of facts and procedures to be learned, the mathematics classroom will remain for many students highly individualistic, with little sense of community. Excellence for the few primarily will be "technical" in nature, and will centre on success in achieving good test results and high marks. Students will acknowledge the standards set by the teacher, and others, and will respond to them according to the degree to which they are capable and willing, given that marks are seen foremost as having credential value.

The characteristics of the "SE" students need to be expanded. Students need to feel that they, together with the teacher, are participating in the creation of a community within the mathematics class. Students need also to be involved in setting the standards for performance, and excellence.

Perhaps we don't properly value the craftsperson aspect of the student, in a subject like mathematics. There is an active moral quality about the excellent craftsperson (Grant, 1985). In the craftsperson we see the <u>person</u>, the <u>labours</u>, and the fruit or <u>product</u> of those labours. Most importantly, the craftsperson has a strong investment of self in the work, and thus a commitment to others, for it is in large part that very commitment in which is revealed the excellence. The devoted craftsperson is neither a "Somebody" nor anonymous. Do we permit and encourage the investment of self in the mathematics class? We support and informally acknowledge good character qualities, but do we see school for the intrinsic value of what we do and learn there; and for those instrumental values which lead us to a valuing of school for learning, and community (e.g., Yeakey and Johnson, 1985)?

Do we promote the learning of mathematics as a mind tool, akin to the craftsperson's physical tools? Craftspeople establish a close relation with their tools; they become, for the master craftsperson, a extension of themselves. Long before this stage of personal development, however, craftspeople develop a respect for their tools, along with a knowledge of their function. School mathematics has been interpreted as a tool at the secondary level, but what kind of tool? For what uses is secondary mathematics proposed? Where do we make more than cursory connections, and begin to establish the relationship of mathematics to the world of the student - whether academic, technical/ vocational, or everyday?

Revisiting the Students "Excellent-as"

In terms of educational orientations, a classroom/school/system that celebrated community would represent not a single orientation but a mix of all conceptual perspectives - technical, rational, personal, and social. That is, there are opportunities for students to actively explore the content, process, and structures of the subject; opportunities to actively engage in a thoughtful, creative investigation of the subject; and opportunities for students to investigate the possible relationship(s) of mathematics to other areas of personal interest. There are opportunities for students to integrate their critically evaluated mathematics knowledge, skills, and general understanding with a number of subject studies, along with personal understanding from everyday life experiences, to effectively inform their actions in the world.

A community-oriented classroom does not mean a classroom where everyone is excelling in mathematics. The range of apparent mathematics abilities would still be present. Teaching approaches would acknowledge a range of learning styles within the classroom, however. One would also still find those people considered to be students excellent-in-mathematics, excellent-as-such, and excellent-as-human beings. There would be a greater celebration of these individuals as part of the mathematics (classroom) community. The meanings of these notions of personal excellence would be changed, or expanded and elaborated.

Consider, for example, one of the "excellent" student types, the SEM student who attains his or her excellence status by virtue of doing well on the prevailing form(s) of assessment while appearing to show little interest in mathematics in class. This person is, in effect, a successful technician in school mathematics. There is, within the structures of a technically oriented educational system, room for such students; they are legitimate products of the educational system. This is not to say that this person could not have been more; it is to say that this person in this educational context has chosen not to be more. For that reason, in the teacher's classroom they may be somewhat marginalized. Still, some students may admire this person for his or her lack of study.

Within any of the other three educational frameworks, and certainly within a community-oriented classroom in which the freedom to be open to a combined outlook was present, this "category" of student would not exist, at least in its more extreme form (recall the description in Chapter 5 of Len Coleman's high achieving IB student who did nothing in class). The nature of assessment would induce, or necessitate, the student participating more fully in the spirit of the learning in order to achieve "success" in evaluation. A passive presence and high achievement would not be compatible.

Students excellent-as-such (SEAS) are individuals acting in the full spirit of the given educational system. They are defined by their proximity to "ideal studentness": good to very high achievement, and a willingness to participate in the system's educational processes to reach and maintain those achievement levels. The SEAS identification implies that such persons have clearly invested themselves in the (mathematics) work at hand, and have developed the necessary (mathematics) skills for success. This positive characteristic should be acknowledged regardless of the relative emphasis of the investment on mathematics, or on getting through with good credentials.

To be identified as an SEAS is a clear recognition by the teacher (and perhaps by some other students) of personal qualities as well as cognitive abilities and achievements. Dedication to the task in the form of self-disciplined study, and perseverance in the face of possible initial difficulties in understanding are positive human qualities. To be identified, therefore, as a student excellent-as-such, or as a student excellent-as-human being in the mathematics classroom is an honourable achievement, even if the person is unaware of such external identification.

What is problematic with the SEAS within an educational orientation that is predominantly technical is, first, that while the student personally creates for him- or herself the conditions necessary to be identified as an SEAS, it is only the teacher who participates in the creation of the "group." That is, the individual still remains isolated within the class. Second, as we have seen, in the technical mode, which may be marked by individualistic competitiveness, there is still a significant element of compliance. Third (related to the second), the student's investment is frequently for the primary purpose of getting through, and in this there is a lack of an active moral dimension to the "excellence" even though it is in part about personal qualities.

In an environment in which the classroom is seen as an active, shared community, the SEAS is neither isolated nor exalted as a "Somebody." The SEAS is still honoured for personal qualities, and achievement, but the qualities are those, in addition to self-discipline and perseverance, which link the person to other members of the class, and reveal a prizing of the self while caring and sharing with others. Achievement is based on more than tests. Not only does it take into consideration other modes of mathematics assessment, but it includes an evaluation of the apparent depth to which the student, in his/her relations with the teacher and students, has attempted to give personal meaning to the mathematics. Only in classrooms which encourage participation in mathematics in orientations that are rational, personal, and social can such evaluation be itself meaningfully attempted. Clearly, in order for teachers to feel they can function in such a manner, structural changes will be necessary.

Returning to the Research Questions

In Chapter 1 the questions considered to be critical to this research were set out. As a means of providing closure, the questions are reviewed below.

All of the questions have been addressed. At times the response to a particular question evolved over several sections. For other questions the response was direct and brief. In some cases, the response was clear and evident in the perceptions and interpretations of most or all of the participants. At other times, meanings were limited or unclear, or varied substantially among the participants. That is the nature of an interpretive study involving a number of participants.

What follows are brief summary responses to the research questions. There is a danger of oversimplifying the significance of the question, and the body of work on the many pages which precede this. The reader is urged to keep these cautionary remarks in mind while reading these summary. Here are the questions.

(a) What forms of excellence for students in mathematics are recognized by mathematics teachers and students? How are these forms recognized, and valued? Why are these forms of excellence valued? What variations in views are there among the teacher and student participants?

And

(b) What standards are associated with the various forms of student excellence? Why have these standards been set? What is the nature of the values that shape those standards?

The categories of students excellent-as contribute in a major way to identifying those forms of student excellence which are given recognition in the mathematics environment. At various places we have addressed the question of the standards and underlying values which give rise to the recognition of these forms of excellence. The dominant technical framework within which the teachers and student find themselves functioning serves to help shape and constrain what "excellences" are valued. At the same time, the participants in the educational enterprise push (perhaps weakly) at the bounds of this framework to make some allowance for students whose qualities would not be recognized by institutional excellence criteria.

(c) What purposes and values for teaching and studying mathematics do teachers and students hold? How does this understanding of the purposes and values of school mathematics support, or form the foundation for, the forms of student excellence and their associated standards identified in the study?

Various purposes and values were ascribed to the study of mathematics, including its preparatory role - marks and credits (for entrance to post-secondary study), acquiring basic mathematics knowledge and skills, work habit development (self-discipline, perseverance, etc.) - and, to a lesser extent, mind development. Often, visions of mathematics' purpose and values were fuzzy and limited in development. Some saw no value in its study; it was just something that one could successfully do. Some saw value in the mathematics itself, and what it represented as a form of knowledge of, and a way of speaking about, the world; this view was very limited. It was as if, at the end of the students' secondary academic study, the curtain on this meaning of mathematics was only just beginning to rise. "Getting through," demonstrating good work habits, and receiving good marks if possible, were strong among the valued aspects of mathematics study, and underpinned many of the forms of recognized forms of student excellence.

(d) What forms of student excellence and associated standards are not valued or recognized?

Excellences associated with the rational, personal, and social conceptions of education were not well recognized.

(e) Is excellence in mathematics and schooling stressed, or identified as a goal of teaching? Why is this so, or not so?

In Chapter 5 the nature and degree of excellence of Fairfield school was discussed. We saw that the goal of teachers was to try to have students working to their apparent levels of ability. Students generally believed that the school and the teachers, while very good in terms of the apparent general quality of schools and teachers within the system, did not particularly encourage students to strive to push themselves. The constraints of time, content, student ability and a possible decline in achievement levels were among the critical reasons given for this student position.

(f) What significance is attributed, or not attributed, to student excellence in mathematics, or schooling in general, by the participants?

Student excellence in mathematics is certainly acknowledged, in various forms, as we have seen. Those few who stand out particularly as students excellent-in-mathematics are often recognized as revealing qualities beyond that of technical goodness in mathematics. These individuals are likely to be recognized at the school and in other circumstances for their abilities and achievements. The qualities of the SEAS or SEHB which have led to their being informally recognized as such, primarily by the teacher, are often not identified by the system beyond the classroom. This, of course, is not to say that these personal qualities have been lost.

(g) How do the perceived social values of the school student body influence, or interact with, the desire to be excellent, or the recognition of excellence, according to the student participants?

The range of social values expressed by the participating students was substantial. Educational values which could be associated with all four conceptions of education - technical, rational, personal, and social - were identified. The recognition and significance of excellence (in mathematics, for example) thus varied. However, because of its dominant nature, the mark, as based on subject achievement, ranked as a major element of any will to be excellent, or any recognition of excellence in others.

(h) Upon what aspects of the human character do the identified forms of student excellence appear to draw? How are these forms of excellence shaped by competitiveness, cooperation, community, and individualism?

These questions have been addressed in the discussion of the student excellent-in-mathematics, excellent-as-such, and excellent-as-human being. Individualism and competitiveness are significant influences. This is not to say that cooperation and community could not also figure strongly in shaping the nature of excellences in the mathematics classroom. At the present time, however, these elements are little evident in secondary mathematics classrooms.

Another element of the notion of excellence has also emerged, more fundamental perhaps than that addressed by the questions above. Comparison, difference, and tension all appear as basic qualities of excellence. Comparison and difference arise, almost by definition, in a consideration of excellence. Students and teachers turn to comparison and look for difference in establishing standards and identifying those who meet those standards. Basic goals and values held by the students and teachers serve as guides in looking for difference. Intent or purpose as implied by the question "What counts for me in what I am doing?" or more specifically, "What do I hope most to achieve in teaching (or studying) this course?" appears as a major consideration in arriving at goals.

It is, however, the sense of tension that appears most strongly in an exploration of excellence in an educational context. Tension has implicitly or explicitly been evident in numerous places in these deliberations. At times these tensions have served to highlight and differentiate some condition of excellence from other forms. At other times - often because of constraints imposed by an essentially "technical" educational system - the tension has served to limit or deny the possibility of excellence.

Comparison, difference, and tension appear as basic qualities inherent in the notion of excellence - at least as it is considered in the secondary mathematics classroom. However, the context of the classroom, the nature of the community that functions there, and the degree to which that community is prepared to take ownership of and responsibility for what it learns, will have a fundamental impact on the nature of the comparison, difference, and tensions.

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Appendix A
Introduction to the Research
Provided to Prospective Participating Teachers

The Meanings of Excellence for High School Mathematics Teachers and Students Introduction to the Research

Researcher: Doug Franks

I am a doctoral student in the Department of Secondary Education at the University of Alberta. My interests are in mathematics education and curriculum. My supervisor is Dr. Ken Jacknicke. Also on my supervisory committee are Dr. Tom Kieren and Dr. Larry Beauchamp of the Department of Secondary Education.

I can be reached at work at (telephone number), or leave a message with the Department at **. Home phone is **. My supervisory committee members can be reached by calling **.

Sections in this paper:

- -The Nature of My Study
- -Who Will the Study Involve?
- -What Will the Study Involve?
- -How Long Will I be in the School?
- -What Sort of Analysis Will I be Doing?
- -What Will I do With the Data/Analysis?
- -Ethical Considerations
- -The Value of the Study for the Participants

(1) The Nature of My Study

These days one hears a lot about "excellence in education." Much of the discussion comes from the United States, but in Canada, and in [province], the phrase also appears frequently in official documents. I do not want to state my position too vividly or in much detail, because in this research I am interested in what others have to say about excellence. My general position is that educational excellence can be considered in a number of ways.

In a mathematics context, this fall I want to examine how teachers and students feel about the notion of excellence. This will involve exploring math. teachers' and students' beliefs about "excellence" in general, about excellence in mathematics within a mathematics context, within a school or educational context, and within the larger societal context.

Last February I conducted a one month pilot study on this topic with a (city) high school teacher and some of his mathematics students. That work resulted in some preliminary interpretations of what excellence means to teachers and students, and clarifications in research focus and methodology. I now want to proceed with a more substantial study.

(2) What Teachers and Students Will the Study Involve?

Participation will be completely voluntary.

(a) Teachers: Two (experienced) mathematics teachers, preferably, but not necessarily, Mathematics 30 instructors.

(b) Students: For each teacher, approximately two students from each of two of the teacher's classes (therefore approximately 2 x 2 x 2 = 8 students. Six to eight students would be satisfactory.) I would like most of these students to be grade 12 students.

A conventional criterion of excellence in math is typically steady grades of greater than 80%. However, I do not want to impose any predetermined criterion on the selection of the students. Therefore, before deciding which students to ask to participate, I would like to consult with the teacher and a number of student members of the class for their understanding of who is "excellent." This will be a process that will take a little time, and must be done discreetly and tactfully. I hope to have students participating who are, and who are not, considered excellent.

(3) What Methods Will the Study Involve?

Briefly, the research will primarily involve interviews with the participating teachers and students, and classroom observation.

The principal method will be audiotaped semi-structured (conversational) individual interviews with teachers and some students. These are interviews in which some common questions are asked of all, but which also go in unique directions based on what is said in the particular discussion and in previous talks. At some time I may also want to hold a group interview with the participating students. Classroom observations (field notes) will be required. The focus of these will be the teacher and the selected students. The observations will serve as a basis for the interviews.

I anticipate holding approximately 6 in-depth interviews with each of the teachers, and 4 interviews with each of the students. Each interview will last from 30 minutes to an hour. I would like to systematically observe 2 of each of the math teachers' classes - perhaps 2 periods per week of each of the four classes if the scheduling will permit.

In addition I will want to keep track of, and discuss teacher tests/resource material, and how the selected students are doing on their mathematics tests. I am interested as well in school documents and artifacts that address the question of how the school recognizes student effort and ability.

The research will not involve any type of mathematics teaching or testing by me. The classes will not be audiotaped or videotaped. I may want to record some of the classroom discussion of the students specifically participating in the study. At this time I do not plan to do so, but I may want at some time to conduct a questionnaire survey.

This is not an evaluation of students or teachers.

(4) How Long Will I be in the School?

I would like to begin sitting in a math class of each of the teachers in September, 1988.

I want to begin systematic classroom observation in late September or early October, 1988.

In October I want to make the selection of students and begin interviews.

Because of the time involved in scheduling and holding interviews, transcribing the tapes, and preparing for the next interview with each person, I expect the research will go into December, and possibly January, 1989.

(5) What Sort of Analysis Will I be Doing?

A qualitative analysis aimed at gaining an in-depth understanding of the notion of excellence for high school mathematics teachers and students of mathematics. A second reader will be involved to check for the consistency of my interpretations, and for bias.

The nature of this study is such that there will be no statistical analysis. Random sampling is not important. What will be necessary to report is some description of the context in which the study takes place: general characteristics of the school, of the the class environment, of the type of mathematics being taught.

(6) What Will I do With the Data/Analysis?

(a) A PhD dissertation will be produced.

(b) Some papers based upon the research may be produced and presented at conferences and for publication in journals.

(7) Ethical Considerations

At the beginning the informed consent of all participants, and of parents where necessary (students under 18), will be obtained in writing. School administrators will be informed of the general nature of the research. School board approval is required.

Participation by all teachers and students is strictly voluntary, and anyone may withdraw at any time.

Fictional names will be used in all written materials based on the research. To the fullest extent possible, anonymity and confidentiality will be maintained. Complete anonymity is not possible, because a few others in the school will be aware of the research and who is participating. The publication of direct quotations from the transcripts will be necessary to provide evidence for the interpretations. Participants will be made aware of these limitations at the start of the research. The second reader of the research will be sworn to confidentiality. Distribution of the tapes and transcriptions will be limited to the second reader, and my supervisory committee.

Participants will be part of the validation process by engaging in discussions with the researcher about what has been said, and the interpretations made of the data. Release of all data for publication in the dissertation and follow-up papers will be negotiated with all direct participants. Data which participants do not want released will not be used.

All direct participants who wish a summary of the study and/or a final copy of the dissertation will receive one.

(8) The Value of the Study for the Participants

This may sound somewhat lofty and esoteric, but I believe that a major personal benefit for the teacher participants will be a deeper, clearer understanding of education in general and why they are teaching mathematics in particular. Any time one engages in in-depth reflection on something he or she is quite involved with, it almost certainly will have such an effect. Seldom do we teachers get the opportunity to really talk about what we do and how we feel about it. Teachers in other studies involving reflection on their work have found the process enlightening and helpful.

In the case of the student participants, I think very often students view school (and mathematics) as having only a "future-careers" benefit (if that). I anticipate that this study will force the student participants to think more deeply about their own education, in particular, their mathematics education.

I think the teacher participants will also benefit from reading the views of excellence held by students who have been in their classes.

<u>Notes</u>

Appendix B
Information Sheet and Parent Research Permission

Information Sheet
and
Parent/Guardian Research Permission

My name is Doug Franks. I am conducting a research project with Mr. Len Coleman and Mr. Frank Tilson, mathematics teachers at Fairfield High School. I am observing some of Mr. Coleman's and Mr. Tilson's classes, and interviewing them and some of the students in their classes. As part of this research, I would like permission to speak to (student's name) about such things as his/her experiences with mathematics, his/her attitudes toward mathematics, and his/her feelings about his/her personal ability in mathematics and in other subjects. I will also be asking ____________ about his/her marks in mathematics and overall. These talks will cover experiences in past years and the current year.

The general theme of my study is educational excellence. It is an expression that is used frequently by government personnel and school board administrations. I am very interested in exploring teachers' and students' personal beliefs and perceptions of the notion, and in particular, how and where studying mathematics "fits" in their feelings about excellence.

I am a graduate student in the Department of Secondary Education, University of Alberta. This research is part of a larger work toward a Ph.D. degree. The City Public School Board is aware of my research, and has given me permission to proceed.

These conversations would take place from approximately October to December, 1988. I envision four to five discussions with each student, each approximately 30 minutes in length, over that period of time. The interviews will be audiotape recorded in order that I may have an accurate record of what is said. The talks will not be scheduled to take place during any of ____________'s classes (including the math class).

Participation is strictly voluntary, and ____________ may withdraw completely at any time. Confidentiality and anonymity will be maintained to the fullest extent possible. Complete confidentiality and anonymity cannot be guaranteed because the teacher and some others in the mathematics class know of ____________'s participation. However, a fictitious name will be used in any reference to him/her in my writings (such as my thesis). Also, at the end of our discussions, ____________ will have an opportunity to sit down with me and think about what he/she has said, and anything that he/she does not wish me to use in my work will be eliminated from further consideration.

If you have any questions, please do not hesitate to call me at (telephone number) (home) or ** (university). If you agree to let ____________ participate in this research project, I would very much appreciate your signing the form on the following page and having it returned to me at Fairfield as soon as possible. Thank you.

Parental/Guardian Consent Slip

I/we have read the description of the Fairfield High School mathematics research project of Doug Franks, and understand the nature of its aims and methodology. Under the conditions of participation, confidentiality and anonymity cited above, I/we hereby grant permission to let ____________ participate in the project.

Date: ____________

Parent/Guardian(s)

____

____

Appendix C
Fairfield Orientation Night Information Sheet

Welcome to Fairfield!

DID YOU KNOW THAT...

-48% of last year's graduates are presently enrolled in [province] post secondary institutions?

-Fairfield's dropout rate is the lowest of all major City high schools?

-last year 83 Fairfield grads won over $94800.00 in Heritage Scholarships?

-Fairfield students took gold, silver, and bronze medals in this year's Science Olympics?

-Fairfield's Concert Band won gold at the [province] Music Fest?

-Our [sports] teams are this year's city champions in Senior Football, Mixed Curling, Senior Boys' Basketball, Junior Girls' Basketball, Junior Girls' Volleyball, Senior Boys' Volleyball, and we put 4 members onto the provincial Cross Country Running team!

-Fairfield students recently took 1st and 2nd place in the [sponsor] Camera [province] Contest!

Appendix D
Fairfield High School Mathematics Streams

The High School Mathematics Streams

The provincial Department of Education provided for three "streams" of high school mathematics. At the time of the field research in 1988-89, these streams were (i) Mathematics 15 and Mathematics 25, (ii) Mathematics 13, 23, and 33, and (iii) Mathematics 10, 20, and 30. The courses listed within each stream were normally taken in grades ten, eleven, and twelve respectively (grade ten and eleven for Mathematics 15 and Mathematics 25). An advanced mathematics course, Mathematics 31, was also a provincial course. A brief description of each of these streams follows. The mathematics courses offered at Fairfield are indicated.

Mathematics 15 and 25 were designed for students who appeared to have considerable difficulty and/or very little interest in school mathematics. They emphasized practice in computation skills with an everyday living/consumer orientation. Fairfield offered only Mathematics 15 because one five credit course in mathematics was sufficient to graduate from high school, and the Mathematics 15 students, few in number, had previously expressed little interest in going on to Mathematics 25. Teacher Len Coleman concurred that these students would probably gain little from the course.

The Mathematics 13-23-33 sequence was designed for students who felt a need to study mathematics in high school but who had experienced some difficulty, or who had limited interest in the subject. The content was "academic" in orientation, but limited in scope and depth, and the pace of instruction was slower than that in the "academic" Mathematics 10-20-30 stream. Completion of Mathematics 33 was sufficient to permit potential admission to some post-secondary programs. Fairfield offered this mathematics sequence of courses.

Mathematics 10-20-30 was considered the academic stream of mathematics in the province, and was offered at Fairfield. The completion of Mathematics 30 was one of the requirements to receive an "Advanced High School Diploma" from the Department of Education. A student potentially had wide access to post-secondary institutions with this certificate, assuming sufficiently high grades. This stream of courses was offered at Fairfield.

Mathematics 31 was an advanced course focusing principally on introductory calculus. Students in Mathematics 31 were assumed to have some ability and interest in mathematics. Students who expected to enrol in post-secondary mathematics, science, or engineering-related programs, for example, were typically encouraged or required by the post-secondary institutions to take this course. Mathematics 30 was a pre- or co-requisite course. Fairfield offered Mathematics 31.

The province set the curriculum (as content) in all the above courses, but only in Mathematics 30 were the students required to write a provincially set final examination (Diploma exam). The final grade for the course was composed equally of fifty percent of each of the Mathematics 30 teacher's grade and the Diploma examination mark.

Fairfield was one of four high schools in the school district which offered the International Baccalaureate (IB) program, an advanced, internationally developed and recognized academic program. This program was not administered by the Department of Education. Some courses were unique to the IB program, while others, such as mathematics, were academically advanced versions of the provincial courses (Mathematics 10-20-30-31 IB). After completion of Mathematics 30 IB, students wrote the Mathematics 30 Diploma examination; after completion of Mathematics 31 IB, they wrote the IB mathematics examination.

Appendix E(i)
Example Frank Tilson Mathematics 30 Test
(Reviewed in Interview 2)

MATH 30

Name ________________________

[Value of each question is in brackets]

1. How many terms are there in 7, 3, -1, -5,... -181?

[3]

2. Insert 4 arithmetic means between $9 + 3\sqrt{3}$ and $9 - 7\sqrt{3}$

[3]

3. Find the number of multiples of 7 <u>between</u> 6 and 245.

[4]

4. In an arithmetic series the sum to 6 terms is 120 and the sum to 14 terms is 616. Find the tenth term.

[5]

5. If $3x - 2$, $x + 4$ and $x^2 - 32$ form an arithmetic sequence find the value of x.

[5]

6. How many terms of the series 45 + 36 + 27 + 18 + ... must be added to yield a sum of 126?

[5]

7. Find the tenth term of 40, -20, 10, -5 ...

[3]

8. Find the number of terms in 4/3, 2, 3 ... 243/16

[4]

9. Find the sum to eight terms of 2048 - 1024 + 512 - 256 + ...

[4]

10. Insert 3 geometric means between -5 and -16/125.

[4]

11. In a geometric sequence the third term is -2 and the seventh term is -162. Find the eighth term.

[4]

12. If $x + 2$, $3x - 1$ and $5x + 3$ form a geometric sequence find the value of x.

[5]

13. Find the sum of $\sum_{x=5}^{9} x^2 - 3$

[2]

14. Write using sigma notation 2 + 5/4 + 10/9 + 17/16 + ... + 50/49.

[2]

Note: Sufficient space was provided for students to show their work on the original test.

Appendix E(ii)

Example Len Coleman Mathematics 31 Test
(Reviewed in Interview 2)

MATH 31 CHAPTER SIX

Name ____________________

[Value of each question is in brackets]

A. Find dy/dx

1. $6x^2 - 3y^3 = y$

[3]

2. $x^5 + 3x^2y^2 - 2xy^2 + 4x = 0$

[4]

3. $\dfrac{1}{\sqrt{x^2 + y^2}} = y^2$

[5]

4. For what values of x is $y = \dfrac{5}{x^2 + 5}$ increasing?

[4]

5. Find the equation of the line tangent to $x^2 - xy - y^2 = -1$ at the point where $x = 1$.

[8]

B. (a) Find the maximum and/or minimum values
(b) Find the points of inflection
(c) Sketch the graph

6. $y = \dfrac{1}{1 + 3x^2}$

[14]

7. $y = x^4 - 4x^3 + 10$

[14]

Note: Sufficient space was provided for students to show their work on the original test.

Appendix F
Interview Promnt: Student Report Card with Interview Questions

CITY PUBLIC SCHOOLS - PROGRESS REPORT

STUDENT IDENTIFICATION	TELEPHONE		
		12-A	

SCHOOL YEAR		REPORT PERIOD ENDING
1988/89	NO.1	OCTOBER 31,

COURSE CODE	SUBJECT	SEM CODE	TCH	CRED VAL	MARK THIS REPT	CURRENT REPORTING PERIOD REMARKS	CLASS AVG	CLS-ABSNT THIS REPT	CLS-ABSNT THIS YEAR	PREVIOUS MARKS 1	2	3	F. M.
31501	SOC ST 30	1		5	B 74		67	3	3				
32301	BIOLOGY 30	1		5	B 73	A PLEASURE TO HAVE IN CLASS	67	1	1				
32402	CHEM 30	2		5									
34102	DRAMA 30	2		5									
31000	ENGLISH 30	3		5	A 89	AN EXCELLENT STUDENT KEEP UP THE GOOD WORK	66						
3200.	MATH 30	3		5	C 52	AN EXCELLENT STUDENT	59						

Well done!

MARKING SCALE
80-100 (A) - OUTSTANDING
65-79 (B) - ABOVE AVERAGE
50-64 (C) - AVERAGE

BELOW 50 (F) - NO CREDITS AWARDED

Questions - Teachers - Interview #3
Report Card

(I) Take a few seconds to read this recent report card over.

(A) Then I'd like your specific reactions to this student's report.

[Probe: Make sure the discussion includes (avoid gender):
(a) What do you make of this student's abilities in mathematics?

(b) What do you make of this person as a mathematics high school student?

(c) This person is identified as an "excellent student" by two different teachers in two quite distinct subjects. The marks achieved vary greatly. What is your reaction to the use of the descriptor "excellent" (in both cases)? (Is this acceptable usage? Is this misleading usage? How do you think a parent should react to these uses of the word? How does one correlate "excellent" and the marking scale descriptors in the case of this student?)

(d) How meaningful is the administrator's "Well done" remark? (Is Mathematics 30 really being ccnsidered here?)

(e) Under what circumstances, if any, would you identify as "Excellent" a student who got a term mark of 52% in Mathematics 30? Is there an example from your own teaching history that you can describe? In the present Math 30/31 classes?]

(B) On the report card generally:

As a teacher in the same school district, you also have to use this report form.
(a) What is your general reaction to its format?

(b) What are your feelings about routinely identifying a student who gets a term mark of 80% in mathematics as "Outstanding"?
[More probing: Are there times when you believe it is inappropriate to have a student (and his/her parents) think of him or herself as "outstanding" in mathematics even though the mark is 80% or better? If so, describe those occasions. Example? In the present Math 30/31 classes?

Suppose 3 students, respectively registered in Mathematics 10, 13, and 15, each got 82%. According to the scale they would all be considered "Outstanding." What are your reactions to this? What if they each got 95%?]

Appendix G
Interview Prompt: Researcher's Description of "Excellent" Students

A Short Description of Some Students

I taught mathematics in a vocational high school. Students of all ranges of abilities - including high ability - could register (i.e., there was no upper cut off). The mathematics was, of course, of a more technical nature than you find in an academic school like Fairfield.

I have difficulty recalling any student I considered thoroughly "excellent." Three examples:

Dale was quiet, polite, usually did very well on tests, did his homework, had neat workmanship (he was a draftsman), sometimes helped other students, asked questions in order to understand but was usually quick to "pick it up," and occasionally demonstrated an interest in pursuing a problem beyond what was at hand. But he lacked a "spark."

Linda listened in class, worked in class, did her homework, did well and demonstrated depth of understanding on her tests - by-and-large they were too easy for her. She often discussed the work at hand with a small group of her female drafting peers. But she appeared not to be interested in being there. She could be "icy" at times.

John was cheery, outgoing. An automotive repair student. He usually "picked up" the mathematics material quickly and did well on tests. He helped those around him - sometimes too much: He was a crutch for some. But he often did not complete his homework. His workmanship was sloppy (but I could still discern understanding). In class the peer help discussions often became social discussions. I frequently reminded him to get back to the work at hand. He was friendly but not particularly respectful. The potential was greater than the exhibited reality. Perhaps he felt the situation did not require "digging deep."

Questions

(a) What are your reactions to this short descriptive piece? (In any and all respects that come to mind, without concern for being tactful or polite.)

(b) What does it trigger in your mind regarding <u>mathematics</u> student excellence? mathematics <u>student</u> excellence?

Please don't ask me any questions, however, such as "What do you mean here?" or "What is an excellent student for you?"

Appendix H

Student Group Interview Questions

Student Group Interview Questions

(1) Fairfield:

I'd like to ask about the nature of Fairfield.

(a) What does it seem to value in its students?

- What does the school not seem to value in its students?

(b) What does it seem to require of its students?

(c) In what ways does it honour its students?

- In what ways, if any, does it fail to honour its students?

EXAMPLES?

Related questions:

What is your perception of the school in terms of academics?

- As grade 12 students, what do you believe is expected of you in terms of academic work? Is this realistic?
- Same question, specifically in terms of mathematics.

(2) I'd like your feelings, based on your years of studying mathematics, on the balance of the statement:

"Being good in mathematics means ... "

(Consider: What, if any, are the criteria of excellence that you understand to be present in mathematics?)

(3) It has been said that in education students have a claim to knowledge.

(a) What claims on education do you feel justified in making?

(b) What claims on mathematics education?

(4) It has also been said, about marks or grades:

"As indicators of 'success' or 'progress,' marks or grades carry very important meanings."

What meanings, if any, do marks or grades carry for you? Are these important? What experiences lead you to feel this way?

Appendix I
The Interview, Analysis, and Interpretation Process: Excerpts from Interviews with Darren on Excellence in School and School Mathematics

Excerpts from Interviews with Darren on Excellence in School and School Mathematics

The excerpts are from those aspects of the interviews which particularly focus on gaining an understanding of the nature and significance for Darren of student excellence in education and in mathematics education. Insights evolve over the full series of five interviews. Notice the process of frequently returning to particular statements and discussions in previous conversations to affirm, modify or deepen interpretations. Notice also the relative unstructured character of the conversations. This sometimes produced hesitation in interviewer questioning, but it did permit the discussion to go in directions based on the particular responses given by Darren.

Some interviews focused more extensively and specifically on the theme of (personal) excellence than others, hence the variation in number and length of excerpts. See Chapter 3 for a more complete discussion of interview topics.

The excerpts begin with Interview #1 as Darren has been criticizing one of his science teachers for using class time to discuss things which do not appear relevant to doing and being successful in school science.

Interview #1 (1988-11-02), pp. 13-14.

I: Right. And you don't find, ah, - this year's math teacher, he's OK?

Darren: Oh, yes. I find that, um, he teaches you things that you're going to be tested on, and nothing else that's useless, that, you know --- The way I look at it, I mean, if marks mean so much, I don't want to know about anything that, you know, I'm not going to be tested on.... You know, I want to know what's needed to be known. Any extra stuff, I don't want any part of it.

I: Right. OK. In other words, ah, your aim is to, ah, just to focus on what you're going to be tested on, because that's where the marks/

Darren: Yes, because marks/ If marks weren't as important as they are ---/

I: OK, so you see marks as being important.

Darren: If you want to go to university.

I: Is that your hope?

Darren: Yes.... I'm looking at Business.... And it's not easy to enter, Faculty of Business.

Comment: The highly instrumental value Darren attaches to his secondary education is already evident in this first interview, which was essentially a "get acquainted" conversation. We see at this time he intends to go on to post-secondary study in a career- and financially-oriented faculty. Secondary education appears to be seen entirely as a stepping stone, and the only thing that appears to "count" is marks, which must be high to get into university. Any aspects of high school academic education which do not contribute directly to achievement in his courses are irrelevant, and worse, a waste of time.

Interview #2 (1988-11-16), p.3-4.

I: If I were to give you a rating scale - poor, fair, good, and excellent - just those four words, and I asked you to place yourself somewhere along that line, and it doesn't have to be exactly at one of those four, it can be somewhere in between if you like, where would you place yourself in terms of how you feel about your own -

and this is kind of gut, inside feelings - about your own ability in math. And don't be modest, or immodest or - you know, just kind of realistic.

Darren: Well, if I apply myself, I'd be, think, better, ah, word would be, like, 'above average' student, instead of/ Like, I'm not going to be an excellent student, getting 90, but I should be able to get into the 75 to 80 range. You know, better applied, I should be able to do that.

I: OK.

Darren: I've done that before. It's just that, I feel I understand some of the concepts --- before some of the people do in my class, you know, but, when it comes to the test, I'm having problems with long-term memory, or something. Because when it's first handed out, I understand it, and I wish [Len Coleman] could test us that day.

<u>Comment</u>: This part of Interview #2 is an early attempt to get at Darren's perceptions of his own status as a senior mathematics student. The question regarding "self-rating" was asked of all students. Student excellence is comparative, or normative. He sees himself as better than most in his class ("above average"), but apparently, not as good as some others. Marks are clearly a measure of excellence in mathematics (90% seems to signify excellence, 75% - 80% is above average, here). We also begin to see that perceptions of "understanding" mathematics help to shape the quality of an individual's ability to excel on tests, for example. In his own case, that understanding appears to fluctuate, and at this point he attributes that to possible "long-term memory" difficulties. It suggests that his belief in his abilities in mathematics does not always correlate well with his test product.

<u>Interview #2, pp. 7-8.</u>

Darren: That last test we had though, I <u>thought</u> I was pretty well prepared for it. You know, I was --- I studied for long/ like, throughout the week, I was studying for long periods of time. Usually I'm finding that when it comes to a test, so far this year, I --- am los/ It's like, a lot/ losing confidence, or something. I'm just not doing too well, so far.

Like, I'm prepared, and then, soon as I walk in that room, I get all tense and ---. First question - If I'm stuck on a question, I could be stuck on it for fifteen minutes before I realize --- you know,/

I: Right.

Darren: how much time is really ---. Just, <u>too tense</u>, for the tests so far. I've got to/

I: Well, how do you/ Ah, do you feel that way in other courses?

Darren: No [tone of 'thinking about it']. Just in math. Well, physics to an extent.

<u>Comment</u>: Part of this interview was a discussion of recent tests and exercises. The themes of personal success and self-confidence, and difficulties with tests that were mentioned in the first Interview #2 excerpt reappear here. Beliefs about mathematics ability may not be challenged at this point, but beliefs about the capability to demonstrate acquired knowledge and skill on tests are certainly being undermined. Darren is busy searching for explanations for his weak performance on tests. Long-term memory problems were mentioned earlier in the interview, here test anxiety is cited as a major factor.

Interview #3 (1988-12-05), pp. 23-26.

I: The last time we/ What was it the last time or the first time - one of them, we/there was a couple of comments. Remember I asked you, How do you see yourself as a student?

Darren: Uh-huh.

I: I forget what/ I think you said, I think you saw yourself "above average." That's what you felt. Ah, you made some comment, you know, "I'm not going to be an excellent student, getting 90%." And, ah, another point in time, you also said, "Marks were very important." And, you kind of communicated again today, particularly if you want to get into the Faculty of Business, things like that, these are crucial kinds of things. Ah, but another, sort of - section of our comments, before, ... you said it was your feeling, in talking about the Math 30 class you're in now, that you fe/ you had a feeling that a number of the students in the class had difficulty - had -- some trouble understanding; perhaps that was/

Darren: At least the first time through.

I: Yes, well, I don't know; perhaps now, in the last two weeks, three weeks, you feel differently about it. But that's sort of how you indicated then.

Darren: Uh-huh.

I: And you thought - it was your feeling at least, at that time, that you - I guess probably to do with this question of how, how you saw yourself - you felt you coul/ It was your impression you felt you could catch on to the math more easily than, than at least several of the other students in the class. It's not a big class, but -/

Darren: Yes, that's/

I: That was the reading you had.

Darren: Not the outstanding students (slight laugh),/

I: Yes.

Darren: You know, there's a few of them.

I: Are there, in that class?

Darren: Yes, there's a few -- that are even in my Physics 30 class, and doing good in both.

I: OK. Well, that sort of --. Ah, you yourself didn't see yourself as an 'excellent' student, would you/ these students that you mentioned, would you classify them as ---

Darren: Yes they're/

I: From what you know of them?

Darren: I'd say, committed students, you know. They don't do anything unless the homework's done, and the -- you know, I --/ It's kind of like you don't see them at parties, or - hall parties, or --- They don/ I think the best way to describe them is "committed" students, you know.

I: OK.

Darren: Good work ethic, and ---

I: Uh-huh.

Darren: they want to succeed. I -- could be -- what different/ You know, what makes me different from them is they're, really committed students. And I seem to be committed sometimes, and not committed at all, other times, and, yeah - back and forth, and --/

I: Are these people you talk to in class? Sort of like,/

Darren: Yes.

I: you turn to -- oh, ah, just generally?, or are they people you talk to about math?

Darren: -- Ah, I <u>don't</u> - know them that well,/

I: So that some of those girls that sit, ah/

Darren: One sits two behind me, and another sits - to the left. Yasmin and - Becky/

I: Yes. OK.

Darren: They're pretty good students, I think, you know.... I think Martha - Wong/

I: Wong? Oh, yes. Yes.

Darren: She's a good student too ---. All three of them are in my physics class. And they seem to be understanding everything. I've almost given up in physics, this year.

I: Is that right? Oh, that's too bad.

Darren: Oh, I jus/ He goes ---. Even the guy who sits beside me. I feel sorry for this one guy. He wants to get into physics, and he, he's good, he's a good student, but, the way that, I guess, this guy teaches is just totally over the head of this guy. He's losing it. He, like, gets so frustrated. You know,

I: Right.

Darren: and I'm just the same.

I: That's too bad.
OK. Let me just ask - If you can pull some of those thoughts together you had about some of those students, and - this is a very hypothetical kind of question, but ... let's suppose, if I were to ask you to finish this statement, "Being good in math means ...," what would you say?

Darren: Well, you'd have to look at the marks. It boils right down to marks. Being good in math is ---/

I: Means getting --/

Darren & I: higher marks.

Darren: Yes. I mean, ah, you can't/ Some people are natural at it, you know. You have to say that a person getting 90 is definitely better than a person getting 60 when it comes to a subject like math.

I: OK.

Darren: It all boils down to marks.

I: [overlap with previous Darren] That's interesting. You see, some people don/ OK, some people would say, when I ask them now, or just in the past, that sometimes marks don't adequately represent, ah, what they see as their own ability.

Darren: Well that's just a question of them trying hard enough, or --- you know --.

I: You say that's a bunch of rubbish, that, ah,/

Darren: No it's not. It's/ I agree with them. Like, um, -- I don't know how to put this -- Some people don't think that their mark fairly represents their ability. The only thing I can say is, you have to try harder. You know.

I: OK. In other words, there's a distinction between, um, ability over here, and, ah, -- actually, trying hard, and producing something.

Darren: Yes, well, see/

I: Sometimes the two don't/

Darren: You know, the bottom line is, marks are going to get you places. You, you can't walk up to university and say, "Yes, but I have great ability." Like, they're not --/ that's not going to get you anywhere.

<u>Comment</u>: In the first part of this excerpt confirmation is sought that marks are a very significant aspect of excellence, and this point is reiterated later in Darren's response to "Being good in math means ...". The implication is that a 90% mark suggests greater knowledge and skill in mathematics than a 60% mark does. Again we see Darren's focus on the mark as apparently the most significant thing that one can take away from a course. The utilitarian, instrumental value of the mark is ranked very high. The language of business is invoked: the "bottom line" is access to career opportunities.

In the excerpt we also begin to see what Darren believes it takes to consistently achieve high grades: "commitment" and "hard work," together with at least some ability in mathematics. Again, the notion of excellence as comparative is clear: he looks for difference. To gain a sense of the character qualities necessary for to achieve excellence he looks to those few students in the class who he feels are outstanding. These are qualities which he admits he lacks, at least in mathematics, and which separate him from those who are excellent (although he continues to believe that ha has above average ability). These students have made academic success their highest priority, which for him may not represent a desirable balance of academic/non-academic activities. These are people who appear to be students excellent-as-such (although Darren does not use this language).

One begins to see Darren's personal struggles: the value of high marks and level of commitment necessary to consistently achieve them versus the desire to live a more varied young adult life style. We see in this interview also that at the root of Darren's apparent long-term memory difficulties and test anxiety may be his lack of consistent commitment to study: he acknowledges that ability without commitment is very likely to lead to test results which do not correlate well with beliefs about personal mathematics ability.

<u>Interview #4 (1988-12-19), pp. 7-8.</u>

This excerpt opens with Darren is describing a student in grade nine who used to assist him with his mathematics problems.

Darren: ...most of the time, all you have to do is break down a question for somebody, and lead them along the way, and they're going to figure it out for themselves.

I: Right.

Darren: He was good at that. He just wouldn't say, "Well, to do this question, this is how you do it," and write it out for you, and -

I: Right.

Darren: and you look at it, and you have to go back, and see why (this works-?).

I: [Overlap with previous Darren] Right. OK.
So, I take it this fellow does - pretty well in math.

Darren: Oh, yes.

I: He must have done fairly well/

Darren: Still is.

I: Ah, I was wondering -- You remember last time I made some reference to this idea of an excellent student, and we talked about people in your class, in this class you're in right now. Is this a, a fellow you would call excellent?

Darren: Oh, yes. I think he was in IB math.

I: Oh, is that right?

Darren: Might still be, I'm not sure. Could have finished his math last year, too.

I: OK. So, he just seemed to have abilities, and understandings that - could see through the problems.

Darren: Oh, I think he/he had, ah/ you know, it's mind maturity back then, too, you know. Maybe his mind was a little more mature to handle abstract ideas, than, you know, other people's minds were at the time.

I: OK. Uh-huh.

Darren: You know, could be that, or --. He worked hard, too. That showed.

Comment: In this excerpt, Darren continues to develop characteristics of excellence in mathematics, with another student example. This is a student excellent-in-mathematics (SEM): he has a degree of understanding of the subject that few other students at that level have. The student is able to explain concepts or processes to others in ways that they can understand. His mathematics ability appears to be strong. At the same time, hard work, or a commitment to the subject also is a factor in this student's success and ability to understand.

Interview #4, pp. 11-12, 14-15.

Darren has a copy of the group interview question sheet (Appendix H).

I: ...I know last time I actually gave you that statement.... 'Being good in math means....' So, I won't ask you to kind of finish the sentence again, but I am curious/ one of the things that I ... have in my mind here is, is the notion of, ah - as somebody who's gone to school, and studied math, and, ah - from a school context, do you have a sense of what, you know, a notion of 'criteria of excellence' means, in 'present in math'?
... First of all, does that sentence [in question #2] have any meaning to you, or is it hard to understand?

Darren: No, it's pretty straightforward.

I: Is it?

Darren: (You-?) want to know the criteria of excellence.

I: Yes.

Darren: I have to say it's marks.

I: It's marks. Yes.

Darren: The only thing that's going to get you anywhere is marks.... I wish it wasn't like that. Because, you know, you can look at people like Einstein, who was never very good in school. I guess he had a learning disability. You know, he just/ the system squeezed him out, because his marks weren't good, and he comes, later on, with, you know, insight unheard of,

I: Right.

Darren: and ends up, you know, making history in physics and chemistry.

I: Ummm. And basically, how the world thinks of itself.

Darren: You know, that's one case of a person. Most times, if you don't have the marks, the system squeezes you out, and you're never heard of again, you know.

I: OK. Well/ If we/ What does it take to get marks? I mean, it takes being able to do the problems, and things like that. Right?

Darren: Hard work ---. Probably right up there, hard work.

I: OK.

Darren: Um --- sometimes you think, you know, repetition, that's what it is.

I: Uh-huh. OK.

Darren: Um - what else?

I: If you could - Well, think of yourself, or think of, ah, even this young fellow from grade nine, or/

Darren: Well, good thinking is <u>very</u> important, probably - Well, hard work would probably be first, and then would come good teaching, I would say, because, ah, you know, you can have the best teacher in the world, and if you don't apply yourself (seriously-?), there's no way.

I: Right.
What/ What's good teaching? How would you compare good math teaching to good English teaching? Or good/

Darren: Ahhh, that's a/

I: That might be kind of a wild question.

Darren: Ahh, it's almost like two different fields of education.... It's almost like apples and oranges.

...

I: OK. Do I t[illegible] then that/ I mean, granted, obviously there must be a certa[illegible]nt of ability, natural ability,

Darren: Yes.

I: to see things, but that, ah, by-and-large, ah, um, -- given a reasonable amount of ability - somebody who is not totally stupid -

Darren: Right.

I: that, that anybody, with hard work, and teachers that are informative, and, ah - anybody could ... in some way, be an excellent student?

Darren: Welllll, I'd say that's true. You know, we're saying a student without any learning disorders,

I: Sure.

Darren: or something like that - I agree. Because, I've seen people who are stupid in life, they couldn't even cross a raod, without getting hit three or four times by a car [I: laugh], but yet, it comes into/ you come into class, and, ah, they're getting 80s and everything.

I: Yes.

Darren: But they couldn't drive a car to save their life, or anything practical. So, sometime - you know, that might be the hard work aspect right there. You know, ... they're getting good marks, because of hard work even though, you know, in life they're not too bright.

I: Right.

Darren: I've seen that happen, lots of times. Mostly in junior high. I don't know if I've seen that happen too much in high school.... A really incredibly stupid person is getting good marks.

I: Right.

Darren: But, for sure in junior high I used to see that all the time.... Just, people work hard, not much of a social life, they come home, they do their homework, they read/

I: Yes. Well, that's interesting. You know/
OK, last time, when we were talking, sort of about this same thing - we talked about some of the people in your own class, and, and in fact, I asked you/ We got onto the business of, ah, "How would you describe the students in your class?" and ... I think you said they, they would be excellent - Yasmin, and Martha Wong, and I think you said, "Well, the best way I would describe them is 'committed'." And I took that notion of 'committed' to mean somebody who, ah, really applies themself, works hard, doesn't have any social life/

Darren: Well, not "any," but -

I: Or, very little.

Darren: Yes. Their schoolwork definitely/

I: Priorities.

Darren: comes before, anything following it,

I: Right.

Darren: I would say. I mean, the girl who sits behind me sometimes asks me the stupidest questions, I've ever -

I: Uh-huh.

Darren: But yet, come-/ I'm sure she's beating me on my average, right now. I beat her on that last test but, before that, it's been close, or, she's beat me.

Comment: This excerpt opens with a return to the statement "Being good in math means ...," this time with an attempt to probe using the language of "criteria of excellence." Are marks the strong factor that Darren has previously indicated they were? Can we expand his means of determining excellence in secondary mathematics? Again, he stresses marks as the criterion of excellence. Without good marks one is destined to go nowhere, he feels; one is "squeezed out of the system." Only in exceptional cases do those who fail to achieve success in school make their 'mark' in the world. Again, he indicates that hard work and commitment is the only sure way to consistently achieve these good grades.

We also build on Interview #3 in terms of the potential for excellence. Ability, along with commitment, is necessary if one is to be successful in the subject. However, excellence is within the reach of many students, because most have sufficient ability. The issue for these students, then, is one of commitment.

Darren indicates the importance of good teaching to achieving success in school. In a brief effort to probe the meaning of good teaching for Darren, the interviewer asks him to compare good mathematics teaching and good English teaching. The opportunity to discuss the topic through the process of comparison has been found to help some students get started, but this approach seems only to complicate the issue for Darren. Interestingly, he appears to see no similarities between teaching in the two subject areas, which suggests that he is functioning academically at the rather shallow level of instrumental understanding (this is also supported by his demand in earlier interviews that he be taught only what will be tested).

In this excerpt we also see that while he recognizes the hard work and commitment of some students has got them the good marks which he desires, Darren's respect for these students is not without limits. These people may very will be lacking in other desirable human qualities, such as the practical knowledge needed to function successfully in everyday life. He seems particularly contemptuous of these students.

This suggests that (some) students compartmentalize life's activities: one can achieve success and recognition in one area but that respect is not therefore automatically granted to the person in all areas of endeavour. In fact, achieving in some area may set one up for greater scrutiny: the "stigma of excellence" factor may be at work here. Academic achievement may be a "compartment" that especially comes under scrutiny in the world of the students.

Interview #4, p. 17.

A brief excerpt from a section on competition:

Darren: In my social class, I've seen/ you know, they'll sit at the front of the room, most of the ex-IB people, -

I: Uh-huh.

Darren: They're what you call mark mongers. Anything for an extra mark, you know.

I: OK. So, even though you feel marks are critical, um, --- um, they're not that critical.

Darren: Well, we can't get an ulcer over it.... You know, that's the way I look at it.

Comment: Again, the limits of respect for those students who academically do well is very evident. He has contempt for those who appear to cheapen themselves in the search for every mark they can get. Sitting in the front (and presumably taking notes, and asking questions) appears to qualify for this contempt. (Interestingly, Darren also sat quite near the front in Mathematics 30.) Perhaps these students also argue with the teacher over test scoring. It is clear, too, that Darren is only willing to apply himself, or commit himself, just so far to the task of succeeding on tests, and obtaining desirable grades. The struggle identified earlier - commitment, hard work, and good marks on the one hand, and a desire for a varied, socially active life style on the other, continues to be evident.

I: ...it's the whole question of excellence, excelling and that's also been a kind of theme that I've been looking at, but in a very broad way.... we've dealt with this topic before, but let me bring us up to snuff a little bit on what we have said before.
Ah, OK, - we've talked about, on more than one occasion, the standard of excellence in mathematics is marks.

Darren: Um.

I: OK. That's what you've, ah --. And then I guess we've talked about/ OK, what does it take to excel, if that's what math is?: Effort, hard work, commitment, understanding everything - those kinds of things were the kinds of words that got used.
I think in our last interview, too, we talked quite a bit about this in a way, and it was your feeling - and you might want to qualify this now, I'll just leave it to you - you felt at the time that anyone with a reasonable ability in mathematics, ah, could excel. By that I mean, they could get the high marks. If they work at it. In other words, if there was that effort, hard work,

Darren: Yes.

I: commitment.

Darren: As long as, you know, there is a/ you can't work with no ability. I mean, a guy can work as hard as you want.

I: Yes.

Darren: If there's no ability, what's going to come of it?

I: Yes.

Darren: But, ah, I say a person of average ability, who works hard in mathematics, no reason why they can't score between 65 and 75.

I: OK. Well, is that excelling in mathematics?

Darren: I guess (if-?) it's a personal goal, excelling, really. It's/ You could see/

I: Oh, OK. In other words, you don't have/ there is no sort of absolute number/

Darren: No, because when you think about it,

I: that says 'this is excelling,'

Darren: Yes.

I: and then, go below that, this says, 'this is not excelling.' Is that what you mean?

Darren: If you have a mark, the highest marks in high school,

I: OK.

Darren: and you're thinking long term, say you want to go to university to get the good job - I suppose that's the ultimate excelling, you know, you're coming out with a good job. OK, if you drop out of university, side-tracked, whatever, and you end up being in construction, and you're not getting your huge job, you look back at your mark in math, and I don't know if you can, you know, Was it excellence? Did you really get anything out of it? You know. there's a lot of ways to look at that.

I: OK. In other words, almost a measure of excellence has --/

Darren: It's almost long term.

I: is looking beyond/

Darren: Yes.

I: the immediate, "What am I doing this month?", or, ah/

Darren: It's "What are you going to do with it?"

I: OK. OK.

Darren: Now, that could be the ultimate -/

I: Uh-huh.

Darren: form of excellence, because, you know, really you're not getting paid to come to school. They don't/ I suppose you get scholarships with high marks, so, you know, that's another form of excellence, but really, I suppose unless you're, you're getting something long term out of it, really who can say what/ Mind you, yes, there you go. There's different/ Everyone has their own opinion of excellence.

I: Yes. It's a very/ a kind of a/

Darren: It's personal.

I: personal sort of thing.

Well, OK. I'm not even sure this is in keeping after the kinds of things that you said. Maybe I've, ah, I'm barking up the wrong tree. But let me try to pursue what I have written, and thought I would deal with anyway. You can correct me, or decide that that's inappropriate as far as the way you think.

If we focus a little more specifically on the subject of mathematics itself, if we could do that, kind of based on the kinds of things we've already talked about before and a little bit on what we've said about what math is now.

Just some interpretation that I'd like to run by you. Getting high marks means you've done well on the tests.

Darren: Yes.

I: This means you've answered the questions with the right answers; got the right answers. Ummm, so, is this what the standard of excellence in mathematics is? The/

Darren: The standard; yes.

I: Yes.

Darren: High marks.

I: The standard of excellence is getting the correct answers, which translates into getting full marks for the question.

Darren: Well, getting the right answer, and applying what you used to answer bonus questions.

I: OK.

Darren: Really, you know, bonus question on every test is always, seems to me, like a - you know, you have to apply your knowledge that much further; you know, beyond the call of duty.

I: OK. Right. This may be beating the thing to death, but, if that's what it is, what does it take to consistently get the correct answers? Now I know you've said hard work, and effort, and we've even talked about, takes good teaching too.

Darren: Yes.

I: Teachers have to be/help you.

Darren: Yes. Even though the books are fairly self-explanatory.

I: Is there anything else that you would say, ah/ I guess, I guess in a way it's looking into that black box that's called ability, and I'm not sure that that's an appropriate thing to ask, "What is ability?" But, on the other hand, maybe you've got some insights into that. If not - I don't want to get too psychological here, but what does it/ your sense of what it might take to consistently get good/ get the correct answers, in other words, get the things marked right.

[A brief discussion of psychology and brain development followed.]

I: I should be asking you, kind of base things on your experience, and your own experience tells you that given, ah, the reasonable ability that people have got in Math 20, 30,

Darren: Uh-huh.

I: then it's things like effort, good teaching, and a sense of academic commitment to the subject.

Darren: [overlap with the last of the previous] Setting goals for yourself.

I: OK. Ah, the thing is, those kinds of goals are/ could apply to any subject - physics, chem, English, social studies. Ah, physical education.

Darren: Yes.

I: And, ah, -- you know, they're not really mathematics oriented. Um, I guess that was what I was trying to separate. Can we do a little separation here? Can we say, you know, math is - we've got this general, personal drive,/

Darren: Well, I suppose with social, you/

I: Can we make distinctions?

Darren: I suppose you would need a little - like, most people, if you have an interest in history, like I do - I like social class; I could sit through a whole day of social class.

I: Uh-huh.

Darren: And there are people I know who, as soon as they go in there, they just turn their mind right off, and they daydream, because they, they lack an appreciation for history and it just flows through them.

I: Right.

Darren: You know, they really don't care. So, that's - having/ as far as I'm concerned, anybody can have the ability to understand history. It's not, you know/ I suppose some of the questions they ask get, you know, pretty in-depth, pretty heavy, but, for general, you know, you have to have an interest, that's a goal set for yourself right there. If you want to do well.

I: Would you say/ You could say the same thing about other subjects as well?

Darren: Yes. Math,/

I: [some overlap with previous] Math. Maybe one of the things you need, maybe, to, ah, that will certainly assist in achieving excellence in math - or any subject - is this having an interest in it.

Darren: Yes. I guess that's number one. That could be the number one needed function, is to have an interest. Some people are good with their goals, even if they are not interested. They force themselves to (take-?) an interest, and end up doing well, you know.

I: Yes.

Darren: The two probably run neck-and-neck, I suppose.

Comment: This excerpt begins with the interviewer seeking to confirm the human qualities discussed in earlier interviews that, along with some mathematics ability, lead to excelling in school mathematics, in terms of marks. The widespread potential for excellence in mathematics among students is also revisited.

A significant deepening in our understanding of Darren's belief that the potential is great occurs when he diverges from his earlier statements that appear to suggest that only high marks qualify as markers of excellence. High marks are still very much a sign of short term excellence, but the question, "What are you going to do with it?" gives rise to the matter of the steady pursuit of a long term personal goal - especially that of the "huge job." Achieving school marks (perhaps only 65% to 75%) sufficient to get one into university, where one continues to apply oneself diligently, and which finally leads to the successful career may in fact be the "ultimate form of excellence." (Is this another mark of the student excellent-as-such? It can be interpreted as such.) High marks in mathematics, for example, which lead to university, are in effect wasted if one drops out, or does something else for which there was no need to work hard to achieve the high mathematics marks. Interestingly, Darren ends that segment of the discussion with the acknowledgement that others may disagree with his assessment of excellence; it is a very personal notion.

The next section of this excerpt is an attempt by the interviewer to see if there is not something in Darren's perspective on excellence in mathematics that highlights the fact that it is mathematics that is being discussed. Hard work and commitment to a task or goal are general human qualities, not at all unique to mathematics. Although only moderate ability in mathematics is apparently necessary to excel in the subject, the interviewer turns, hesitantly, to the question of the meaning of mathematics ability. What is it, for example, that leads to some people better answering test questions, and therefore getting more right answers and high marks? The interviewer does not want the talk to become psychological or theoretical; unfortunately that is the direction the conversation takes, with Darren trying to recall what he had been told about brain development (this section has been edited out).

The question of the meaning of mathematics ability remains somewhat moot for Darren, although in Interview #4 we learned something of its meaning in the brief discussion of the grade nine student: his capacity to understand quickly, and to explain in terms that others could understand, for example. Our understanding of excellence in mathematics for Darren has reached the following level: ability and the qualities of hard work and commitment to goals go hand-in-hand. Without some ability, very little will be achieved; without hard work, ability alone will not produce consistent success (except in a few extraordinary cases). In the last part of the above excerpt another characteristic of the successful student is added: taking an interest in what one is doing. For Darren, achieving one's goals involves committing oneself to working hard and to taking an interest in the subject itself.

Interview #5, pp. 27-29.

I: Throughout our discussions I've had the sense of someone who has kind of been engaged in this sort of ongoing struggle. You wanted high marks, at least for reasons of getting into the Faculty of Business,

Darren: Uh-huh.

I: particularly. Ah, but I have the sense, even according to yourself, you were - well, I used the word 'prone' - to insufficiently applying yourself.

Darren: At times, yes.

I: At times. You'd then get upset with your perceived inconsistency in applying yourself.
Ah, on the other hand, I think, yourself - and maybe a lot of others too - seem/ you're only prepared, or willing to devote so much time to things like academic studies, which includes math. You've got other interests, outside and inside of school -

Darren: Too many.

I: for example, football in the fall, and then, these other interests, that you've mentioned work and music. Ah, I'm just curious; I put this question, "Is this an essential division in school life - probably particularly high school, when people get to be the age - 16, 17, 18 years old - and the social on the one hand, and the academic on the other hand?" Is there/

Darren: Always means trouble.

I: Is there always that tension there?

Darren: Oh, yes.

I: That that's part of school life, or -

Darren: The kids that usually do really well in school are the ones with next to zero social life.

I: They - sacrifice -

Darren: But there are exceptions, of kids who just naturally do well, and they, you know, maybe have never cracked open a book to study in their life.

I: Right.

Darren: Never studied for a test; maybe ten minutes, they're prepared,

I: Right.

Darren: they write it, they do well. That night they go out, be home, whatever.

I: Yes.

Darren: I've seen that happen, which amazes the hell out of me.

I: Yes. OK.
But by-and-large, there's these two -

Darren: Tensions.

I: tensions, <u>spheres</u>, if you like, of interest,

Darren: Most people try/

I: that people are confronted with in high school.

Darren: try to want to keep them balanced. You know, your head above water on both sides.

I: OK.

Darren: You know, you don't want your social life to become too dominant, and you're sinking in school.

I: Right. OK.

Darren: Try to keep them fairly even, and (1 word-?).

I: OK.

Comment: In this excerpt from Interview #5, we return to a theme that was earlier discussed as a "struggle" for Darren: The question of the need to commit oneself academically if one wanted to achieve the kind of marks one desired on the one hand, and on the other, a limit to the willingness to make that commitment, to give up non-academic activities. Some evidence of the close relationship between excellence and tension becomes apparent. Darren readily acknowledges the difficulty this tension presents for himself and other secondary students; this struggle is one many students experience. For him, and for many others, he says, the struggle is to try to achieve some sort of balance between their academic and social lives. The two are always tugging at one another. Some students, those do well academically, generally have given up much of their social life, according to Darren. Presumably, there are those who give too little time to their academic endeavours. No doubt, most of these people experience academic difficulty.

Interview #5, pp. 30-32

I: OK, let me ask you then, in talking about the school, and probably in mathematics: Does the school encourage excelling? And here my emphasis is on the word encourage. Now, here I'm really relying on your sense of/ your sense of -

Darren: Yes.

I: the three years you've been here.

Darren: I don't really know if you get/ like, they don't really reward you,

I: No?

Darren: as far as I've seen, really, for - Oh, you know, they offer you/ it's not like - they don't keep it a secret, all the scholarships you can try for.

I: Right.

Darren: They're only too happy to tell you the information. I suppose there is one way. Um, as far as their awards go, I, I - depends, I've never really/

I: What about particular subjects? I mean, if we looked at - lets take mathematics, seeing as how this is sort of the context for this piece of work. What you're talking about there, you know, is a sort of general - schools, as -

Darren: I suppose some kids shoot for the awards at the end of the year. You know, I, -- I've never really shot for - you know, that, that's/

I: OK, what was - I don't hear -

Darren: Encourage -

I: Encourage - yes -

Darren: They encourage -

I: Be discouraged - I don't suppose they <u>dis</u>courage you.

Darren: No, no.

I: Yes.

Darren: But they don't/ I really don't think they purposely encourage. They can do that 'til they're, you know, blue in the face,

I: Yes.

Darren: some students it just won't work. They use discipline. You know, if you're not there, you're going to get suspended, so -

I: But as you said, it's pretty much a personal kind of -

Darren: Yes, really. It has to be, really.

I: [overlap with previous] You said before, talked about it in terms of very personal - . Right, OK.

OK. Well let me throw this sort of second question - Given what we've talked about, the nature of school itself - it's got the academic, it's got the social kinds of things that sort of divide people's times, it's got/ it's got good teachers but it's - you know, not sure whether it sort of encourages,

Darren: Yes.

I: ah, that much. Ah, this is an academic school, on the other hand. <u>But</u>, would you say school/ is, is school <u>about</u> excelling in subjects? Is that what school, in general, is about?

Darren: Well, perhaps, in theory it's supposed to provide you with knowledge. Just, you know, just so the mass of people are educated, ... type of thing. Because you talk about that in social, democracy just won't work if your mass is uneducated.

I: Uh-huh.

Darren: that's the theory, but, you know, the practice is the people who give you jobs, they look to see what your marks are in school, and that's the bottom line, you know.

I: Yes. Yes, OK.

Well, what is/ what do you think school is about? If that's what it is in theory, in reality, you've been here three years, just being right in the middle of it all -

Darren: - It's what tax bracket you want to belong to later in life, is what it boiled down to for me. You do well, here/ well, actually there are students who do poorly in high school and, I don't know, night courses or whatever, do get university, and so get the good job with the good paying and the good benefits, but,

I: Right.

Darren: but, that's what it is to me, just preparation for a job.

I: OK.

<u>Comment</u>: This excerpt, from later in Interview #5, returns to the level of the school. The school had been discussed in earlier interviews; it had been acknowledged as academic in orientation. Much discussion about personal student excellence had also taken place in several interviews. The questions here were (i) does the school, Fairfield, actively encourage students to excel, and (ii) is schooling (not just Fairfield) about excelling in one's studies? Darren's response to the first question is somewhat ambivalent. The members of the school certainly do not discourage students from excelling, and they do award achievers, and encourage students to seek scholarships. He

appears at one point to have equated "encourage" with "coerce" (a point the interviewer did not pursue or clarify, unfortunately). Students faced with disciplinary action are more likely resist than to be moved to excel, he believes. Whether or not the school or individual teachers encourage excellence, however, at a deeper level, excellence is a personal matter. Only the individual can choose to reach for high levels of achievement. This is consistent with Darren's beliefs that fundamentally excellence in mathematics involves hard work, commitment to goals, and a decision to get involved, to take an interest in the subject.

The last question asks, "Is school about excelling in subjects?" Here Darren makes a clear distinction between the intrinsic and instrumental values of schooling. One can hear in part of his response the message he has likely been given at various times that schooling is about becoming educated, becoming an informed, responsible citizen of contemporary society. For this moment, one hears in his response attributes of education consistent with aspects of the rational, personal, and social conceptions of society. But Darren the realist has not "bought into" this vision of education. The bottom line is that schooling is just one necessary step along the way to the high paying job. This, too, is consistent with Darren's view of the nature and meaning of excellence.

Appendix J
Pilot Study

The Pilot Study

I. Introduction

A four week pilot study was conducted in February and early March, 1988 at a large urban Catholic composite high school. The aims of the pilot were to (a) provide a preliminary interpretation of the meanings of excellence for mathematics teachers and students; (b) assess the general feasibility of a study such as this, (c) assess the feasibility of involving both teachers and students, (d) assess the appropriateness, comprehensiveness and relative value of the various data gathering methods, and (e) in general, provide a clearer focus for the fall study.

II. Participants

One mathematics teacher and four students from the teacher's classes participated.

In all cases participation was voluntary, although it should be noted that the teacher asked each of the students if they would "mind talking to Mr. Franks." The selection procedure will be dealt with in greater detail later.

(i) Teacher

The teacher, Bill Cassidy (all participant names are fictitious), was the head of the school mathematics department, which had ten full time mathematics teachers. He had well over ten years of teaching experience, almost all of it at this school. Mathematics was the focus of his teaching throughout, although he had also taught other subjects. At the time of the pilot study, he was teaching one class of each of Mathematics 15, 30, and 31, and two classes of Mathematics 10.

Mr. Cassidy had a B.Ed. with a major in mathematics, and a Diploma and M.Ed. in Educational Administration.

I first introduced Mr. Cassidy to the study in December, 1987. He and I did know one another before this time.

(ii) Students

Two grade 10 students from one of the Math 10 classes and two grade 12 students from the Math 30 class participated - one male and one female in each case.

The teacher made the original selection recommendations on the basis of achievement level in mathematics and the student's likely willingness and ability to be articulate.

The research was verbally described to each student. The students were also given a written description of the research. All of the students agreed to take part, although one girl withdrew before the interviews began, and was replaced by another girl. Since they all were under eighteen years of age, written informed consent from their parents was also obtained from each of them.

There were very few students in either the Math 10 or the Math 30 class who were achieving consistently at levels higher than 80%. The school had an Honour Roll. To get on it a student's average mark in five subjects, including English, had to be at least 80%. The list was produced on a reporting term-by-term basis. Only one student from Mr. Cassidy's Math 10 class, and none from his Math 30 class, was on the current term's honour list. Mr. Cassidy accounted for much of this by noting that the Math 10 and Math 30 Honours classes which the school offered had many of the students who were achieving higher marks. He noted that none of the girls in his two classes was achieving at the 80% level in mathematics.

Mathematics 10 Students:

Jack was a very high achiever in mathematics, and did very well in other subjects. In grade nine his mathematics mark throughout the year was 100%. He was continuing at this level in grade ten. He was on the high school's Honour Roll. Mr. Cassidy described Jack as self-motivated, meticulous, "very bright" and a hard worker. He was an "excellent" student in Mathematics 10.

Helen was one of only seven girls out of a total of twenty-four students in the class. She stated that her mathematics mark for the latest term was in the "high 70s." Mr. Cassidy described her as "about average." On a mathematics test she wrote in February, she received 64%.

Mathematics 30 Students:

Carrie was also described by Mr. Cassidy as an average student in mathematics. Carrie showed me her current report card. Her marks in the "academic" subjects for both terms were in the mid-60s to mid-70s range, although in Art and Ukrainian they exceeded 90%. She claimed that she had been on the Honour Roll in previous years, and in the first term of the present year. Her current term math mark was 63%. Her mark on a mathematics test she wrote in February was 69%. In our conversations there was a clear sense of frustration with her present level of marks in mathematics and in some other subjects. She felt she was "not getting anywhere" despite "working as hard as [she] can work" (1). [The number in brackets is the number of the interview from which the quote is taken.] (Carrie was back on the Honour Roll again in the following term.)

Robert was described by Mr. Cassidy as an honours student in mathematics, although he had never been on the Honour Roll. Robert said he always had difficulty with English. His current math term mark was 81%. He achieved a mark of 91% on the February test.

III. Data Collection

The major research data collection methods consisted of audiotape recorded semi-structured conversations with the participants, classroom observation, and document collection.

(i) Semi-Structured Conversations

Four discussions were held with the teacher, and three with each of the students, for a total of sixteen. Each lasted approximately 25 to 45 minutes. Each talk was transcribed in full before the next one took place. Almost all of the interviews were held in the last three weeks of the research period, after some time had been spent observing in the classroom.

The first discussion with each person was generally fact-finding and exploratory. In the case of the students, the same initial questions were usually asked of each person. Later discussions built on previous talks, seeking clarification and greater depth. New areas were also taken up.

Talks with the teacher became more truly dialogic and conversational than those with the students. While discussions with Mr. Cassidy still had a "researcher questions, participant responds" orientation, my remarks were more often complex, lengthy and interpretive. Occasionally I would state my feelings on the matter under discussion.

The interviews with the students were certainly only semi-structured - "intensive interviews" in Williamson et al. (1977) terms - in that, while a number of the same questions were asked of each student, the talks tended to go in unique directions. The questions were less complex, and more direct. There was a greater concern for choosing the few words which would best indicate my intent (although this was not always achieved). There was a greater concern to avoid leading questions. I avoided espousing a position.

In the interviews the questions did tend to be somewhat general. They do need to be more focused, but not exclusively so, on the experiences of the participants.

Face validity with the teacher was attained by giving him a copy of each interview the day before the following discussion was scheduled. He read it over and was asked how he felt about it. Did he agree with what he had said? Did he wish to clarify any points? Did he wish to withdraw any statements from the record? Although the next conversation often explored further some of the issues discussed, because of time constraints, no in-depth interpretations of the conversations were made and provided to Mr. Cassidy.

The students were not given a copy of their previous interview to read. However, the principal purpose of the third interview was to review the first and second talks on a page-by-page basis, providing an opportunity for clarification where the student wished to make it, and an opportunity to have deleted from any further consideration any comments whatsoever the student wished. Again, no substantial interpretation was provided to the students.

This interpretive report prepared on the pilot was first reviewed in draft form with the teacher and the students before it was finalized and distributed. This provided validation of my interpretations of their beliefs of the meanings of excellence.

(ii) Classroom Observations

I observed five of the fifteen Mathematics 10 classes and five of the fourteen Mathematics 30 classes held during the four week period of the study. These observations were considerably loaded toward the first half of the research period (while much of the interviewing occurred in the second half). I occasionally became a participant, moving about the class and assisting the students.

Classroom observation served a number of purposes: (a) to become somewhat less of a stranger to the research participants, (b) to determine in a very particular way the subject matter being presented or studied in class, (c) to gain some understanding of the teacher's style of teaching, (d) to gain some understanding of the classroom actions of the student participants (participation in class, work habits, and so on), (e) to gain some understanding of the general teacher-students relationship, (f) to gain some understanding of the particular relationships between the teacher and the student research participants, (g) to gain some understanding of the nature of the interactions of the student participants with other students. Observing the class first facilitated the interviews.

The observations were also conducted for two very important reasons related to validity: (a) to serve as a means of verifying the statements of the teacher and the students regarding classroom activities, and (b) to provide an opportunity to gain a sense of the degree of consistency between teacher or student statements of belief about mathematics and mathematics teaching and learning, and teacher or student actions in the classroom.

It was not my original intent to limit the classroom observations once the interviews began. However, I found that efficiently scheduling interviews and classroom observations was often not possible. Transcription typically took three to four hours per tape and had to be done almost every day. Time spent at the school between interviews and observations did not seem particularly productive, (although it could have been used more effectively for document and artifact viewing).

Second, and perhaps most important, I questioned how valuable continued observations would be. After observing these two classes a total of ten times in the first two weeks, I felt I had a reasonably good understanding of Mr. Cassidy's classroom routine, which was similar for the two classes. The first part of the period was spent in whole-group session reviewing homework problems and introducing new material. Typically a little more than half the class was spent with students doing exercises individually at their desks, with Mr. Cassidy either moving among the students offering help, or at his desk helping students who came up. The students worked alone except for those times when one student might seek help from another on a particular problem. I felt I had some understanding of the classroom in terms of all the issues raised above. I believe now that this was a premature judgement. I need to pay continued close attention to the activities in the classroom as one basis for the interviews.

It may also be valuable to occasionally observe the other classes the teacher has, particularly if they are of a significantly different nature than those being observed regularly. For example, observing a Mathematics 15 class, or an honours class may be instructive. I did not observe Mr. Cassidy's Mathematics 15; I believe I should have. My feeling is that there may have been more student-teacher interaction, not only to do with class management, but also regarding mathematics applications, social issues and everyday living.

(iii) Document and Artifact Collection

Document collection was initially to be limited to the texts used, teacher resource materials and tests, and student tests and records. In the pilot study I did not push to see the student records or report cards, although Carrie did show me her most recent report card. The other three students simply told me their most recent report card marks. Helen could only recall her marks very approximately. As noted earlier, I also saw the marked mathematics tests the students had written in February.

In the major study, some official record will have to be requested as one piece of evidence of level of academic achievement.

I now realize that the range of documents to collect must be expanded to include school literature that describes school philosophy and courses offered (for example, the student handbook), forms of achievement recognition (handbook, newsletters to parents, memos to staff), administration views of student achievements in the school and district (school newsletters and memos, school board newsletters), and statements of the aims of education (school, school board, and government documents). It should also include the identification of school artifacts symbolizing student recognition (trophies, plaques, honour rolls). While some of these materials were collected and/or noted in the pilot, the document collection was not comprehensive.

These documents are particularly important to gaining an understanding of the meaning of excellence to the teacher. In this present pilot research, a vision of what it meant to be excellent in mathematics could not be separated from excellence in education generally, and this in turn needed to be considered in relation to the vision of education the school held. In terms of the aims of this research, various items on this added list of documentation appeared in fact to be more important, in the case of this teacher at least, than the original set of documents identified to collect. However, the textbooks used, other teacher resource material (teacher prepared or acquired) and teacher tests are still necessary.

These documents, particularly those that signify forms of student recognition, are also important when exploring meanings with the students.

The documents need to be introduced carefully, however. Their function will best be served when they can be introduced into conversations of experiences in which they have a place.

(iv) Other Sources of Data

Informal conversations with the teacher and observations of the interactions and relationships of the teacher with other teachers in the mathematics department were other important sources of information. For example, as head of a department with ten teachers, Mr. Cassidy had some concern for consistency, if not in teaching styles, than at least in terms of academic results. Such a concern may serve as a constraint on, or an incentive to, the activities of the classroom when interpreted in terms of attaining excellence mathematically or educationally in general. It may also serve to help shape what it means to be excellent in these ways.

(v) General Reflections on the Data Collection Methods

One of the aims of this pilot was to assess the appropriateness, comprehensiveness, and relative value of the data collection methods. While the recorded discussions are the principal means of exploring what mathematics excellence and educational excellence means to the participants, the other methods are also a valuable part of the overall research strategy. Each has the potential to serve as a partial check on the data obtained through the other procedures. The teacher and student discussions also provide a check on one another. Consistent teacher and student statements strengthen the point being made; apparent contradictory statements indicate a tension that needs to be pursued. The educationally-related environmental and social contexts of the teacher and students must also be considered. Classroom observation and school document collection provide ways into understanding those contexts. Documentation also provides insights into the societal context of which these people are a part.

IV. Interpretation

A thematic analysis of the teacher's and students' views of excellence is presented here. A general, more interpretive discussion follows the presentation of themes of each group.

An Outline of Themes of Excellence: Teacher

Initial Comment I: Views of Personal Ability in Mathematics

Mr. Cassidy said he liked mathematics when he was a student, and found learning the concepts and problem solving a challenge. He perceived learning mathematics as learning a language. As a teacher he has not found mathematics difficult. He considered himself a capable mathematics teacher. By this he meant (i) that in general he got along well with the students and had few classroom management problems, and (ii) the achievement levels of his students were consistent with those obtained by the students of his mathematics department colleagues.

Initial Comment II: Views of School Mathematics

A small percentage of the students Mr. Cassidy taught may become mathematicians, but the study of school mathematics was not to produce mathematicians. Some students may eventually make extensive use of mathematics in their careers, but Mr. Cassidy did not teach the subject with this as his principal objective. Instead, mathematics, as a school subject, was "a medium to get to the kids" (1). It was an opportunity to encourage young people to extend themselves, to go beyond what they think they are capable of. Students should not be stood over and forced "to work beyond what they want to work....That's up to them" (1). They should be encouraged to work; if they seem to have the ability they should be told that they could do better if they were willing to apply themselves, and they should be encouraged to seek help when they need it. Students also should not be "spoon-fed." It was a matter of personal decision and initiative. This was particularly the case with the senior academic students, i.e., those in Mathematics 30 and 31. (The students in the study agreed that Mr. Cassidy neither spoon-fed them nor forced them to work. His approach was not one of detailed, lengthy discussion and explanation. One student remarked in the third interview that "You have to be pretty smart to understand what [Mr. Cassidy] is saying." Students had considerable time to work on their own in class, and, if necessary, to take the initiative of seeking help from Mr. Cassidy or other students.)

Mr. Cassidy believed that it was important that the applications of mathematics be discussed with students. "As much as I can relate the program to everyday life, I try that" (2). Some topics, such as "straight polynomials and factoring" did not lend themselves to discussions of application, a position which was supported by observations in both classrooms. Extensive discussion of applications was something of an ideal condition, however. The heavy program (2) often left time for little more than a brief commentary on specific applications, history, and so on.

Still, the mathematics needed for everyday life applications could be acquired by the end of grade six or seven. The main aim of studying the increasingly complex senior mathematics was to develop thinking and general problem solving skills to assist in handling the general career and everyday human problems encountered later in life. The acquisition of content knowledge, although necessary, was less important (2) than developing strategies for decision-making (4). Further, becoming successful in school mathematics not only developed one's logical thought processes; but also provided one with the realization that problems could be overcome. The personal effort to overcome difficulties in mathematics and learning to seek help when it was needed would be valuable lessons later in life.

This was in fact the principal value of all schooling, not just mathematics (although by its nature mathematics did emphasize decision-making growth). Mathematics was just one component. On the other hand, Mr. Cassidy also believed that many in society typically considered mathematics to be difficult. Therefore the subject had the added virtue that academic success in it was often looked upon quite favourably by, for example, employers (2).

Themes of Excellence

(1) In Tune with the School's Vision

Mr. Cassidy had a vision of education that was in tune with what he believed was the basic philosophy of the school: provide program opportunities for all students in an effort to insure that they become caring, contributing members of society. His hope for the students in his classes was that they did more than simply hold a job; that they did not hold others back; that whatever they did, they be the best they could be (1).

Excellence was something that was personal; it could not be directly taught (1). Nevertheless, Mr. Cassidy believed that teachers and the school could have a substantial impact through providing opportunities for, and guiding and encouraging students to reach toward their full potential, that is, to be excellent (4). In this case, the school, not the individual classroom, was the 'unit of excellence': that is, the school had to have a well-defined philosophy, with "everybody [teachers, administrators and other staff] pointed in the same direction" (4). The school was more than the sum of its classroom and administrative parts. Individual teachers had to care for young people, and encourage students to reach beyond present levels of ability and skill, and increasingly make choices for themselves, but it would take all school members, jointly participating in a variety of curricular and extracurricular activities, to create an atmosphere and concrete conditions conducive to motivating students to become effective, excellent students and citizens.

(2) The Limits of Marks

High marks were a sign of excellence in terms of academic standing, but a knowledge of the student's marks alone indicated very little of the character of that excellence. This knowledge said nothing about the process undergone to acquire the marks, and the process was very important. "If we're talking about excellence in terms of a class of kids achieving highest marks, that doesn't mean anything to me, because I think I could set them down and...probably prepare every single kid to achieve really high marks. They probably wouldn't learn very much because I'd be on their cases all the time" (2).

(3) A Truer Sense of Excellence

True excellence in a student was marked off by self-motivation, persistence, and a desire to work and apply oneself, coupled ("balanced" - (4)) with, in the case of mathematics study, an ability to solve problems, make decisions, and in general demonstrate good reasoning skills. The real measure of one's excellence could in fact only be taken later in one's life: "Is he a self-starter when he finishes school? Does he try to achieve goals that are beyond the everyday, mundane type of lifestyle?" (3). The nature of school was such that it could not provide final answers to these questions.

One strong relationship between such excellence and marks was this: Consistent achievement of high grades, especially over a range of courses sufficient to warrant Honour Roll status, was a strong sign of hard work and/or well developed, efficient and effective work habits (2).

(4) Variations of Excellence

Mr. Cassidy believed in various types of excellence, and that excellence could be exhibited at all levels of ability. He believed that to acknowledge the achievement of only those in the academic path (10-20-30) was elitist and wrong. For example, it was his claim that, "theoretically," there should be an equal number of high achievers across the Mathematics 10, 13, and 15 levels (3). Furthermore, one could not say that a high achiever (in marks) in Math 10 had reached a level of excellence beyond the others in Mathematics 13 or 15. This was consistent with Mr. Cassidy's claim that excellence was not only keyed to an ability to successfully do the work at hand, but also to showing initiative and working hard to learn. Seldom should a Mathematics 15 student, for example, be considered a Mathematics 10 level student who just could not be bothered trying. If a Mathematics 15 student obtained high marks, it was very likely due to hard work and personal initiative, and thus the student deserved every bit as much as the high achieving Mathematics 10 student to be called excellent. Where the difference possibly occurred was in whether one might call this Mathematics 15 student excellent in <u>mathematics</u>.

It was also Mr. Cassidy's position that the school recognized in various ways those students who exhibited a number of different forms of excellence, for example, in athletics, academically, and in shop. The school did so through the Honour Roll, Awards Night, report card, and informally. All students, no matter what program they were in, could make the Honour Roll as long as their average mark for five courses including English was at least 80%. Those students who made the Honour Roll received a gold seal on their report card. According to Mr. Cassidy, the school had a very large awards night at the end of the year, with awards going to a large number of students for a wide variety of achievements. The informal recognition - as verbal praise and encouragement - came from teachers in the classroom.

There was a hierarchy of recognition, however, that was evident in the school, and even moreso in the school system and in society generally. Achievement in the academic subjects, as revealed by marks, was ranked higher than other forms of achievement. It was here that Mr. Cassidy had "difficulty with the system" (2). The school, the school system, and the province devoted too much attention to diploma examination marks for comparison reasons. Too much recognition was granted by the system and the state to those with high academic achievement, particularly in the form of financial recognition (for example, the provincial student scholarships). Too little was granted to those who demonstrated other forms of excellence in school (with the possible exception of those who showed outstanding athletic ability), and to those who applied themselves while in school, but whose marks were not "conventionally" excellent.

General Comments on Excellence

Mr. Cassidy considered excellence an elusive, difficult to fully articulate and measure quality, potentially having many contributing variables (4). The possibility of demonstrating excellence in school mathematics in a manner completely distinct from exhibiting excellence derived from schooling in general was not possible because the notion of excellence was fundamentally linked with such human traits as initiative, working hard, and persistence, and with such social qualities as caring, being socially responsible (the meaning of which was much less elaborated in this short study than that by Prakash and Waks (1985)), and being societally productive.

Understanding Mr. Cassidy's Beliefs about Educational Excellence in Terms of His Mathematics Teaching

Based on a limited number of classroom observations, many of Mr. Cassidy's teaching practices and views on evaluation seemed consistent with his general philosophy of education and educational excellence:
(i) His classroom teaching and department stance was "low key." He did not talk extensively or loudly. He exchanged quips with students and colleagues. He was occasionally mildly sarcastic with those students who did not appear to be applying themselves.
(ii) He introduced new material with explanations and a limited number of representative examples. He did not spend much class time reviewing exercises. He once remarked to a student that when someone asked him to go over all the questions because they had difficulty with them, he interpreted that as meaning they did not (try to) do their homework.
(iii) He often provided an extensive period of class time for students to work on assigned exercises either alone or in small informal groups. Mr. Cassidy circulated among the students while they were working, offering help if they asked for it. He occasionally would review a problem at the board. He also worked at his desk at the front of the

room, and he expected students to show initiative and go to see him if they needed help.

(iv) Mr. Cassidy did not give very many tests to the students, fewer, he said, than the other teachers in the department. He felt that students were not there to be tested all the time (1). Mr. Cassidy said that he argued at a school administration meeting that two hour, end-of-first-semester examinations for full year courses should be replaced by class time tests. (His suggestion was not accepted.)

(v) Mr. Cassidy believed that the grade 12 provincial diploma examinations were unnecessary. Teachers knew what their students were capable of. The examinations led to teaching to them. They led to the use of multiple choice examinations in class in order to prepare students for this type of test. This form of evaluation had limited value for learning a student's strengths and weaknesses in mathematics. The examinations led to school and teacher comparisons. Shortly after the field study began, he noted a recent School Board newsletter containing a short article comparing two sets of grade 12 diploma examination results for the school system. Prominent in the piece was a bar graph display, with percentages presented to one decimal place. He pointed this article out as an example of the district's preoccupation with comparisons and rankings.

On the other hand, Mr. Cassidy seemed to be caught in some compromise and apparent contradiction.

(i) He did give multiple choice examinations to his Mathematics 30 students. Since the reality was that these students did have to write multiple choice provincial exams, it was only fair to them that they should be experienced with the multiple choice format.

(ii) He appeared to teach mathematics in a manner that emphasized "how-to-do-it" with small pieces of topics at a time.

(iii) His evaluation of the students was based solely on paper-and-pencil tests. The tests consisted of a series of isolated questions which focused on content knowledge and skills. They were closely modelled on the type of exercises done in class. The Mathematics 10 and 30 tests administered during the field study dealt with such topics as simplifying rational expressions, and factoring and dividing polynomials. In Mathematics 30 he gave the students multiple choice examinations. He believed that this form of paper-and-pencil testing was really insufficient (3), but that time, large numbers of students, money, policy (e.g., diploma examinations), and system structure prevented the introduction of more in-depth appropriate procedures. These procedures included such things as watching and listening one-on-one as students solved problems, detailed journals recording the mathematics progress of each student as they proceeded from grade to grade (these were NCTM suggestions readily agreed to by Mr. Cassidy), and holding contests which required students to research a relatively complex problem and attempt to model the situation mathematically. This latter procedure would be a much truer test (see Excellence items 2 and 3 above) of one's mathematical ability as a problem solver.

Mr. Cassidy was agreeable to substantial change in curriculum and evaluation approaches, but adequate time, materials and research support, and funding had to go hand-in-hand with these changes. He doubted that these conditions would ever be put in place in the foreseeable future.

Discussion: The Question of "Contradiction"

In describing and analyzing Mr. Cassidy's perspective as an experienced teacher, we are quickly reminded of some of the positions and research presented in Chapter 2, such as those of Cusick (1985) and Blase (1986). We see a strong compatibility between what Mr. Cassidy believes the school's vision for young people is, and his own educational views. He does believe that the school has an integrated sense of itself, and this vision "affects the way you teach" (1).

One can see in Mr. Cassidy's views and teaching style many of the characteristics of mathematics teachers cited by Fey (1979), Goodlad (1984), Romberg and Carpenter (1986) and others. These authors are often critical of some of these teaching perspectives and styles. As I have done above, one could note points of apparent contradiction between what is discussed and what is practiced when it comes to views of excellence in mathematics and in education.

But this is likely perceived as contradiction from the point of view of the outsider only. One must push deeper, attempting to grasp the situational meanings as they are understood by the teacher. While a one month study is a very limited endeavour on which to base much in-depth interpretation, Mr. Cassidy did seem to clearly recognize at least many of the constraints the structure and functions of formal education in Canadian society impose on the individual teacher. He appeared to be quite aware of the differences, often significant, between what he considered as an ideal education in mathematics and in general (as embodied in the beliefs and actions of students), and what he believed he must pragmatically do to be successful as a teacher in the system. He did what he felt he could within the sanctioned limits as he understood them. I suggest the contradiction and compromise an observer might claim to be present are instead recognized by Mr. Cassidy as the limits to the concrete institutionalization in classrooms and schools of idealized meanings of excellence.

As noted earlier, Mr. Cassidy believed the notion of excellence was a difficult and elusive one to fully articulate and measure. While meanings were closely tied to achievement levels in some respects, they were certainly not limited to such criteria.

Given the formal educational system, with its constraints and apparent focus on academic achievement, the most likely notion of excellence to be achieved in school, in mathematics, is the "technical" (Prakash & Waks, 1985), that is, a focus on having the students become very successful on tests, and thus get high grades. Yet this is not a stated principal aim for Mr. Cassidy. On the other hand, to deny this as being any sort of significant objective of his would not be possible (and still remain a teacher in the system). Of necessity he must strive to ensure a certain level of technical competency in mathematics across his students.

Mr.Cassidy seemed definitely to see himself as having an opportunity not only to teach the students mathematics but also to build moral character, to assist them in developing life skills, to shape and mold them into positively contributing, caring and committed members of society - i.e., the perceived dual roles of mathematics teacher and educator. In Blase's (1986) language, Mr. Cassidy very much appeared to exemplify the experienced teacher who has become "humanized" in the process of being socialized into the world of school (although we must be careful not to claim that this was the process through which Mr. Cassidy came to believe and act as he did).

For mathematics teacher Mr. Cassidy, the meaning of excellence had less to do with turning out those who excel in mathematics (as mathematicians - the "rational" view of excellence (Prakash & Waks, 1985)) - and much more to do with attempting to ensure a good grounding in skills for later life which mathematics particularly provided. There is little doubt that Mr. Cassidy would not discourage the student who demonstrated a well-defined "logical-mathematical intelligence" (Gardner, 1983; Greene, 1984), who demonstrated knowledge, skills, ability, and creativity in mathematics. But the reality of his situation, as he understood it - a teacher serving a large number of students who had a wide variety of abilities and skills (and ability and skill levels) in a large school in a large school district in an even larger structured provincial system of education meant that it was not feasible to focus one's personal efforts on an intense "initiation" (Prakash & Waks, 1985) of all students to the disciplne of mathematics.

The fundamental vision of the school, as Mr. Cassidy understood it, and which he desired to pursue with students, revealed a closer relationship with views of excellence such as "self-actualization" and "social responsibility" (Prakash & Waks, 1985). Aspects of what Greene (1984) called "mindfulness" and "open perspectives" were evident in Mr. Cassidy's desires for his students, in his vision of a child receiving an excellent education. Some of the points that Greene stressed as human capacities to be strengthened by education - integrity, autonomy, fidelity, strength of will, and persistence - were also part of Mr. Cassidy's ideal vision of excellence in education. Yet the structure of schooling, the nature of the curiculum, and the limited range of sanctioned evaluation approaches placed constraints on Mr. Cassidy's opportunities to move in these ideal directions. He was not oblivious to these limitations.

Finally, I want to tentatively suggest that "socialization as humanization" (Blase, 1986) may be the long-term response of many teachers to a situation perceived as one which predominantly sanctions and encourages "technical" excellence in a subject area - with "mental proficiency" as the standard - but which teachers themselves do not wish to endorse wholeheartedly as their principal aim as teachers. There is a rejection of this as the fundamental goal of schooling because it signifies, for the teacher, too limited a place for themselves and the school in the lives of children.

An Outline of Themes of Excellence: Students

Initial Comment: Views of School Mathematics

All four students claimed they liked mathematics, although it was not necessarily their favourite subject. Several of them remarked that they liked "working with numbers." Their fondness for mathematics was highly (informally) correlated with their claim that historically they had received good marks in the subject, and that they usually had very little trouble "picking it up."

These students rated themselves in mathematics as either excellent (Jack and Robert) or good (Helen and Carrie). They all expressed confidence in their abilities although Carrie in particular was beginning to feel some doubt.

Some of the students were not meeting with quite the same success this year in mathematics. Carrie's frustration has already been noted. Although the situation was improving, Helen was still in the process of adapting to Mr. Cassidy's teaching approach after three junior high school years with the same teacher. Robert had not met his expectations the first term in mathematics, but had brought his second term mark up to over 80%. Jack continued his high level of achievement in marks from junior high school.

The students identified mathematics as being "either right or wrong" in character, and this set it apart from subjects such as English and social studies. This was a positive attribute of mathematics. Below is a sample of comments from all four participants:

- "it's either right or wrong." (Robert, 1; Helen, 2)

- "there is usually only just one right answer." (Jack, 1)

- "in other subjects you need to do research...but in math...you either know the stuff or you don't." (Robert, 1)

- "math is math." (Helen, 1)

- "it's just something that you have to work at, and you get to plug in numbers and think, think down the answers and stuff." (Carrie, 1)

All four students saw mathematics as essentially an individual activity. One learned it by following the teacher's explanations and examples, and then practicing on one's own. Spontaneously arranged small group work - where one or two students ask another student (like the four participants) how to solve a problem - were good, because peer assistance was valued. On the other hand, organized small group work was considered inappropriate to the nature of mathematics. This view appeared to be based on a history of seldom or never experiencing such group work in their years of mathematics schooling. Full-class discussion (not the teacher-student homework review) was also not the norm in mathematics classes, although some thought such discussion would be interesting and helpful.

The purposes for studying mathematics fell into two categories: (i) it "makes you think a lot" (Robert and Helen), and (ii) it would be useful later in life in career and everyday (Jack and Carrie). This division among the students was not total; Robert, for example, also identified mathematics applications as particularly interesting.

The strength of these perceptions of the the purpose of studying mathematics was questionable: Jack and Carrie also remarked that it was something that had to be taken so one did not question its purpose too much. Helen presently could see little real purpose, but she accepted the explanations of various teachers that mathematics would help develop her mind; they "made sense."

Perspectives on Educational Excellence

(1) The Place of Marks

High marks were an important symbol of excellence. (A "high mark" was a somewhat relative thing, but at a minimum it had to exceed 80% - honours level.) Marks were an external sign of achievement that signified an ability to "pick it up easily," to do the work correctly, and with confidence.

High achievement in the form of marks also signified effort and applying oneself, at least as much as was necessary to achieve the high marks. Jack's goal was always to strive for "perfection" symbolized by 100%. In courses such as mathematics, this meant minutes of study; in English and social studies it meant hours, and still no 100%. Helen, and particularly Carrie, believed that honours level grades implied hard work (seldom 'born' ability) and excellence.

There was a second side to the issue of the significance of marks. High marks served as a signal of excellence to others; lower marks could sometimes be a misleading signal of "averageness." For example, the lower mathematics mark of 71% Robert received in the first term was not consistent with internal beliefs about his personal abilities. However, only those familiar with his past mathematics record such as former teachers would know that this was not representative of his abilities.

Carrie advanced a third, related point which further complicated the interpretation of marks - the interpreter's knowledge of the context and mathematical sophistication. Peers, whose mathematics knowledge might be limited but who know the school context and share the mathematics experience, might conclude that an exam mark in the 60s was good. Someone more advanced in their study of mathematics, yet ignorant of the context, might consider such a grade to be rather average or poor. Thus, the discernment by others of ability in mathematics based on marks was a relative thing. Jack's comments on excellence in the third interview tended to support this view: Grades were important, but "you can't really tell if a person is excellent unless you know how he feels inside....The person himself has to be able to tell you."

(2) Deciding on Excellence: Measuring Ability, Knowledge, Skills, and Understanding in Senior High School Mathematics

The students understood that the measure of what one knew and could do in mathematics was determined by tests only, and represented by a percentage mark. The types of tests used have been briefly described in the teacher section. They were based closely on classroom, worksheet, and text examples and exercises. The focus was on content knowledge and skills.

Students uniformly saw this as an appropriate form of evaluation. Indeed, Jack felt that Mr. Cassidy should administer more tests to permit students to better assess how well they were learning the material and skills. Carrie had another proviso, issued to all teachers: that the test contents should <u>very closely</u> mirror what recently had actually been covered in class. Only then would test marks be an accurate reflection of how well the material had been learned. She noted: "I think the marks should reflect both your work and theirs [the teachers']" (1).

The response to whether other forms of evaluation should go into composing the mark was mixed and of low concern; for some, classroom participation and attitude did have a limited place. No other forms of evaluation were considered.

(3) The Significance of Being Excellent (Or Not) in Mathematics

Jack and Robert were presently receiving marks above 80% in mathematics; Carrie and Helen were not. All four claimed to have been honours students in mathematics at some point in their secondary schooling (e.g., junior high school).

Jack perceived mathematics to be an especially important subject, and was particularly proud to be excelling in it (100% as opposed to being in the 80s). He considered it more valuable to study and retain later in life an understanding of many of the mathematics topics than it was to remember, for example, various laws of physics. He intended to continue to study mathematics at university.

For the others, there did not seem to be any particular significance to excelling (or not) in mathematics. Robert and Helen were pleased to see their mark improve in the second term, and Carrie was distressed to see hers drop in grade 12, but there was no special significance to the fact that this was happening in mathematics.

For reasons of "personal satisfaction" and university entrance it was important for Robert to maintain a good mark in the subject. However, for those same reasons it was just as important to do well in physics. Helen's second term mark was in the "high 70s" she said.

Since she was so close to 80%, and had received such marks in junior high school, would she be pushing to reach honours level in mathematics? The answer was no; she was going to concentrate on those subjects which were below her expectations.

(4) Recognition (and Relation to Others)

(a) Informal recognition

Informal recognition came principally from peers, friends, and teachers, and was the type of recognition one was most likely to receive for "single event" accomplishments such as doing well on a test, or in a particular subject on the report card. For the most part this recognition was positive, and appreciated. Jack in particular frequently received this form of recognition for his efforts, especially in mathematics.

Another form of appreciated recognition for Carrie, Helen, Robert, and Jack in mathematics was the request for help from their peers. This was a sign of long-standing success in the subject. For Helen, who was not on the high school honours list, it was a sign that she was still "sort of" an honours student in mathematics. Carrie was aware, however, that while she still believed herself to be "better than average" (1), she found in this present year that she was having to work more on her own, and offering less help to others. Although not a major concern, this was another factor apparently contributing, at the time of the study, to some loss of confidence in her mathematics abilities.

(b) Formal recognition

Receiving formal academic recognition from the school depended upon how high one's marks were, the student participants said. The main medium of formal recognition was the Honour Roll (and the gold seal on the report card). The list was updated on a term-by-term basis. Everyone thought this was a good and appropriate form of recognition.

There was no formal recognition for those who did well in a few subjects. Robert said that he had never received school-level recognition for his marks in mathematics. (This did not disturb him.)

Jack was the only student presently on the Honour Roll, although Carrie said she had been on it in the past. She was unhappy that she had not quite made it in the most recent term. (Her average was 78%.

As noted earlier, she made it the next term.) "I don't know of anybody who wouldn't want to be recognized for something" (Carrie, 1).

Some believed that effort should be recognized separately. A good attitude and hard work were what teachers such as Mr. Cassidy often asked of the students, and there were those who worked diligently but did not receive the required minimum 80% average. Informal teacher praise was appreciated but formal school recognition would also be welcomed. This list, created on the basis of teacher judgment, was a carryover from junior high school. Robert, who had made the junior high school Effort Board, questioned its value. It might give some students a "boost," but overall "it wouldn't matter much" (2).

(5) The Place of Pressure in Excelling (or Trying To)

Pressure came from three sources: personal, home, and peers. Personal pressure arose, not surprisingly, when personal expectations were not being met, or, as in the case of Jack, in order to maintain high expectations.

Home pressure varied considerably among the four students. Carrie especially felt pressure to raise her grade 12 marks to honours level because past accomplishments indicated "she could do it" and because scholarships were available to those who did (e.g., Rutherford). Although she felt no direct competition with them, knowledge of the academic success of her older brothers in school and university increased the level of personal pressure. When the results she hoped for were not completely realized, frustration set in.

The pressure on Jack was not from home. Personal and peer pressures were the driving forces. He was expected to do well, and being ribbed when he got less than 100% served as a prod to do better next time. "...When I write tests, especially in math, I'm not doing it just for myself, but for other people too" (1). Jack welcomed his classmates' challenges to try to beat him. It spurred him on, and more importantly, it induced the challenger to work hard. It disturbed Jack to think that some students were content to beat another class's test average simply because of his presence. It would be far better to have everyone take up the challenge of trying to beat him, and thus raise the class average that way. He was sure also that students would feel increased personal satisfaction.

There was one other form of pressure which all four students seemed to want to avoid: the high expectations of advanced level courses. The school offered an honours program in mathematics - Mathematics 10H, 20H, and 30H. The qualifications were mathematics marks of 80% or better, and a teacher recommendation. Many of the four participants could have qualified on the basis of marks, but none were in the program and, at the time of the interviews, none seriously entertained entering it. Helen and Robert felt that they would not fit in with those who openly identified themselves as top students in mathematics. Jack and Robert did not want the added of pressure of increased expectations. Both believed themselves to be excelling in Mathematics 10 and 30 respectively; these were the courses they needed to get into university, and there was no point in jeopardizing their standing.

Jack was concerned with losing his 100% standing, and during the field study he received some reinforcement for his position. Jack perceived mathematics as being very objective - "only one right answer" - as opposed to the more subjective social studies, English, and art. He liked that quality in mathematics. But the Mathematics 10H class was doing a poster and presentation project about mathematicians. Jack felt that his inability to draw well would have cost him his perfect standing, and he seemed relieved that he was not in the course. (Since the time of the field research, Jack has decided to enter Mathematics 20H.)

<u>The Non-Specificity of Excellence from the Field Study: Data Limitations</u>

Only a few of the claims for the place of ability, effort, marks, recognition, or pressure in excellence really single out mathematics, perhaps because the focus tended to be on the psychological or social side of excellence. On the most superficial level, excellence in school is signified by high marks, regardless of what the subject is. In response to questions about the nature of mathematics and how it might compare with other subjects, students did allude to certain unique characteristics of school mathematics, as was pointed out earlier. In terms of exploring the meaning of excelling (or not excelling) in mathematics at school, however, the data collected were not sufficient.

Greater attention must be paid to mathematics specifically - for example, more in-depth exploration of (i) the apparent objective nature of mathematics explicitly compared to other subjects, and (ii) the value of excelling, or trying to, in mathematics. These should come though discussions about concrete personal experiences in mathematics.

Second, discussions of excelling or not in an area ought to reveal a substantial affective or emotional character. This also is not strongly present in this field study. Again, I believe greater attention to personal experiences is necessary (for example, Helen and Robert who do not want to be assoicated with Honours students). These personal experiences ought to be the focus, too, of revealing similarities and differences among those who see themselves as "excellent," and distinguishing characteristics between this "excellent" group and those who do not see themselves as "excellent" in mathematics.

V: General Implications of the Pilot Study for the Major Research Project

Some comments regarding data collection have already been made. Other points:

(i) The first two weeks of the field research should be devoted exclusively to observation without concern for confirming students and scheduling interviews.

(ii) Conducting sixteen interviews of thirty minutes or longer, transcribing eleven of the interviews, and preparing for the next discussion all within the period of approximately three weeks was a very time consuming and hurried affair. The preparation time for the following interview or conversation was often too limited to provide for the kind of analysis and reflection needed.

(iii) Time is needed between interviews to permit the integration of discussion, observation and document analyses before going on to the next discussion.

(iv) It is feasible and desirable for students to be involved. The depth and breadth of what excellence means to them is generally not as rich as the teacher's, but each student does have a perspective to share, and for some, perhaps particularly for those who have been identified as excellent, this can be quite complex. The teacher-student dynamics are also significant.

(v) In this pilot, students from grades 10 and 12 participated, and all contributed. Indeed, one of the grade 10 students was the highest achiever in mathematics, and had perhaps the most well-formed views of what it meant to do well in the subject. Nevertheless, I believe it would be desirable to have students at a similar grade level, that is, students who have gone to high school for a similar number of years. If possible, I would recommend that the student participants be in grade 12. It will be necessary to examine the significance of being in this final high school grade.

(vi) Other "excellence" criteria than grades ought to be considered in choosing student participants. Student input on "excellent" students should be sought if possible.

(vii) I should venture in greater depth into areas of apparent compromise and inconsistency. This is not to criticize but to explore the limits of belief and practice in teaching, and in being a mathematics student.

(viii) Attention must be given to the teacher's involvement with and interest in mathematics as a discipline. I found myself in the pilot often exploring the social dimensions of excellence in education and in mathematics education. This was in part due to the teacher's orientation, but the mathematics aspect of the study must be dealt with sufficiently.

(ix) Attention must be given to what the teacher and students understand mathematics to be.

(x) The pilot revealed that the mathematics teacher's relationship with his department colleagues was important; for example, in terms of topics to teach and materials to use, methods and frequency of evaluation, maintaining consistency of average student achievement across sections of the same course, keeping pace with one another, and the importance of a mathematics education. Teacher experiences related to these topics need to be explored.

In the pilot school all the mathematics teachers had desks in the same office. However, with only one teacher participating, the dynamics of the situation, and how it influenced views of educational excellence, could not be explored in any depth.

(xi) It is desirable to have more than one teacher from the same school involved in the study. This would permit the relationships of (viii) to become a greater part of the study.

(xii) For practical reasons, it is important not to have too large a number of participants. I would suggest two teachers and six to eight students.