Choosing Physical Science Courses: The Importance of Cultural and Social Capital in the Enrolment Decisions of High Achieving Students

Introduction

This paper reports and discusses findings from a recent study which explored the science enrolment decisions of high achieving, or ‘science proficient’ secondary level students in Australia (Lyons 2003). The research was prompted by the increasing reluctance of such students to enrol in post-compulsory science courses, particularly in physics and chemistry. The study investigated the influences on students’ deliberations about taking a range of science courses. However, this report confines itself to decisions about enrolling in the physical sciences. The paper summarises the students’ experiences and conceptions of school science, as well as the characteristics of their ‘family worlds’ found to be influential in their decisions. The paper discusses the important roles of cultural and social capital in these decisions, and concludes that enrolment in physical science courses was associated with congruence between the students’ conceptions of school science, and characteristics of their family backgrounds.

Context of the Study

The persistent declines in post-compulsory high school science enrolments over the last two decades have generated concern in many countries, including Australia (Dekkers & DeLaeter 2001), Canada (Bordt et al. 2001), India (Garg & Gupta 2003), Japan (Goto 2001), the USA (National Science Foundation 2002), and ‘every country in the European Union’ (Commission of European Communities 2001: 24). The increasing reluctance of students

---

1 Because of space limitations, the qualitative data supporting these findings are not included in this paper.
to choose science courses, and physical science courses in particular, in their final years of secondary education has important implications not only for the health of scientific endeavour in these countries, but for the scientific literacy of future generations.

Attempts to identify the underlying causes of this trend have for the most part involved quantitative analysis of students’ enrolment rationales (Kelly 1988; Woolnough 1994) and their attitudes to science (see Ramsden 1998). Other studies have analysed the background factors associated with enrolment decisions (Fullarton & Ainley 2000). Although these approaches were unable to clarify just how students’ decisions about further science study are influenced by attitudes or backgrounds, they established a number of important statistical relationships.

First, it has been shown that students choosing physical science courses tend to explain their decisions in terms of university or career aspirations (Fullarton & Ainley 2000; Khoury & Voss 1985; Sleet & Stern 1980; Wood & De Laeter 1986). Second, research has shown that decisions to take physical science courses are associated with similar background factors (Fullerton & Ainley 2000; Mak and Chan 1995; Woolnough 1994), including:

- being male;
- identifying with particular ethnic cultures (esp. Chinese or S.E Asian);
- high academic achievement in school;
- attending particular types of schools (private, public);
- high socioeconomic status of parents, in terms of income and occupation;
- high education levels of parents.

The strong relationships between students’ decisions about science enrolment and their background characteristics encouraged a sociocultural approach. The study adapted the ‘multiple worlds’ model developed by Phelan, Davidson and Cao (1991) to explore influences within the students’ family, peer and school environments. The ‘multiple worlds’ model is a representation of the interrelationships between students’ different social ‘worlds’, and the boundaries between them. The usefulness of this model in the domain of science education was demonstrated by Costa (1995), who found that students whose family and peer worlds were congruent with the values and attitudes of the school engaged more fully with the aims and content of the science programme.
In the study reported here, the model developed by Phelan et al. (1991) was modified (Figure 1) to include the structural, attitudinal and dynamic characteristics of each world, and to investigate the potential influence of mass media images of science or scientists (Chen 1994; Long & Steinke 1994).

Figure 1. The theoretical model of students’ multiple worlds (Lyons 2003). In their transitions between worlds of family, school science, peer and the mass media, students’ are required to negotiate structural, attitudinal and dynamic features of the culture of each world (adapted from Phelan, Davidson & Cao 1991).

The conclusions of Costa (1995) and Phelan et al. (1991) regarding congruence of cultures suggested the influence of cultural capital (Bourdieu & Passeron 1977). Cultural capital describes the cultural goods transmitted by families in the context of education, or ‘pedagogic action’ (1977: 5). While cultural capital may be objectified in books and other educational materials, it is also symbolic, being institutionalised in credentials or degrees, or embodied as dispositions, aptitudes, knowledge or forms of language (Collins & Thompson 1997). The resources of cultural capital accumulated and valued by parents, and transferred to children, are therefore
often associated with socioeconomic background, ethnicity, and parental education (MacLeod 1987). Interestingly, these are among the factors related to science enrolment decisions. Bourdieu and Passeron argued that children whose families provide them with the forms of cultural capital valued by schools are privileged in terms of accumulating further capital in the education system (Blackledge & Hunt 1985; Collins & Thompson 1997).

Phelan et al. (1991) also referred to the effects of family cohesiveness and conflict on students’ engagement with school. Such references to family relationships resonate with Coleman’s (1988) emphasis on the importance of social capital within families. Coleman described a family’s social capital as inhering in the relations between children and parents, with children’s educational outcomes being influenced by the amount of social capital available. The availability of this capital is affected by characteristics of family relationship such as the trustworthiness of family structures, the time parents devote to their children (Coleman 1988), and the efforts of parents in helping overcome obstacles for their children (Coleman 1990).

Methodology

The study incorporated both qualitative and quantitative data collection strategies. First, a survey of 196 students in six high schools in the state of New South Wales, Australia, sought biographical data, enrolment details, sources of enrolment advice, and indications of self-efficacy levels. The science proficient students, aged 15-16 years, had all achieved grades placing them in the top 30 per cent of science students in the state. They had also recently chosen courses for their final two years of high school.

Second, results from the survey provided a context for in-depth interviews with 37 students who had decided in favour of, or against, further science study. The interviews explored the influence of students’ school, peer, family and mass media worlds on their enrolment decisions. Constant comparative analysis of the qualitative data looked for patterns between characteristics of these worlds and enrolment decisions. The analysis also looked for examples of resonance of dissonance in students’ deliberations indicative of congruence or incongruence between different worlds (Aikenhead 1996; Festinger 1964; Costa 1995).

Results And Discussion

Although the study explored potential influences within all four worlds, the characteristics most closely associated with decisions about taking physical
science courses were found within students’ worlds of school science and family.

There was some expectation at the outset of the project that decisions to forgo, or continue with, further science study might be associated with different experiences of school science. However, the study found that interviewees generally described very similar experiences and conceptions of school science, regardless of their enrolment decisions. It was decidedly not the case that science proficient students choosing physics and chemistry courses, or indeed other science courses, described a more, or less, attractive picture of their school science experiences than did those choosing not to continue with science study.

The students’ descriptions of school science generally revolved around four characteristics. First, it was described as a subject that focused on facts, which were transmitted from expert sources - teachers and texts - to relatively passive recipients. Such descriptions are consistent with findings from other research (Goodrum et al. 2001; Rosier & Banks 1990). Students’ responses to this characteristic varied, although the majority were critical of it as a default teaching mode.

Second, curriculum content was often presented in a decontextualised manner, leading many of the students to consider school science irrelevant and boring. Again, similar impressions have been reported in other research (Bennett 2001; Goodrum et al. 2001; Osborne & Collins 2001; Rosier & Banks 1990). The students appreciated teachers who presented the content in an engaging manner, but such attempts appeared to be the exception rather than the rule.

Third, students considered physics and chemistry to be the most difficult of science courses, and generally more difficult than most other subjects. This characterisation has also been reported previously (Ainley 1993; Barnes 1999; Kelly 1988; Osborne, Driver & Simon 1998). The students’ descriptions of their deliberations about whether to take physical science subjects indicated that self-efficacy was an important consideration, especially among girls.

Finally, physics and chemistry were conceptualised as subjects having a primarily strategic value, in that they would enhance the students’ university and career options. This is a common perception of these courses (Barnes 1999; Fullarton & Ainley 2000; Osborne & Collins 2001) and one promoted
strongly in the past by universities (Chadbourne 1995; Fensham 1992). Consistent with this perception, all of the students choosing physical science courses explained their decisions in terms of the strategic value of these courses with regard to university entrance, career paths and maximisation of post-school options. According to the students, this conceptualisation was shared and sustained by teachers, parents and other students. The combination of difficulty and strategic value imbued physical science courses with a certain cachet.

The finding that experiences of junior and middle high school science were generally uninspiring, and that so few students chose physics or chemistry courses for intrinsic reasons, led to a shift of focus from those choosing no science courses to the motivations of those choosing physical sciences. These motivations were generally not based on aspects of the curriculum, such as skills or knowledge, but on what these courses represented in terms of strategic value and, in some cases, prestige. From the perspective of students entering senior science, a culture already existed which presented a choice between anticipated difficulty and abstraction on the one hand, and strategic benefits on the other. Deliberations about science enrolment therefore involved each student referencing their sense of self-efficacy, the nature of their motivations (intrinsic/extrinsic), their orientations (present/future) and their post-school aspirations. Insights into these qualities were found within students’ descriptions of their family worlds.

The students’ narratives implicated three aspects of family worlds as being associated with decisions about physical science courses. These were attitudes to formal education; attitudes to science, and levels of social capital in family relationships.

Almost 80 per cent of the interviewees choosing physical science subjects perceived their parents as being oriented towards the strategic importance of formal education for university or career paths. The students referred to explicit and implicit cues, such as parents’ comments, behaviours or personal histories. Some students saw the high status of their parents’ credentials or occupations as representing what could be achieved through university study. Others mentioned parents who were presently undertaking university study as mature-age students, a choice signifying the high value placed on education credentials. For some of these students, the difficulty of

---

2 In reporting qualitative data, percentages are used as a guide and are not necessarily generalisable.
this undertaking also underscored the importance of maximising educational opportunities at an early age.

Finally, just under half the physical science students referred to parents’ regrets over not having had, or having taken advantage of, their own educational opportunities. The contexts for parental regrets included: lack of useful qualifications; interruption of education or careers for family reasons; loss of opportunity due to immigration or refugee status, and dissatisfaction with employment prospects.

Each of these contexts underscored for students the importance of maximising educational opportunities, especially those associated with credentials. By comparison, students choosing not to enrol in physical science subjects more often described their parents as oriented towards the intrinsic benefits of particular subjects. Many of these students were encouraged to choose courses they enjoyed, or were good at, rather than basing decisions upon the strategic value of particular courses. In other cases, parents made little or no contribution to students subject choices.

The study recognised a relationship between the students’ descriptions of parental attitudes to formal education, and their own intrinsic or strategic explanations for their decisions. This relationship was interpreted in terms of cultural capital (Bourdieu and Passeron 1977), which also pertains to the attitudes and dispositions of parents towards education (Collins & Thompson 1997). In this respect, the extrinsic and intrinsic orientations of parental attitudes to education can be regarded as two forms of cultural capital. Bourdieu and Passeron (1997) argue that such dispositions are transferred from parents to children as part of a process of cultural reproduction. The concept of cultural capital is usually evoked in the context of social class theory, and has been criticised by a number of writers as being too socially deterministic (Hatcher 1998; Hodkinson & Sparkes 1997; Jenkins 1982). Nevertheless it had considerable merit in terms of explaining the correspondence between parents’ attitudes (or at least, students’ perceptions of these attitudes) and their children’s’ science enrolment decisions, particularly since different types of cultural capital have previously been implicated in students’ decision making in other contexts (Grenfell & James 1999; Hodkinson & Sparkes 1997).

Despite the link between parental emphasis on the strategic value of schooling, and enrolment in physical science courses, there were a number of students choosing not to take these courses who described similar parental
attitudes. However, it emerged that in many of these cases the values and attitudes of the parent were not shared by the student, for reasons which are discussed later.

About 71 per cent of the students choosing physical science courses described parents or other family members who advocated or encouraged an interest in science. This was done through the provision of science related materials, such as books, magazines, kits and toys; frequent discussions of science-related issues; help with science projects and homework, and shared viewing of science TV documentaries. Several parents were also involved in science related occupations, such as medicine, engineering or science teaching, indicating to students that science was valued.

The provision of science related materials and knowledge by parents can also be seen as an endowment of cultural capital, in the sense that these are assets that parents consider will enhance their child’s education and, hopefully, their schooling outcomes. Likewise, parents’ use of scientific language is also a form of cultural capital, which, if congruent with the language and attitudes of teachers, can benefit students in their education (Bernstein 1971; Collins & Thompson 1997).

In terms of the robustness of any relationship between cultural capital and enrolment decisions, it was recognised that about a quarter of students choosing physical science courses described family worlds in which science was not highly valued. In addition, about 43 per cent of interviewees choosing not to enrol in physical science courses also described families in which science was advocated or encouraged. While discrepant cases were originally seen as weakening any association between parental attitudes and enrolment intentions, the study again found that the quality of students’ relationships with family members mediated the influence of these attitudes.

With the exception of one case, all of the interviewees choosing physical science subjects described supportive relationships with a parent or family member whose attitudes to education, or science, favoured such a choice. The quality of relationships was determined by students’ descriptions of the support, encouragement or other indicator of socioemotional investment (Bradley & Corwin 2000) they experienced, and the trust and respect they placed in significant family members. These references to family relationships resonated with Coleman’s (1988) emphasis on the importance of ‘social capital’, which he conceived as a resource inhering in family

---

3 For whom there was insufficient data on family relationships
relationships and upon which members could draw in their activities outside the family world. The quality of parent/child relationships was also implicated in the levels of confidence and academic self-efficacy of students, and in some cases, affected the role modelling dynamics within families.

The concept of social capital helped to explain the discrepant cases mentioned earlier in which parental attitudes were not shared by students. In many of these cases, the students revealed problematic aspects of their relationships affecting the degree to which they shared the attitudes or values of particular family members. The contexts included family conflict, loss or significant reduction of contact with a parent, unstable family structures, and lack of involvement or support.

Interaction of family influences

The important role of social capital in the students’ enrolment decisions can be seen in Figure 2, which represents the interactive influence of the three family characteristics discussed above. The intersection produced a number of regions, some of which are associated with enrolment in physical science courses. The main features of these regions are described below.

First, all of the students choosing physical science courses, except one, are located inside ‘Set C’, suggesting strongly that it was important for students choosing these courses to feel, either consciously or unconsciously, that they were supported by the positive relationships they enjoyed within their families. It was apparent from their narratives that the majority of physical science students also possessed a sense of self-efficacy which was both instrumental in their decisions to take ‘more difficult’ science subjects, and rooted in indicators of social capital, such as trust and encouragement.

Second, all of the physical science students are situated within the intersections ‘AC’ and ‘BC’, with the majority being found in the region ‘ABC’. That is, physical science students described family worlds in which, along with the reserves of social capital discussed above, family members emphasised the strategic qualities of education, or provided science related cultural capital or, more trenchantly, did both. In terms of science subject choice, adequate resources of social capital in family relationships were alone insufficient to influence the choice of physical science subjects, as shown by the ten students who were in Set ‘C’ only. The quality of the family relationship was effective only in influencing students to adopt the attitudes and aspirations of family members. However, for this influence to favour the choice of physics and chemistry, it appeared necessary for the
student to perceive that such a decision was consistent with the attitudes of the family member(s).

Third, seven students are found in A or B, but not in C. While each of these students described a parent as advocating science, or the strategic value of science subjects, low levels of social capital in the relationship with that parent weakened the influence of such advocacy.

Figure 2. The interaction of three characteristics of science proficient students’ family worlds found to influence their science enrolment decisions. Key: (m) mother; (f) father; (b) brother; (s) sister; (c) cousin; Students taking physical science courses; students taking other science courses; students taking no science courses. Cases in which the attitudes or relationships depicted above could not be determined are not shown.

The role of congruence between school science and family worlds

The study found that deliberations about taking science courses involved students referencing the types and levels of cultural and social capital within their families, and comparing them with the anticipated characteristics of these courses. The narratives of students choosing physical sciences
indicated that these characteristics resonated with the cultural and social capital within their families. The mechanics of this congruence are shown in Figure 3. As the new model is based upon the deliberations of the relatively small number of science proficient students, it is offered here as a framework for future research in this area, rather than as a model applicable to larger populations.

Figure 3. A model illustrating the congruence between characteristics of family and school science worlds found among science proficient students choosing physical science subjects (Lyons 2003)

The model suggests, firstly, that science proficient students are more likely to choose physical science courses when the importance attributed to science by teachers is congruent with the advocacy for science of a significant, and supportive, family member. This value is embodied in the attitudes and materials constituting the science related cultural capital provided within the family.

Second, enrolment in physical science subjects is more likely where the perception that they are primarily of strategic value resonates with students’ recognition that such a quality is highly valued within the family. The strategic orientation towards education of some parents is also a type of cultural capital, typical of, though not limited to, families of high socioeconomic status (Bourdieu & Passeron 1977). This aspect of the model is, therefore, supported obliquely by the strong statistical correlations found
between enrolment in the physical sciences, and high levels of parental education and socioeconomic status (Fullarton & Ainley 2000; Woolnough 1994).

Third, for some students, the perception that school science is a content-centred subject presented in a transmissive mode may also resonate with their parents’ perceptions of school education as primarily involving the assimilation of content, and of success as measured in terms of examination results. However, the findings in this study showed that the content-centredness of school science was not generally viewed as an attractive characteristic, even among those who did choose physical science subjects. Nevertheless, the model acknowledges that the disadvantages of the dominant pedagogy are, for some students, offset by the strategic value offered by physics and chemistry. Likewise, some students may be willing to tolerate the decontextualised and personally irrelevant content anticipated within these subjects for the benefits they offer in the long term. Such a reconciliation is consistent with the priority given by parents to strategic values over intrinsic ones.

Fourth, the perception that physics and chemistry are the most difficult of science courses may be less daunting for some students due to the levels of confidence, optimism and self-efficacy they possess. Such qualities are associated with the high levels of social capital inhering in their relationships with one or more significant family members, usually a parent. The quality of a parent/child relationship is particularly influential where the parent also emphasises the importance of a strategic orientation, and expresses confidence in their child’s ability to take on challenging subjects.

Conclusion

The concept of cultural capital contributed significantly to this study by providing a theoretical basis for understanding the influence of parents’ attitudes and aspirations on those of their children. The findings suggest that statistical factors relating to enrolment decisions, such as socioeconomic status, parental education or ethnic background, may only be indicators of the more directly influential characteristics of students’ worlds, such as the resources of cultural capital made available by families. It might be more meaningful, therefore, for educators and researchers to consider enrolment choices in terms of cultural capital rather than demographic characteristics.

The most substantial finding of the study was that the influence of parental attitudes on enrolment decisions was strongly affected by the quality of
parent/child relationships. While previous studies have highlighted the connection between the quality of parent/child relationships and other educational outcomes (e.g. Coleman 1988; Lareau 1989), the association between social capital and science enrolment decisions has not previously been articulated. An equally important finding, and an area for further research, was the relationship between social capital and self-efficacy, and the role of both in decisions about enrolment in academically challenging subjects.

Much of the commentary on falling science enrolments in Australia has suggested that external issues, such as perceptions of the low status of science careers, or competition from newer and ‘easier’ school courses, have been drawing students away from science courses (see Werry 1998). This perspective assumes that enrolment in senior science courses, and the physical sciences in particular, is the default choice of any science proficient student, as has been the case in the past. This assumption has been supported by both the customary status of science in the school curriculum, and its widespread inclusion among university prerequisites (Fensham 1992).

Over the course of this study, it became increasingly obvious that the most cogent single force acting against the choice of physical science courses was not external, but rather the culture of school science itself. While emphasising its status and strategic utility, high school science was considered by students in this study, and others (Osborne & Collins 2001; Lindahl 2003), to have fewer intrinsically satisfying characteristics than it might have, even for many students who had achieved well in the subject. Thus, in speculating about the decline in physical science enrolments in Australia, it is suggested that the recent decrease in the strategic value of such courses, as universities offer more flexible options and lower entry criteria for science courses, has only served to highlight the lack of intrinsic benefits of school science as conventionally taught. If this is indeed the case, instead of considering why clever students are no longer taking science courses, it may be more pertinent to ask, ‘why should they?’

References


Werry, J. 1998, ‘Where are the Year 12 science students going?’, Labtalk, 42(3), : 24-29.
