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Career Decision Making among Gifted Students: The Mediation of Teachers

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Abstract

There is international concern about falling enrollments in higher education, particularly the sciences, by gifted students. In this mixed method study, the top performing 200 students (approximately 1%) within a particular education jurisdiction at the beginning of their first year at university were surveyed and 20 interviewed about their school experiences using a biographical interpretive design. This study focussed on identifying those characteristics of teachers which supported students' interests. Participants identified seven characteristics of teachers that students identified as supportive of their potential career pathways. These included connecting pedagogical practices with student interests, being passionate about their subject matter, having good content knowledge, making learning experiences relevant, setting high expectations of students, being a good explainer of complex ideas, and being a good classroom manager. This study extends our knowledge of how teachers influence gifted students and has implications for both pre-service and in-service teacher education and career counselling.

Keywords: Gifted students, career orientations, teacher influences, school experiences, science education, mathematics education, humanities education, career decision making

Introduction

Most developed countries are facing a major skills shortage particularly among knowledge workers. In the sciences, the demand for talented knowledge workers is outstripping the supply (National Science Board, 2006) In the United States, approximately 30% of doctoral graduates in biology are sourced from outside the country. Decreased participation in science and engineering has been identified in a plethora of reports emanating from many countries (See Breakspere, 2003; Glenn, 2000, National Science Board, 1999). Indeed, in some colleges it is becoming more competitive to gain places in subjects such as hospitality than science. These reports describe a perilous situation but provide little analysis of the possible contributing factors (e.g., Chang, 2000). Existing studies, however, do not provide an adequate answer to the essential question of how students become oriented towards careers and decide to pursue a particular area as a career. Yet understanding those factors is important, particularly in the area of the sciences where there is widespread concern in developed countries about falling interest in advanced studies at a time when major social, economic and environmental changes need technological and scientific solutions and an adequately skilled workforce. Particular attention needs to be paid to those students identified as gifted as the future hope for contributing innovative, creative and productive thinkers.

A number of factors might underpin the decrease in participation by the most gifted of students. There is clear evidence that school science, particularly in high school, is dominated by transmission approaches to teaching, overloaded curricula, is perceived as irrelevant and is only understood by those with special aptitude (Costa, 1995; Goodrum, Hackling, & Rennie, 2001; Morrell & Lederman, 1998; Osborne & Collins, 2001). Data from the large-scale international Relevance of Science Education (ROSE) study indicated that science is less popular than most other subjects, boys like science better than girls and, in some countries, including England, girls dislike science very much (Jenkins & Nelson, 2005). This situation is disturbing given the emphases on engaging learners through more student centred approaches (e.g., National Research Council, 1996). Although gifted students might value science their interest is dulled by lack of challenge (Barak, 2002; Diezmann & Watters, 2002; Osborne & Collins, 2001). Given the widespread dissatisfaction with science teaching it is not surprising that only 25% of students intending to pursue further studies or a career in science held positive attitudes to science (Atwater & Wiggins, 1995). Sjøberg and Shreiner (2005), citing data from the ROSE study, have commented that few school students in industrialised societies want to become scientists or have a career as a technologist and are sceptical of science. In recent reviews cited above, much of the blame has been targeted at teachers and teacher educators, and, in response, considerable effort and funding has been implemented towards upskilling existing teachers and attracting more qualified people to the profession. However, if educational experiences are to benefit gifted students and attract these students into science and technology a better understanding of their school experiences and career-decision making processes is essential.

The purpose of this research was to identify teacher-related factors that influenced gifted students in developing an orientation towards a science and technology related career and whether non-science or non-mathematics teachers exhibited different characteristics that students valued. In this study, the school experiences of 20 high-achieving students were investigated during their early university studies. The study involved information obtained through interviews and surveys. However, to frame this study firstly the pertinent literature related to career choice is summarized. Then research that examines student interest in pursuing tertiary science studies is considered.

Background Literature

This review of the literature summarizes research emerging from both psychological and sociological perspectives before examining the specific issues surrounding career choices by science-oriented students and the role of their teachers in developing student career orientations.

The existing research suggests that career choices are determined by the interaction of internal psychological factors and external socio-cultural and structural determinants within the environment in ways that are consistent with Gagné's (2003) differentiated model of talent development. Social cognitive theory provides one avenue to explore career choices. For example, Dai, Moon, and Feldhusen (1998) argued that environmental conditions reciprocally interact with each other to foster achievement and the development of potential. Dai et al (1998) couch their arguments within motivational theory and assert that a general social cognitive perspective is a useful theoretical framework for research on motivational processes involved in the intellectual and personal development of gifted students. Drawing on the work of motivational researchers they highlight some of the contentious issues about student decision making. For example, on one hand gifted girls might perceive advanced studies in mathematics is beyond them if they attribute success to effort whereas an alternative viewpoint is that attributing success to effort nurtures an incremental view of ability and one that protects students' vulnerability under failure. These authors suggest that "the perception of self as highly competent and possessing potentialities valued by society not only enhances one's self-worth and influences effort and education and vocational choices but may also lead … greater goal commitment" (p. 47).

Theories of motivation, such as the Eccles expectancy-value model (Eccles & Wigfield, 2002) suggest that self-beliefs and task beliefs are critical precursors of these high school choices. In Eccles' model, perceived task difficulty contributes to achievement-related outcomes through its influence on expectancies and values. These relations are reciprocal in that choices influence beliefs, which, in turn, impact subsequent choices (Eccles, 1994). Several researchers have argued that out of school science experiences in the early years are powerful contributors to student's interests in science and that positive associations exist between interest and a sense of self confidence. The argument is that self-related beliefs (i.e., self-efficacy or perceptions of ability) may influence the child's ongoing interest in science, mathematics or any other domain of knowledge. Recent work by Zeldin, Britner and Pajares (2008) suggests self-efficacy beliefs are indeed powerful contributors to eminent professionals' selection of and success in scientific careers but that gender differences mediate self-efficacy enhancing factors. Additionally, students develop a perception of the value of committing to a task on the basis that they expect their involvement is worth while (expectancy-value). Children's mathematics and science experiences change dramatically from 5th–12th grade. For instance, the topics covered in school become progressively more advanced and abstract. In addition, research suggests that children's expectancies and values continue to change as they progress through school. In other words, those children who felt science was important, were interested in science, or believed they were good at science were more likely to take more science courses. Eccles' work suggests that students who are high achieving are more likely to engage in extracurricular activities and pursue further studies in these areas. As long ago as the early 1960s, it was evident that students who participated in out of school science programs were more likely to pursue advanced studies in science (Edgerton, 1965).

Early recognition of a person's interest and capability in science may provide the necessary feedback to develop positive dispositions towards a particular career. For example, in an analysis of the career trajectories of talented mathematics students, Lubinski, Benbow,

Webb, and Bleske-Rechek (2006) found that gifted young adolescents who participated in talent development programs associated with the Study of Mathematically Precocious Youth (SMPY) pursued academic careers in the field in which they were identified at rates comparable to those of graduate students attending the top U.S. math, science, and engineering doctoral programs. Additionally, the family circumstances and resources should also influence a child's perceptions of ability and interest. Indeed, Tai, Sadler and Loehr (2006), report that demographic background and general educational background are indicators of social circumstance and academic achievement. In a survey study of 1531 college students they found that demographic predictors accounted for substantial variance in how well students perform in introductory college chemistry courses. Prime among these was the level of parent's education. Bloom (1985) and colleagues (e.g., Gustin, 1985) in an extensive study of retrospective accounts of some 120 outstanding individuals across the arts, sciences and sport highlighted the importance of a supportive formative environment. In the early years, parents played a role in encouraging curiosity and intellectual pursuits without formalised instruction. Indeed, the development of eminent mathematicians (Gustin, 1985) and research neurologists (Sosniak, 1985) revealed a similar early involvement in solitary self-directed learning in math or science presumably with encouragement from parents. The home environment developed the work ethic and encouragement for students to achieve without undue pressure. However, as students progressed especially into high school it was suggested other factors became influential, for example teachers. Slade and Trent (2000) in exploring the impact of teachers particularly on boys' attitude to school identified the characteristics of good teachers as perceived by boys in terms of positive relationships such as listening, respecting, flexible, good explainers and non-rigid disciplinarians. Interestingly, these authors also noted negative pressure placed on gifted students:

> Nonetheless, some 'paying out', and some that is identified as intentionally harmful, is directed at the 'real nerds' but it is claimed that this is retaliatory and about 'social stuff'; is done in different ways, and for reasons that have little to do with cleverness or achievement. The 'real nerds', it is claimed, bring it upon themselves by being deliberately and often aggressively anti-social, sometimes to the point of being offensively elitist. (p. 213)

Encouragement, high sense of self-efficacy and credible models should influence career decision-making. Lent, Brown and Hackett (2000) in a series of papers identified two complementary dimensions to explain career choice, namely cognitive-personal variables (including self-efficacy, goals) and environmental or contextual features. Such contextual features might be real for example, quality of learning experiences and access to resources or perceptual such as opportunities or barriers. Lent and colleagues emphasized that these features interact and career choice might therefore be dependent on how individuals rationalize their experiences. Sadler and Tai, (2001) and Tai et al. (2006) highlighted from their research the importance of high school learning experiences. Successful learning experiences better predicted changes in attitude towards science for example rather than attitude predicting achievement.

The nature of the learning experience might be more significant for influencing girls than boys as sympathetic teachers can influence girls to challenge the constraints of pursuing a science related career (Blickenstaff, 2005). Other psychological constructs have been implicated in career decision making. For example, the inter-relationship of cognitive styles and contextual factors is highlighted in the work of Creed, Patton and Bartrum (2004) who argued that career decision making self-efficacy, internal and external barriers and cognitive style predicted career focus. Others, for example, Achter, Lubinski and Benbow (1999) have argued the existence of a person-environment relationship suggesting

that humanities oriented people and science oriented people are predisposed by the "the ways they view the world and approach problem solving" (p. 778).

In summary, the previous research suggests that influential factors fall within three categories: demographic background; general educational background; and previous science learning experiences (Tai, et al., 2006). The psychological dimension is not without its critics particularly those writers whose perspective encompasses the influence of culture and social context.

Writing from a sociological perspective, Hodkinson and Sparkes (1997) took umbrage with models of career decision which assumed that career selection is essentially an individual process, is rational, and the factors that influence decision making can be influenced or controlled by the individual. They asserted these models tend to ignore chance factors and how individuals respond to serendipitous events as well as the broader cultural and social context. Hodkinson and Sparkes have attempted to explain career decision making through the blending of social, family and cultural factors which provide a framework for personal choices acknowledging the influence of serendipity. Decision making is socially situated but in a dialectical way in which new experiences provide opportunities for learning but also change the way individuals see or experience the world around them which in turn influences how they assimilate new information. Thus life histories are both shaped by experience and in turn shape the experiences that individuals have through what Bandura (1986) described as reciprocal determinism.

An issue not extensively addressed in literature is how people respond to chance, serendipity or opportunity and how they retrospectively report such events. Chance factors might generate opportunities which are perceived to be capitalized upon rationally (Salomone, & Slaney, 1981). Indeed, Creed et al. (2004) suggested that optimistic individuals are more likely to view external factors as challenging opportunities rather than threats. Some argue that career choice is influenced by serendipity or chance to a substantial degree (Betsworth, & Hansen, 1996; Bright, Pryor & Harpham, 2005). In Bright's et al's (2005) study in which they reported attributions made by high school and university students of their career aspiration at least 60% identified one chance factor related to previous work or social experience. Prior and Bright (2003) however argue that career decision making requires people to respond to situations and opportunities or serendipity as it occurs. The significance attributed to chance events influencing career decisions is widespread even among school and university aged students (Bright et al, 2005).

Emerging from early studies on gifted students interests in careers are two propositions which might co-exist among the gifted. Firstly, high interest and ability in a number of areas positions the individual to choose from many career options. Interest is formally defined in motivational literature as "the processes by which the underlying needs or desires of learners are energized" (Alexander, Murphy, Woods, Duhon, & Parker, 1997, p. 128). Many have written about the creative joy and satisfaction of initiating new ideas, and the intellectual pleasures of playing with them theoretically and experimentally and developing a deep and aesthetic appreciation of the world around them (e.g., Koretz, 1991). A considerable body of research has identified achievement in school is a function of many inter-related factors including ability, attitudes, socio-economic variables, interest and academic engagement (e.g., Singh, Granville & Dika, 2002). In particular, motivation, attitude and academic engagement were significant predictors of science and mathematics achievement. Singh et al. (2002) argue that "motivation is affected by more positive school experiences and better instructional approaches" (p. 330). Indeed science achievement has been found to be more strongly aligned to science attitudes and self-confidence than to

aptitude in junior high school (Houtz, 1995; Marsh, & Yeung, 1997; Romance, & Vitale, 2001) a conclusion borne out by meta-analyses of many science enrichment programs (Pyryt, Masharov, & Feng, 1993). These findings support the proposition that interest is a stronger predictor of career choice than ability in a particular school subject area. Unpacking the relationship between interest, motivation and achievement provides further insight into career orientations.

A second proposition emerging from the literature is that gifted students develop select interests early in life which they passionately pursue into adulthood. The assumption that gifted students are multipotential in the sense that they have a wide range of abilities and are able to choose from many potential careers depending on interest and opportunity has been challenged (Achter, Lubinski & Benbow, 1996; Milgram & Hong, 1999). These studies were conducted on students in their early teen years and suggest that interests and abilities in particular domains are developed early in life and influence career decision making. Achter et al. (1999) argue the more intensely focused an individual's ability and preference patterns for particular disciplines the more confident one can be in encouraging further development in that general area. Thus one could hypothesize that retrospective accounts of students' experiences in school would reflect the early development of passion areas both in formal schooling and out-of-school situations that orient students towards career trajectories. Qualitative case studies and longitudinal quantitative studies show students' abilities and high school educational experiences do predict enrollment in mathematics and science in tertiary education (Webb, Lubinski, & Benbow, 2002).

One of the factors that should support the development of interest is the teacher. Several studies have reported the impact of teachers' classroom practices on students' goals (Ames, 1992; Meece, 1991; Turner et al, 2002) and much has been written about the influence of significant teachers in the lives of eminent people (Goertzel, Goertzel, Goertzel, & Hansen, 2004). Research on disengaged boys mentioned earlier in this paper indicated those teacher characteristics that fostered building relationships were important in supporting boys (Slade & Trent, 2000). In discussing the impact teachers had on outstanding achievers, Gustin (1985) reported that the best mathematics teachers "were seen as the ones who would supply books or materials so that the mathematicians could work on their own" (p. 293). What seemed to impress these students were teachers who knew their subject and could seduce students with interesting applications and big ideas. Recognition by teachers which led to independent work or special experiences also was reflected upon as important especially for those in the arts area. Few of these outstanding achievers among mathematicians enjoyed or valued their school experiences. Classroom teachers appeared to play a minimal role in contrast to extracurricular teachers of the arts (e.g., piano) who were highly supportive and enthusiastic about the child's developing skills. For pianists, parents sought out the best of teachers for individual instruction. In the domain of physics, Sadler and Tai, (2001) reported that high school teachers who had the patience and gift of approaching problems and topics from many viewpoints appeared were highly appreciated. However, in a collection of essays from 27 prominent scientists in which they described their childhood, few of the scientists attributed their interest in science to the influence of teachers (Brockman, 2005). Nevertheless, charismatic teachers can provide significant models for students (Brooks, 2001). Clearly, experiences and abilities interact in complex ways to influence career orientations.

In a qualitative study of science students' career decision making, Flegg (1997) described an inductive process by which the child, from the early years, gathers impressions of significant events, people and circumstances to create a dynamic self-image. Image of self as a scientist was a significant referent in deciding whether to follow a science career. That

decision was given direction through alignment of the developing image and already established values and lifestyle features. He argued that career intentions are subject to the passage of time and societal expectations which give the process direction. This picture of a complex interaction of personal and social forces and singular important events and people echoes the general sociological perspectives of career decision making identified by Hodkinson and Sparkes (1997) and also supports a systems theory approach as advocated by Patton and McMahon (2006). These latter authors argue that multiple factors act as a systems of influence which is located within the context of time - past, present and future. Tai, Liu, Maltese, and Fan (2006) in analysing data from the National Education Longitudinal Study of 1988 noted that approximately 50% of students who indicated they would pursue a science related degree when asked in elementary school did so and a third of students who reported non-science career expectations eventually switched into science. What is unclear in the research is the extent to which students become strongly predisposed to science as a possible career in their early years of school and are subsequently swayed by influential teachers or are discouraged by poor teachers. Lyons (2004) suggests that students are discouraged from pursuing higher levels of science by the pedagogical practices and curriculum structures in the early years of high school. Other research indicates that students begin to lose interest in science even earlier during the middle years of schooling (Bazler, Spokane, Ballard, & Fugate, 1993; Jovanovic, & King, 1998; Lyons, 2004, Simpson, & Oliver, 1990) as other more engaging opportunities arise. An important part of the psychological and social environment is the classroom experience. In this domain, the influence of teachers and peers is significant and there is extensive literature on how teachers support learners in heterogeneous classes (e.g., Bransford, Brown, & Cocking, 1999).

Aims

The intention of this research was to document the perceptions of highly successful gifted students about their experiences with teachers in order to identify those characteristics that are influential on student career decision making. Reports cited previously highlight concerns with the nature of teaching and teachers particularly in the area of the sciences. These concerns coupled with the changing nature of youth, suggest that although there is substantive anecdotal data on the impact of significant teachers, there is little recent research that explores the characteristics of influential teachers especially on gifted students and how students' dispositions to topics of interest are influenced.

Methodology

Data sources for this study comprised demographic information from a survey followed by interview data.

The aim of this study was to explore the classroom experiences of gifted students. However the large scale identification of gifted students presented problems. This study was conducted in an educational system in which students are not required to undertake state-wide testing at the conclusion of high school. Additionally, there are no systemic identification processes mandated for the identification of gifted students. Curricular planning and assessment is school based guided by state subject syllabi which are developed by an independent statutory authority referred to here as the State Assessment Authority. In their final two years, students are normally required to study concurrently six subject areas from a choice of over 20 at tertiary entrance level or a range of school based subjects of lower academic standing but of specific interest with substantial vocational and practical components. A strong science program would include Chemistry, Physics, Biology, and an advanced Mathematics along with compulsory English. A strong humanities program would include for example, Modern History, a foreign language,

Geography, Economics, Legal Studies and Drama. English is compulsory for all students. Student progress is assessed throughout the final two years of schooling through a variety of instruments with grades expressed qualitatively in terms of levels of achievement. At the conclusion of the final year, students undertake a state wide Core Skills Test which is subject independent. Achievement on this test and school based performance provides data to the State Assessment Authority from which they are able to rank students for tertiary entrance. On conclusion of High School, students receive a certificate of Education showing subjects studied and levels of achievement gained; and a Tertiary Entrance Statement which reports an Overall Position (OP) which are used to rank students for entrance to tertiary-level courses at universities. Hence students are grouped into one of 21 levels. Level-1 students are generally the top performing two percent. Students choose their degree programs and majors before entry into University.

Hence in this study, giftedness is defined in terms of high performance on the combined core skills test and school based assessment data. Assessment is reported as an overall performance (OP) score on a 1-26 point scale where OP 1 approximately represents the top ranking 2% of 19 000 students who choose to participate in this assessment process in order to enter university. Approximately an equal number do not participate and follow a non-tertiary pathway through vocational education and trade apprenticeships. In the absence of other forms of identification, these high achieving students are considered gifted at least in terms of levels of ability, achievement and commitment (e.g., Renzulli, 2002). The choice of subjects undertaken in the final year of high school is interpreted to represent their discipline orientation.

Participants:
Access to participants was constrained by privacy laws. In order to identify the highest achieving or gifted students, the researcher required the State Assessment Authority to communicate with students. Thus, the Authority distributed on behalf of the researcher a combined invitation to participate, informed consent documentation, and a survey form. The target students met certain criteria namely, those ranked in the top 100 of students who studied a science intense high school program or a humanities intense program. Of the possible 200 participants, 125 agreed to participate and provided their names and contact details directly to the researcher and returned the completed survey form.

Hence the participants in the study were selected on two criteria, namely performance in the top 2% of students (OP1) and a pattern of subjects studied at high school. The top 100 students whose high school final year studies involved primarily science and mathematics subjects such as chemistry, physics and advanced mathematics, and the top 100 students whose final year studies involved humanities/social studies subjects, such as history, geography, arts, music, or languages were identified. The data were collected on the cohort of students completing high school in 2003. Approximately equal numbers of boys and girls were surveyed.

Approximately 80% of the students surveyed agreed to be available for an interview. Approximately equal numbers of science and humanities/social studies oriented students were selected from four universities for interview. Data-collection interviews continued until the range of comments relating to teacher experiences was exhausted or saturated. By the interview with the 20th person, no new perspectives or experiences were emerging.

Survey methods: The top 200 performing students in the state were surveyed for biographical, historical and demographic information. Completed surveys were returned from 129 (64.5%) students. The survey sought demographic data on schools attended, whether the student had been accelerated, their choice of subject selections at high school,

their preferred choice of university and university course, and current university enrolments. The university course selected is indicative of the career orientations as in this jurisdiction students are required to select their ultimate university majors during the final semester of high school. They are able to choose up to six ranked options. Nearly all participating students in this study were successful in being accepted into their first choice course at the university of choice. Data were compiled and descriptive statistics reported.

Interviews: A biographical interpretive design (Holloway & Jefferson, 2000) was followed in the collection of qualitative data from 20 participants. Qualitative methodologies enable researchers to look more closely at phenomena in ways that complement the more quantitative approaches that have provided important theoretical frameworks. The use of a biographical narrative approach allowed participants to come to see themselves as distinct subjects about whom a story can be told. By telling their stories and illustrating their experiences by story, insights into how they experienced events are revealed. The conversation focussed on five areas deemed relevant, namely, school experiences, relationships with teachers, experiences beginning university, friends and relationships with peers and family support. This paper reports stories primarily about school experiences.

The conversational approach commenced with a general introduction that drew attention to the goals of the study being to explore student experiences in school which contributed to their orientation or interest in particular topics such as science, mathematics, art, language or English and to the factors that influenced their decision to pursue their selected university courses. Although a scripted set of general questions or interview guide was used "to ensure the same basic lines of enquiry are followed" (Patton, 2002, p. 343)(See Appendix A), the discussions tended to allow the student to speak freely about experiences with follow-up prompts to explain or expand on issues raised. Interviews ranged from 40 minutes to one hour forty-five minutes and were undertaken in locations of convenience for the participant. Students were encouraged to relate critical experiences in story mode. This open-ended approach enabled the interviewer to get in-depth information from the interviewee (Clandinin & Connelly, 1998; Patton, 2002). Each participant was interviewed only once.

Interview recordings were progressively transcribed verbatim and the transcript returned to the participant to check for accuracies and clarification in a member-checking process. An initial analysis of each interview was made and notes written on a covering sheet to act as a framework for subsequent interviews. After 20 interviews, when it was felt that saturation was achieved and no new information emerging, the transcripts and audio recordings were fed into the software package Transana (Fassnacht & Woods, 2005). This package enabled textual elements and associated audio clips to be coded. Recordings were listened to and transcripts read to identify units of meaning or categories (Strauss & Corbin, 1990). This first step constituted the process of open coding whereby units of meaning were identified and labels in the form of keywords that conveyed particular meaning were assigned to utterances in a first attempt to condense the mass of data into categories. Because the software package allowed the raw audio data to be concomitantly tagged with the textual transcription, it was possible to listen to pooled coded utterances and interpret meaning within the context of the conversation. Each interview was coded as soon as possible after transcription and member checking.

In the next step the keywords representing initial codes were examined for patterns and connections. Keywords were subsequently clustered to form themes that described the experiences of the participants and how these experiences impacted on the students' interests, motivations and decisions. This step constituted what Strauss and Corbin refer

to as axial coding. New ideas or hypotheses were postulated and questions about cause, consequences and relationships were noted. Thus as data were analysed progressively, central themes emerged that captured the essence of student experiences with little new information being identified by interview 20. Data were co-coded by a research assistant and discrepancies reviewed and differences reconciled. Emerging themes were noted and influenced the direction of subsequent interviews.

Qualitative research uses a naturalistic approach that seeks to understand phenomena in context-specific settings. Qualitative research seeks illumination, understanding, and extrapolation to similar situations. In qualitative research, the researcher needs to demonstrate credibility, neutrality or trustworthiness (Golafshani, 2003). The main strategy to achieve this is the development of an audit trail in which detailed records of the conditions of data collection were documented in ways that would enable subsequent researchers to follow the procedures under similar conditions. In addition, credibility was established by member checking and the use of prolonged data collection involving 20 participants until no new issues emerged.

Results

The first set of data derived from the survey describes the characteristics of the cohort of participants and their school histories. The second set of data also derived from the survey provides an overview of the courses students enrolled in at university. The final set of data reports the qualitative experiences of the interviewed students specifically in relation to the role played by significant teachers.

Characteristics of survey cohort: Of the students who responded to the survey (n=124), approximately 90% were residents of middle socio economic locales and 60% were female. Of the valid responses, 42.7% had studied an exclusively advanced science program and 57.7% pursued a strong humanities program in the final two years of school. Approximately 80% of humanities/arts students and 40% of science oriented students responded giving a net response rate of 62%. Figure 1 provides a breakdown of the types of schools attended. Thirty-three percent attended a State Government high school in their final year of schooling, 30.2% attended a Catholic school, and 36.4% attended a Private school. The syllabus documents used by all systems are the same and set by the State Assessment Authority. This distribution contrasts with an approximate distribution of 64% Government high schools, 18.1% Catholic high schools and 17.8% Private high schools for the whole cohort of students graduating in 2003. Figure 1 also depicts the proportion of the participant group that studied two or more enabling sciences (e.g., chemistry, physics or advanced mathematics) and the proportion that studied only humanities subjects (e.g., history, geography, studies of society, legal studies or accounting).

Figure 1: **Profile of responding students by school attended and courses studied.**

This pattern reflects an overrepresentation of gifted students in Private and Catholic schools for their final years of schooling. Although some of the private high schools provide scholarships to attract outstanding scholars the proportion of scholarships is small and few of the participants in this study acknowledged being a recipient of a scholarship. Two possible reasons can explain this pattern. Firstly, the private school sector is perceived to be well resourced with good school facilities and experienced teachers. Hence, more affluent parents are willing to provide what seemingly are better

opportunities for both academic and social development. Secondly, student populations are more homogeneous in terms of commitment to schooling with less behavioral management issues detracting from the quality of the learning environments.

University enrollments: Fifty-nine percent of students in the cohort were from the metropolitan area of the major city and thus living within an hour's drive of three major universities. The largest proportion of students undertook tertiary studies at the established high reputation university (45.6%) (Figure 2 Institution A) with substantial enrolments at two other metropolitan universities (34%) (Figure 2 Institutions B & C). The remaining students attended one of five regional universities (Figure 2 Institution D) or attended institutions outside their home state. The latter accounted for less than 3% of students. Thus, almost half of the students from more remote areas of the state attended the metropolitan universities which are acknowledged to be of higher academic standards.

Figure 2: Selection of university. A, B & C are metropolitan institutions and D is the composite of regional universities.

Entry into university is based on meeting minimum standards within a quota system. Students apply through a central agency and nominate their preferred courses of study. Table 1 shows the range of enrollments. Notably, enrollments in science and technology related courses including health sciences amount to approximately 30%. Given that 42.7% of the responding cohort had primarily studied science in high school, there is a clear drift in choice of university course away from science even from students with a high school concentration in the enabling sciences. Of the responding girls, only 14% undertook a science related course at university whereas the corresponding proportion for boys was 44%. Table 2 presents the high school enrolment and ultimate university course taken by the students who participated in the interviews. In the table, MathsB is a regular level mathematics and MathsC is an advanced mathematics. Religion is a specialised humanities subject that adopts a theological approach to the study of religions in general. All students also studied English.

Table 1

Enrolment preferences

Course	% Total
Law	20.0
Business/Commerce/Economics	12.5
Science	12.5
Engineering	7.5
Health Sciences (Optometry, Pharmacy, Medicine, Nursing)	6.7
Law/ Arts	6.7
Arts	5.0
Creative Industries/Drama/Fine Arts	5.0
Music	5.0
Education	4.2
Law/Commerce/Finance combined degree	4.2
Journalism	2.5
Psychology	2.5
Science/Law/Business combined degree	2.5
Information Technology	1.7
Languages and Applied Linguistics	0.8
Philosophy	0.8

Table 2

Student school attendance, subject choices and university enrolments.

Name	School Leaving Subjects*	University Course
Alex	MathsB; MathsC; Chem.; Physics;	Physiotherapy
Alice	Business; French; French Extension; Art;	Psychology
Barry	Mathematics B; Economics; French; Modern History;	Law
Byron	MathsB; MathsC; Chem.; Physics; Japanese	Maths/Science
Cid*	MathsB; MathsC; Physics; Chem.; Computing	Maths/Science
Cathy	MathsB; MathsC; Physics; Chem.; Biology	Science
Charles	MathsB; MathsC; Chem.; Physics; Japanese; Religion;	Maths/Science
David	MathsB; Biology; Chem.; Physics; Economics	Science
Dehlia	MathsB; Biology; Chem.; Physics; Accounting;	Nursing
Felicity	MathsB; Biology; Chem.; Physics; Japanese; Religion	Science
Gina	Maths; Ancient History; Modern History; Economics; Legal Studies	Arts/Law
Jake	MathsB; MathsC; Chem.; Physics; Engineering; Music	Science
Jane	MathsB; Chem; Phys; Graphics	Business/Finance
Jenny	MathsB; MathsC; Biology ; Chem.; Physics;	Science/Law
Julie	MathsB; MathsC; Chem.; Physics; Religion	Science/Arts
Kal	English; Art; Drama; Modern History; Religion	Arts/Law
Mabel	MathsB; Multistrand Science; Legal Studies; Ancient History; Modern History	Arts
Mary	Business; Drama; Study of Society; Modern History;	Journalism
Robert	MathsB; MathsC; Chem.; Physics; Film & TV;	Science
Steven	MathsB; Graphics, Computing; Art	Creative Industries

Note: Cid completed a semester university course on social science while in his final year of high school.

Influence of teachers: In analysing the qualitative data (n=20), a range of themes emerged which interact and contribute to a student's career decision making. These include approaches to learning, views of particular careers, academic experiences and family factors. The focus in this paper is on the influence of teachers.

Nearly all students appeared to like school and to be accepting of their teachers. A small number of students appeared to be sufficiently inspired by their teachers to pursue studies in the area of that teacher's expertise. For example, a mathematics teacher who had a previous career in economics inspired one female student to pursue a course in economics with a strong mathematical component. However, there is no evidence, that teachers were fundamentally instrumental in orienting students towards particular careers or disciplinary areas. Nearly all students described a particular passion or interest in their disciplinary area from an early age although their interest crystallized during their high school experiences. Nevertheless, there were a number of characteristics that students saw as important in their interactions with teachers which encouraged them to pursue the study of particular disciplines. Thus, emerging from the analysis were seven inter-related themes that described student attitudes towards their teachers. These are summarized in Table 3. An initial perception in these findings is that other than perhaps the capacity to be an explainer, teachers of science and the humanities appear to share similar valued characteristics.

Table 3

Characteristics exhibited by influential teachers or not exhibited by disliked teachers

Category	Humanities (n=6)	Science (n=13)	Total
Connection	5	9	14
Passion	1	4	5
Knowledge	1	5	6
Relevance	2	7	9
High Expectations	1	4	5
Explainers	0	4	4
Management	0	1	1

Each of these themes will be discussed and supporting evidence provided.

Connection: The most frequently cited characteristic that students acknowledged in a teacher was his or her ability to understand them by acknowledging interests and connecting pedagogical practices with those interests. Three examples of how this characteristic was manifested are presented. First, Alex (all names are pseudonyms) – a science-oriented student – was particularly fond of cricket. His teacher was aware of this interest and connected with Alex by using examples from this sport. As Alex asserts making this personal connection fostered his interest in learning physics.

> I especially remember our English teacher and physics teacher. They had an idea of what everyone in the class was into and so, for me, who was into cricket and bit of ball sports explaining dynamic motion in terms of that sort of made it more interesting and I was more eager to learn because of it. (Alex)

Thus, in explaining the principles of dynamics, the teacher used analogies that drew upon cricket and thus were of significance to Alex. This adaptation to the teacher's practice showed that he was aware of Alex's interests and could capitalize on these interests by demonstrating the usefulness of physics for understanding cricket ball behavior. Teachers

walk a fine line in setting boundaries in relation to interactions with students. With Alex, the teacher had identified the right level of interaction which generated respect and admiration and which provided a safe and motivating environment.

Second, being down to earth and friendly, was seen by Cid as a way that his mathematics teacher and later physics teacher connected with him at a personal level.

> I think it was the fact that he was down to earth and friendly. I think that, you discover it more and more as you go on, that just because people are clever doesn't mean that they're at all pleasant. (Cid)

Third, the theme of connection also included messages to the student which suggested the teacher was a co-learner willing to engage with the student in achieving a common learning outcome. Mary, who was passionate about drama and performance, described her learning environment in terms of the relationship of the teacher with the students. She argued that she felt the teacher was a co-learner and she was able to relate to the teacher because of the discourses and practices adopted by the teacher.

> I think I sort of connected on a wave length with my drama teacher rather than maths teacher. The cultural environment was very different. In drama your teacher was always involved in all the activities you were doing, all the different dramatic things you were doing, whereas with maths you sit at the desk and your teacher's at the blackboard, and you learn off them rather than learning with them. That was sort of the difference I think that I had. (Mary)

Connectedness was also important in that the students felt obliged to achieve for the teacher. In describing her experiences a science-oriented student, Cathy argued for a reciprocation of commitment:

> I think one of the critical things is that teachers can recognize different approaches to learning and provide support … I think, if I had a good teacher who I liked I would really work very hard for them to make them proud of me. My chemistry teacher, who was really young and had only been teaching for a couple of years but there was just something about her that I really liked and I wanted to do well for her. (Cathy)

The response of Cathy is consistent with Cialdini's (2001) argument that when people connect a sense of affinity, rapport and affection is developed which fosters a reciprocation of commitment. In this exchange, Cathy illustrated she was aware of the teacher's commitment and tried to repay that commitment by engaging with chemistry to please the teacher.

Thus, the notion of being able to connect with the student was identified in 14 of the 20 interviews as an important attribute which encouraged students to engage with that teacher's specialist subject area. Connection is about building relationships in which students and teachers set mutually common goals in achieving within the relevant discipline. It also meant that teachers understood the needs of their students and responded accordingly, for example with Cid who had been identified early as a gifted child, his preferred teachers allowed him freedom to explore his own interests as long as he kept them informed.

Passion: Clearly evident to a number of the students was the passion exhibited by some teachers. Passion and commitment among inspirational leaders is well known. The success of individuals in attracting strong following such as Ghandi, Mother Teresa or the Dali Lama is based on their obvious passion for a cause or their work. Teachers who have this

passion are able to connect with students, they value their disciplinary area and respect students (Day, 2004). Passion indeed is an antecedent to connection. The also have confidence and high expectations of their students.

This passion was recognized by participants to evident for teaching or for their discipline area. For example, the following exchange highlights the passion for teaching exhibited by Jenny's Chemistry teacher. Jenny is now studying a combination of science and law.

Interviewer	Does one particular teacher stand out in your mind, good or bad?
Jenny	Yes my Year 11 and 12-chemistry teacher. He was um … I think that's the reason I loved chemistry so much. He was just so funny and he made it really interesting. He was really good. Everybody loved him.
Interviewer	What are the characteristics of a good teacher then?
Jenny	He loved teaching. Like you could tell, he just wanted to help students. Like he'd organize after school tutorials and a few times it was just 3 or 4 people that would come but even then he would say I can come early mornings or afternoons or whenever you were free. He just wanted, I mean he did organize some but really early in the morning, for just one student. He just loved to teach.

In response to a question about what challenged her in school, the response of another student Jane, highlighted a common perception among interviewees that students were motivated when teachers were enthusiastic or passionate about their subject area:

> In grade 11 I became a bit more (interested), I started to enjoy it (school) a lot more, I had a pretty good teacher and she enjoyed maths herself so when she'd do something from the board, she would get really enthused and get the class a bit enthused as well (Jane).

Students also reflected negatively on those teachers who lacked passion as the comments of Julie and Mabel indicate.

> Well a good secondary teacher is someone who teaches it because they like the work and you can get along well with them if you really enjoy the subject and you enjoy learning about it. I can't stand teachers who just sit up there and teach a bit because they're getting paid to and that's it. (Julie)

> We did go on an excursion to the Law Courts and we got to go and see some trials in progress and stuff like that which was good um and that was a good day out actually, yeah but yeah I think maybe he just didn't seem as enthusiastic and I don't know like it was sort of a bit of a chore like I guess which maybe you know what I mean like if the teacher is not as enthusiastic I guess. (Mabel)

Although Mabel continued in a humanities course at University she did not pursue her interest in law.

Both science and humanities oriented students acknowledged passion was an important attribute which appears to have been important in maintaining their interest in their disciplinary focus. These quotations highlight a personality characteristic of teachers which is best described as a passion for teaching and their subject area. They demonstrated commitment to their profession and as such provided role models for students. As Flegg (1997) reported, students develop an image of what it would be like engaged in a particular profession which influenced their career decision making. Hence to be involved in science or drama, albeit as a teacher, was seen to be emotionally rewarding.

Knowledge: Teacher background in the subject matter being taught makes a difference in how well students perform. Up to 20% of the variation in national assessment scores can be attributed to teacher knowledge of their subject area (Darling-Hammond, 1999). That teachers' knowledge was important was acknowledged by these gifted students. This knowledge related not just to the disciplinary knowledge but also to their capacity to explain this knowledge. Although students generally focussed on their secondary teachers, some made reference to elementary teachers who had good general knowledge or were well read. One teacher was singled out by Gina, who went on to study Arts/Law, as influential in primary school because of her general knowledge about the world and history as a consequence of extensive travel. This teacher was close to retirement but her age was valued by Gina who argued: "I think there's something to be said for having an older teacher that has probably more experience." This teacher was able to challenge the students with a broader curriculum by drawing upon personal travel experiences often supplemented with photographs and pictures of places she had visited which were of historical significance:

> I remember things like the pictures about the explorers and things and thinking that this is the most boring stuff ever and then at school she was more into world history as a subject. (Gina)

Felicity and Robert, both of whom pursued science degrees, reflected on the knowledge base of their secondary teachers. The credibility of the teacher, his approachability, and capacity to explain merged to produce an impressive teacher. Felicity highlights an important perception that her mathematics teacher was teaching at a level that matched her ability but which might have been too challenging for less able students. Robert's perception of his mathematics C teacher also highlights the applied nature of the teacher's knowledge. Mathematics C is an advanced level, pre-engineering mathematics. The capacity to relate theoretical mathematics to an application was clearly influential in Robert's learning of mathematics.

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> I liked my maths teachers. I had one teacher, I had him from grade 9 onwards, he was a very good maths teacher because he was actually an engineer and he'd done Masters in maths and something else, so he was very, very intelligent, and some people had trouble grasping what he was saying, but I thought he always covered everything well, and he was approachable. (Felicity)

> My Maths C (advanced mathematics) teacher was really good. He just, you knew he knew the stuff really well so you asked him a question he'd be able to go on and explain something else but he would be able to handle a change or explain something really well and he would just make it interesting. I don't know how much you've done of maths but, like you'd be doing the spin motion of a wheel, it was actually brought in a wheel or something. (Robert)

The important aspect of knowledge that students recognized was a practical level of knowledge which presumably equipped teachers with the necessary experiences or pedagogical content knowledge to explain and relate complex ideas to students.

Relevance: Expectancy-value theory suggests that engagement and motivation depend on the long term value attributed to a learning task (Eccles & Wigfield, 2002). Most students enter school enthusiastic to learn and gifted students in particular exhibit high motivation to engage in activities they value. In regular classes, gifted students are rarely challenged and provided with opportunities to pursue topics of interest. Thus teachers who responded to the individual student's interests were valued. The importance of being able to link new ideas, concepts to students' experiences was highlighted by Kal.

Kal who eventually pursued a degree in law described how his music teacher realized that not all students would want to become musicians and so used music and music lessons as a medium for developing other skills and links with students' interests.

> He wasn't teaching from the point of view of you all want to be musicians at the end of school, he was saying well what can you get out of it that you can take into any skill and often like if he was talking about certain type of music or something, he'd teach us how to like write an essay that you could use then in any subject or a way of writing that was logical that could be used in anything and then he'd often make links with other subjects…I liked that. (Kal)

Charles also recognized good teachers as those who drew upon other domains such as sport to illustrate principles.

> One of his other responsibilities was, as a netball coach, and he would bring in like netball analogies when he was talking about it or make up stupid stories that would accompany the work problem and make it a bit more interesting rather than being a straight out work problem. (Charles)

Although this theme appears to be related to the previously discussed "connection" theme, the difference relates to the focus of connecting explanations to other domains. The teacher who displayed this characteristic focussed on drawing analogies with real-life situations or extra-curricular activities rather than capitalizing on individual students' passions. This theme is naturally related to the theme of knowledge as teachers who can see relationships between curriculum content and real life experiences are likely to have substantial subject-matter knowledge and pedagogical content knowledge.

High Expectations: A principle of differentiation is that all students are held to high expectations by their teachers (Moon, 2005). Implicit in holding high expectations of students is potential to enhance student expectancy of success through reinforcement of self-efficacy (Bandura, 1986). Several students expanded on their view of effective teachers by emphasising how they not only connected with the student but that they held high expectations and would encourage students. Some, for example Cathy, although struggling with physics was encouraged. This behavior would have enhanced a fragile sense of self-efficacy in Cathy's assessment of her own ability in physics. Cathy has pursued a science degree.

> My physics teacher loved physics, he just really liked me, and always encouraged me. I never thought I was very good at physics, but he would always encourage me. (Cathy)

Kal appreciated his elementary teacher who recognized his strengths and "pushed him":

> I think she knew that I wanted to do well and therefore pushed me to do well, whereas other teachers wouldn't care as much. (Kal)

Steven, who was enthusiastic about art, design and creativity in the media, and went on to study media production at university, seemed frustrated by teachers who did not value his interests. He needed teachers who would recognize, encourage and indeed push him.

> The overall sense I got from primary (elementary) school is that teachers never pushed really in a certain direction unless you were falling behind. Once you were up to satisfactory level, there wasn't really that much emphasis on a singular level towards individual students and I can't ever remember being, you know, pushed in art. (Steven)

Teachers played an important role in Steven's life and he dropped the study of music because of the teacher failed to challenge him. Steven's case highlights the effect of negative situations but nevertheless he persisted and suggested in his interview that his acquaintances provided the reinforcement he needed to build as strong sense of self-efficacy:

> It's more, when I showed them (friends) an art work or a project or whatever I was doing and I get the reaction, oh that's really good. You're a good artist or you're really talented. That may have been feeding my desire to be successful in whatever area. (Steven)

Other students appreciated their teachers because they nominated students to participate in special programs. David is one of the few students interviewed who attributed his particular interest in science to a specific action by one teacher. His primary teacher selected him to attend an enrichment program run by a local university. This recognition affirmed David's dispositions towards science which he is now studying at University.

Explanation: The capacity of teachers to explain complex ideas well has already been described in the context of other themes. However, the capacity to explain complex ideas is a characteristic of teachers that goes beyond their content knowledge and draws upon other attributes such as pedagogical content knowledge. A criticism of many high school teachers is their emphasis on content at the expense of effective pedagogy (e.g., Goodrum, et al., 2001). Jane points out her mathematics teacher would use multiple ways of explaining ideas and also link these to real situations. The use of multiple ways to help explain ideas represents one critical feature of this theme.

> They have to be able to explain it thoroughly and not just in one way so you can see it graphically and on a calculator and written in the book and explain it so students who understand stuff a little bit differently can still understand and even the people who might understand it the first time, their understanding will be reinforced by learning it different ways and then also relating stuff to real life situations (Jane)

Jane was a member of the humanities/social science cohort and one of the few students to pursue advanced mathematics. Jane performed well in mathematics and enrolled in a commerce degree which required a sound mathematics grounding.

The capacity to explain also encompassed the pedagogical strategies and the capacity of the teacher to facilitate learning. For example, Felicity highlighted in describing her biology teacher:

> I liked they way he did his notes, he'd always have overheads set out for each chapter and they were just so easy to read and keep track of, so that when you go back and study it, you could just remember it in lots. Whereas, my biology teacher just had a tendency to ramble and draw a picture and say 'That explains everything you need to know about this chapter' and it didn't always. So... so physics and chemistry was just really orderly. (Felicity)

Clearly Felicity valued a teacher who could communicate his ideas and foster an ordered learning environment. Being knowledgeable but a poor explainer was a concern to most students in the cohort bordering on derision "It's hard for high school teachers if they can't show you mathematical proof so they do have to kind of explain it in a hand wavy kind of way" (Ryan).

Management: Classroom behavior is of major concern to most teachers and in many

instances distracts the teacher from effective practices. Good classroom management requires proactive planning and attention to a range of factors many of which are pedagogical (Kern & Clemens, 2007). However, in mixed ability classes teachers often struggle with the extreme diversity of ability and are unable to address the learning needs of all children. Anecdotal evidence suggests many students express concerns about disruptive classes. However, class management was rarely mentioned among the participants in this study. One possibility is because many of the students were in private schools or in high school subjects that tended to be selected by more conscientious students. However, Jake who attended a government school described his classes as often "rowdy" and in need of a good classroom manager. Although teachers had used a range of strategies, he valued those who were more effective in their approaches to behavior management.

> He had been in behavior management before and he used to always take us out for sport and stuff when we got a bit rowdy and he introduced a system called, what did he call it, it was basically you earn money, not real money, like classroom money. (Jake)

The theme of classroom management featured in many of the reflections of participants about their elementary school experiences. Most described the learning environments as fun and commented that their teachers provided caring and risk free environments.

Discussion

The literature informing this study suggests that individual decision making and contextual factors contribute to career decision making by students in general. (Creed, Patton, & Bartrum, 2004; Hodkinson & Sparkes; Patton & McMahon, 2006). Career decision making is complex and occurs within context of time and place and culture. There is limited literature that addresses how gifted students become oriented to a particular career. This paper has explored the role of the teacher as a contextual element in mediating this orientation. The study reveals four key issues related to the role of teachers which need to be considered by both professional developers and pre-service teacher educators if quality experiences are to be had by highly able or gifted students. However, the characteristics displayed by teachers in the majority of cases were not instrumental in influencing student orientations to one career or another. These characteristics were for the most part reinforcing and for those students undecided about their future positive assurance that they were capable of proceeding to careers in the chosen field.

Firstly, gifted students, at least those highly achieving students in this study, are committed and are prepared to engage with learning if there is clear recognition of the student's abilities by the teacher. The nature of the relationships with teachers is an important element of the curriculum. Positive relationships were established by the capacity of the teacher to connect at a personal level with students. In this sense, positive relationships at least maintained interest and commitment consistent with the findings of Singh et al. (2002) and lend support to the suggestion that interest is a stronger predictor of career choice than ability. Those students in the study who were disinterested in particular career directions were so disposed from an early age again emphasising the importance of effective early years experience in school. However, family and social contexts were important in fostering interest early in life as Flegg (1997) reported.

These students pursued topics when they saw direct evidence of how the material was linked to their everyday experiences. This connection could provide the opportunities to "play with ideas" and examine how those ideas foster an aesthetic appreciation of the world around them (Koretz, 1991). The capacity to make these links might be greater for gifted students. Furthermore, being in the right class at the right time is a serendipitous

event but these students capitalised on their chance. Curriculum reform movements, such as context-based learning, problem-based learning represents approaches that capitalize on connectedness. There are implications for pre-service teacher education where the focus is often on the techniques and theories of teaching and learning but with less emphasis on connecting with students as persons, understanding their drives and in particular valuing the special needs of the gifted student.

Secondly, highly competent teachers were admired and respected. Competent teachers produce effective learning experiences which meet the needs of individuals (Bransford, Brown, & Cocking, 1999). The level of preparation of teachers in their content area is being debated with policy leaders advocating stronger pre-service education in the disciplines and new models of teacher recruitment to attract highly competent teachers. These high achieving students respected and valued the teacher's knowledge base but also that the teacher knew how to use that knowledge and knew how to relate to adolescents. Both humanities and science oriented students appear to value the same teacher attributes so one proposition that can be drawn from the drift away from science in choosing university courses is that there are fewer science teachers who have these characteristics than humanities teachers. This assertion is worth pursuing in further research.

Thirdly, most of these students were high achievers and academically successful. They all proceeded to university. It could be argued that they were fortunate in that there was support from teachers for their interest and in the best of situations they were challenged. Establishing and maintaining high standards can be argued to be a critical component to confront underachievement. High expectations and appropriate feedback based on achievement is necessary to establish a strong sense of self-efficacy and hence willingness on the part of gifted students to engage in challenging fields.

Fourthly, few of the teachers made career changing impacts for these gifted students. At best they reinforced existing dispositions, provided reinforcement, modelled good behaviors and provided clear explanations of the conceptual areas being studied. Other contextual and personal factors not described in this paper contribute to the rich experiences that students experience and which impact on career decisions. A good teacher will reinforce and open up specific avenues for students to follow.

Concluding Comments and Implications

This research extends our understanding of how teachers influence career orientations of high achieving students. The picture that has emerged is that these highly able students took advantage of the situations provided to them. Few of these students could explicitly state when and where they made a decision to pursue a particular career. Decision making was socially situated in a dialectical way in which new experiences provided opportunities for learning but also changed the way they responded to these opportunities consistent with Bandura's (1986) reciprocal determinism. They also sought out new experiences as a consequence of previous experiences.

The findings support the claims by Lent, Brown and Hackett (2000) that career choice is influenced by cognitive-personal variables and environmental or contextual features. However, these findings are not inconsistent with Achter et al.'s (1999) argument that suggests students are oriented cognitively towards either the humanities or sciences from an early age but there is potential for teachers to contribute to refining student orientation. Indeed, Flegg (1997) argued that students began with an image of themselves as a professional scientist or other career role which was subsequently filtered and refined as the student developed and experiences broadened. Nevertheless, we must bear in mind that this study has examined only one small part of students' experiences. If we

acknowledge the complexity of career decision making, we have to accept that there are many other factors that impact student career decision making. As system theorists would argue "an individual cannot be separated from their context, and behavior cannot be accounted for in a linear way" (Patton & McMahon, 2006, p. 161). There are also other limitations in that the study has focussed on gifted students and does not explore how these students' experiences might differ from less able students. However, it is the gifted students who are more likely to proceed successfully to a science career.

There are implications for the recruitment and training of teachers. The implication for recruitment is that practical experience in industry adds value to the disciplinary knowledge teachers have. The data here suggest one element that needs to be considered is the quality of knowledge and experience the teacher brings to the classroom and how that knowledge can be complimented with a deep understanding of learners needs especially those with the greatest potential to be leaders in the fields. Being able to connect conceptual knowledge with applications was an important attribute of effective teachers who influenced these students. Teachers who had authentic experiences in industry before embarking on a teaching career featured among those identified as having supportive characteristics. There are implications for teaching which inform the debate about the training of teachers and the extent to which different teacher education programs are effective in developing quality teachers. The challenge is clear for teacher educators to develop or highlight those personality and cognitive characteristics of teachers valued by high achieving students and to ensure that models of effective learning environments are modelled. Support and relationships with the teacher were valued where there appeared some intellectual benefit for the student. Most methods courses tend to focus on the strategies and theories of teaching and pay limited attention to those affective and social characteristics of teachers. Highlighting the importance of teacher-student relationships and interactions should be a central element of preservice programs.

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