Student subject choice in the final years of school: Why science is perceived to be of poor value

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Abstract

The decision to continue with science in school has a critical impact on the supply of the scientific skills necessary for a prosperous modern society. Low participation rates in post-compulsory school science has been a persistent problem and the decision process employed by students in choosing science is poorly understood. In this study 10 focus groups were conducted with 50 students from four schools. Students were asked how they selected their subjects and their opinions on choosing science. Students described their subject selection as a two-stage process. First, they chose and rejected subjects based on enjoyment, interest and need. Second, they sought information and advice to fulfil their subject quota. Compared to other subjects, the sciences were considered more difficult and useful only for stereotypical scientific careers. It is suggested that science may be 'overpriced' and 'undervalued' by students and that these perceptions can be addressed at subject selection time.

Keywords: post-compulsory, school, science, subject choice, STEM

Background to the study

This study was conducted in response to concerns expressed by educators and policy makers of several nations that insufficient numbers of students are choosing science to meet the demand for scientifically trained and literate individuals (European Commission 2004; National Academy of Sciences Committee on Science Engineering and Public Policy 2007; Office of the Chief Scientist 2014). The decision to choose to continue with post-compulsory science at school is critical because improved scientific literacy provides citizens with skills necessary to critically evaluate and make informed decisions about complex issues that impact their lives (Rennie et al. 2001) and; scientific literacy is also linked to study of science at a tertiary level (Thomson 2005). This study investigated students' decision-making at the time they were choosing their senior high school subjects and identified strategies to influence them to consider continuing with post-compulsory science.

This research was directed at discovering ways to alter student behaviour with respect to science choice. It is known that some students change their mind and reject science when the subject choice decision is made (Venville et al. 2010). This study is novel as it sought to understand what influences the choice of science at the point in time students are making this choice. As the study focuses on predicting and changing behaviour at the time decisions are made, it is informed by the Theory of Planned Behaviour (Fishbein and Ajzen 2010). This theory has been validated in numerous contexts including science subject choice (Taylor 2015). The model gives prominence to the proximal antecedents to the intention to behave and suggests that an individual's beliefs about how well they will do in an activity and how much they value that activity will explain their choices of, persistence at, and performance of, those activities. This study provides critical evidence on the impact of the factors that students consider at the point in time when science is chosen or rejected.

The remainder of this paper is organised into four sections: 1) background literature; 2) the methodology used to conduct the focus groups; 3) the research findings including a model for how students choose their subjects; and 4) a conclusion suggesting how these findings may be used to influence science choice.

Background Literature

This study is distinctive as it focuses on the method that students use to choose their subjects and how this may affect the choice of science. To understand the decision, it is necessary to define the factors involved in the decision-making process. There is a large body of international research on the factors influencing students' choice and rejection of science (e.g. Ainley et al. 2008; Henriksen 2015; Lyons and Quinn 2010). To provide a clear and concise description, these factors have be organised into two areas: *intrinsic* factors relating to the students themselves and their preferences, and *extrinsic* factors relating to the environment within which students choose their subjects.

Intrinsic Factors for Choice of Science

Among the intrinsic factors affecting students' choice of science are attitude, interest, engagement, ability, self-efficacy and gender.

Student attitudes to different aspects of science have been identified as important for understanding why the proportion of students choosing science has declined to an unsatisfactory level (Osborne et al. 2009; Regan and DeWitt 2015). Studies in western societies have found that student attitudes to science decline during secondary school (Summers and Abd-El-Khalick 2019), student interest in doing school science has declined, and school science is less popular than other subjects (Bøe et al. 2011; Tytler and Osborne 2012). However, in a longitudinal study in England, most children surveyed enjoyed science in secondary school and had a positive view of scientists (DeWitt et al. 2014). In their review, Tytler and Osborne (2012) comment that the picture of how students' attitudes towards science have changed in past decades is still unclear.

The beliefs adolescents have about their abilities (self-efficacy) influence their choices (Bandura 2006). According to Brown and Lent (2006), interests are strongly predicted by self-efficacy and by outcome expectations. By mid to late adolescence, students are likely to form an enduring interest in activities they see themselves as competent in and expect to receive valued outcomes from. Ainley and Ainley's (2011) analysis of 2006 data from the Program for International Student Assessment (PISA) shows that interest and engagement in science is linked to adolescents' intentions to continue with science. If students perceive classroom science as uninteresting and difficult then it may result in fewer students choosing to continue with science (Goodrum et al. 2012).

Gender-based preferences for certain science subjects are also important for choice of science at school and have been widely studied (Regan and DeWitt 2015). Choice of science is gendered, with boys displaying higher participation rates in all science subjects except biology (Jaremus et al. 2019). Regan and DeWitt's (2015) review suggests that fewer girls than boys may choose science because girls report comparatively lower self-efficacy in science, they have a less positive attitude to it, and they may see it as "masculine". In his review of 30 years of research into this issue, Blickenstaff (2005) suggested the problem was unresolved but that improvements in the teaching of science may increase girls' participation in science.

Extrinsic Factors for Choice of Science

Students' school and home environments have been found to be associated with the decline in the proportion of students choosing science at school (Cleaves 2005). The extrinsic conditions affecting the choice of science include socio-economic factors, persons of influence, teaching, careers, and logistics of choice.

The socio-economic status of a student and their school is associated with a student's performance in science (McConney and Perry 2010; Smith and Gorard 2011), and their decision to continue with science (Ainley et al. 2008). Students are more likely to choose to study science if their parents are well educated and affluent (Anderhag et al. 2013), and English is a first language (Ainley et al. 2008). Students from low socio-economic backgrounds have been shown to be more likely to choose science if they believe it is useful for careers (Mujtaba et al. 2018).

Persons of influence to the student such as parents, teachers and peers can affect a student's choice of science (Regan and DeWitt 2015). Parents influence the context within which children form their educational aspirations and expectations, and can provide support for children who express an interest in STEM (Lloyd et al. 2018). The impact of peers is uncertain, although an important period of peer influence is known to occur around the age students choose their senior subjects (Ryan 2000).

Tytler and Osborne (2012) suggest that student success in science is impacted by teaching quality. Positive experiences of science teaching are important for students choosing science (Henriksen 2015; Tytler 2007). However, science teaching has been criticised for utilising outdated teaching techniques (Goodrum et al. 2012; Tytler 2007) which may negatively impact the choice of science.

Career and study options also influence the subjects that students choose (Bøe et al. 2011) with the choice of science being a critical decision point on the path to a science, technology, engineering and mathematics (STEM)-related career (Thomson 2005). The perceived utility of science has been found to be positively associated with students' science-related career aspirations (Sheldrake et al. 2017). There is concern that students may choose other subjects because they are unaware of the diversity of science-related careers (Goodrum et al. 2012). Stereotypical images of scientists in laboratory coats and perceptions of science being difficult, isolating and uncreative have also been noted as negative influencers of science choice at school (Regan and DeWitt 2015).

The logistics of choice and timetabling can mean that some subjects may be unavailable to students in their final years of school (Goodrum et al. 2012). Lyons and Quinn (2010) suggest that competition from an increased range of subjects may result in fewer students choosing science.

Taken together, the factors thought to affect the choice of science are numerous and students place different levels of importance on these factors in their decision-making process (Palmer 2017). Further, intrinsic and extrinsic factors interact, for example Taylor (2015) suggests that the beliefs students have about the outcomes of choosing science (an intrinsic factor) are important determinants in students choosing science and these are impacted by the influential role or parents in the formation of these beliefs: an extrinsic factor (Wang and Degol 2013).

This research breaks new ground by looking beyond the factors for choice to consider how choice of science is influenced by the decision-making process itself. To understand this process, we conducted focus groups with students who had recently made, or were in the process of making, their subject selection and asked them what factors they considered when choosing subjects and how they made their decision. In this context, we then asked students about choosing science.

Methods

Data Collection

For this qualitative study, students were asked to describe how they chose their subjects generally and then how they valued science in this subject selection process. Australian students choose their subjects in Year 10 for study in their final two years of school (Years 11 and 12); 10 focus groups were conducted with 50 students (26 girls and 24 boys) in Year 10 (ages 15 and 16) and Year 11 (ages 16 and 17) from four schools in metropolitan Sydney, Australia. There were 15 students from government schools and 35 from non-government schools. School staff were asked to provide (ideally) two groups of six students from both Years 10 and 11 to participate in the focus groups. Only the Year 10 students who were achieving a passing grade in science (as defined by the school), and thus considered potential science students, were selected. The Year 11 focus groups comprised students who had chosen science and those who had 'surprised their teachers by not choosing science'.

The schools chosen were of similar size (1000-1500 students) and of similar socio-economic status (SES). The socio-economic aspect of students' lives is believed to strongly impact science subject choice (Ainley et al. 2008). The study focused on schools from areas of above-average SES in an attempt to minimise this variable and thus concentrate on factors within schools and those relating to students, as these are open to intervention within the school setting.

This study was approved by a university ethics committee and the relevant Government education department. Informed consent was obtained from all student participants and their parents. All data collected are anonymised.

Table 1 shows the composition of the 10 focus groups: 31 Year 10 students (six focus groups) and 19 Year 11 students (four focus groups) provided by the schools. The final column of the table shows the proportion of students in the Year 11 focus groups who did or did not choose science. The five Year 10 students from the government co-educational school (row 3) had already made their subject selection when focus groups were held and all had not chosen science even though teachers had identified them as high achievers in science. The remaining Year 10 students were in the process of choosing their subjects.

Table 1

Student participants in the focus groups

School type	Year group	Participants	Number of students who chose a science
Government girls' school	10	5	n/a
	10	5	n/a
Government co-educational school*	10	5 (3 girls, 2 boys)	No girls, 1 boy

Non-government girls' school	10	6	n/a
	11	5	4
	11	2	1
Non-government boys' school	10	4	n/a
	10	6	n/a
	11	6	3
	11	6	4

*Students in year 10 at this school had made their subject selection when the focus group was held.

Focus groups were 30-40 minutes long, held on school grounds, audio recorded and transcribed. The Year 10 and 11 students were asked about:

- the process they used to choose their subjects;
- how difficult choosing was;
- who they asked for help;
- the factors they considered; and
- their choice to study or not study science.

Analysis

Transcripts from the focus groups were analysed within a Grounded Theory approach employing a constant comparative procedure (Glaser 1992) that was managed in the software package NVIVO (version 9.2). Student comments were coded into nodes that represented themes as they emerged from the data. Comments that related to multiple themes were coded into all the nodes that applied. The content of the nodes was then reviewed to identify relationships resulting in a structure of 'parent nodes' of major themes, and 'child nodes' that were sub-themes to the parent nodes. The process of coding was iterative; as new themes were discovered, those transcripts already coded were reviewed and recoded if necessary. This coding created a structure of interrelated nodes each containing pertinent participant comments. NVIVO analysis tools were used to run enquiries on the nodes to investigate relationships between nodes and measure frequencies of comments on themes.

Results

The three parent nodes were: *Student Characteristics*, *Subject Characteristics,* and *Choice Process*. Each of the parent nodes contained associated child nodes with specific comments on factors relating to the general theme represented by the parent node. Two of the child nodes, *Career* and *Teaching*, were further coded into sub-nodes. Comments made by Year 10 and Year 11 students are presented together in this section as these two groups expressed very similar views. Table 2 shows the three parent nodes and child nodes within each parent node.

Table 2

Parent nodes and child nodes within each parent node

Parent nodes	*Student Characteristics*	*Subject Characteristics*	*Choice Process*
Child nodes	Interest and enjoyment	Career or study need	Choice of subject method

	Ability Previous experience Teacher quality Attitude to teacher Gender	Knowledge of career ATAR and scaling* Difficulty Logistics Career advice Usefulness Career information	Peer or sibling influence Teacher advice Parental influence Subject information Complexity of choice

* Australian Tertiary Admission Rank (ATAR), a rank used for admission to most Australian universities and the scaling used in its calculation.

The number of student comments coded into the 20 child nodes grouped into the three parent nodes are shown in Fig. 1. The number of comments provide an indication of how often particular topics were referred to in discussions. It is important to note that students can make multiple comments on the same topic and each discrete comment is coded separately.

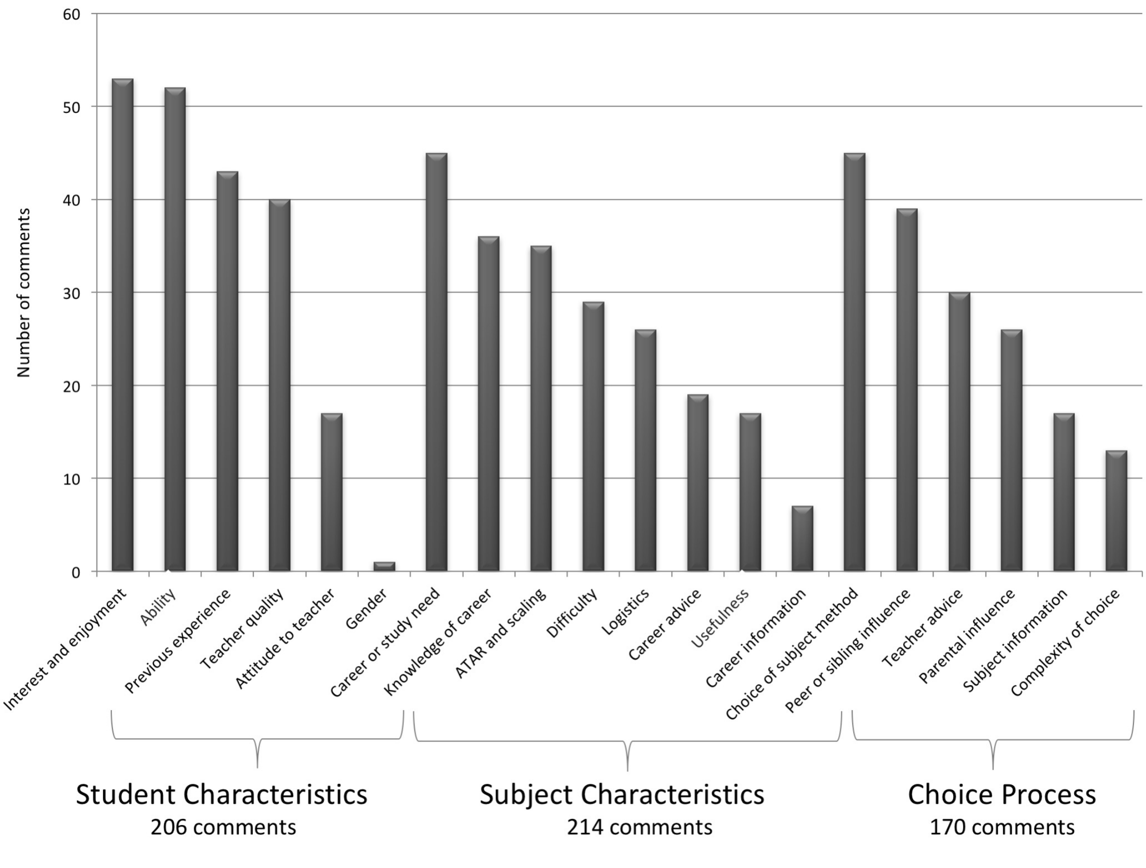

Fig. 1 The number of comments coded to each child nodes grouped into the three parent nodes

Relationship between nodes

The interrelatedness of student comments was measured using Jaccard's coefficient (Tan et al. 2006) and this is presented in the dendogram in Fig. 2. The closer the nodes are on the branches of the dendrogram, the higher the degree of common coding in those nodes. The Jaccard's coefficient for three pairs of nodes was 1, meaning that students nearly always spoke about these topics together. These pairs were *Interest and enjoyment* with *Ability*; *Peer* *or sibling influence* with *ATAR and scaling*; and *Usefulness* with *Previous experience* and these data suggest these topics are closely linked.

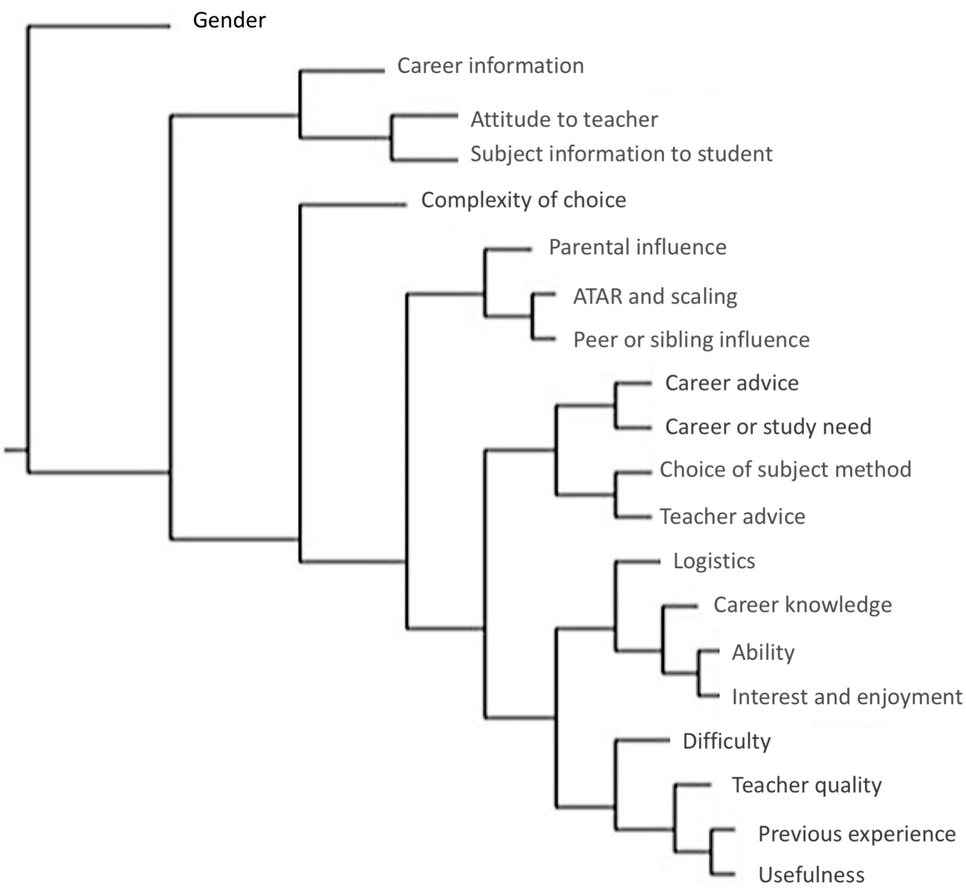

Fig. 2 Dendrogram showing nodes clustered by coding similarity

This section has described how the three parent nodes were interrelated. The next sections discuss some key findings in each child node within these parent nodes.

Key findings

The number of comments coded to each node is indicated in brackets next to the title of the node. This allows the inferences reported to be related to the number of comments made by students on a particular theme.

Student Characteristics (206)

The *Student Characteristics* parent node contains 206 comments that reflect students' personal preferences, ability to do well in subjects, and how these comments relate to the subject choices made. Comments were coded in four child nodes: *Interest and enjoyment*, *Ability*, *Teaching'* and *Gender*. *Teaching* was further analysed and coded into three additional sub-nodes: *Previous experience*, Q*uality* and *Attitude to teacher*. Fig. 3 shows the structure of the *Student Characteristics* parent node.

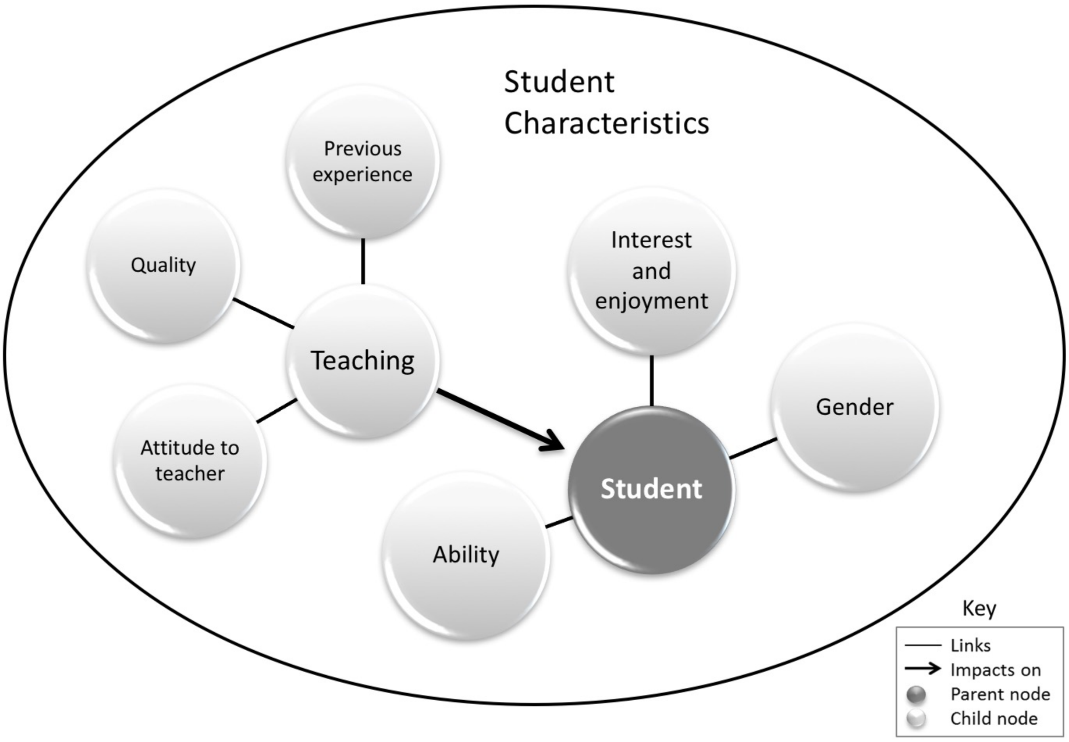

Fig. 3 Structure of the *Student Characteristics* parent node

Interest and Enjoyment (53). Students widely stated that the primary reason they chose a subject was an interest in, or engagement with, that subject. Although interest and enjoyment are not synonymous (Krapp and Prenzel 2011), the terms ‘enjoy’, ‘like’ and ‘interest’ seemed to be used interchangeably by students to convey the idea that they generally had positive feelings towards a subject. When asked why they chose certain subjects, students commented that they generally chose subjects that they enjoyed and avoided subjects that they did not. There were 20 student comments about avoiding subjects they did not like and 10 about subjects they enjoyed. This may indicate that students are more focused on avoiding subjects that they do not like than choosing subjects that they do like. Three students stated they would choose a subject they did not enjoy if they felt they needed it for a future career or could obtain good marks in it.

Ability (52). Students commented on the relationship between academic proficiency in a subject (referred to by them as being ‘good at’ a subject or ‘getting good marks’) and their interest and enjoyment of it. Comments coded within the node of *Ability* were almost always also coded to the node of *Interest and enjoyment*, which suggests that these two themes are closely linked. Students who performed well in a range of subjects appeared to place more importance on selecting subjects they found interesting, whereas students with fewer interests or lower overall histories of achievement found the decision to be one of choosing between unattractive options.

Gender (1). Within *Student Characteristics*, gender was raised as an issue for choice of science on one occasion by a Year 11 girl who said science is "daunting" because it is a "male subject".

Teaching (100). The comments that were coded to the *Teaching* child node were further coded into three sub-nodes: *Previous experience*, *Quality* and *Attitude to teacher*.

Previous experience (43). Student's experiences of how a subject has been taught were frequently spoken of by students with regard to subject choice. Students more frequently made negative comments about past teaching (n = 23) than positive comments (n = 5) and noted that teaching was a consideration in choosing subjects. Countering this view were two students who stated that dislike of a teacher or their anticipation of poor teaching was not sufficient to dissuade them from choosing a subject. Four students specifically mentioned that a good experience with past teaching had positively influenced their view of science.

Quality (40). Three students specificially related their own academic performance to their perceptions of the quality of the teaching they received. However, as students did not know which teachers they would be allocated for Year 11, their ability to estimate future teaching quality for a subject was limited. To assess the quality of expected teaching, students looked to the performance of their past teachers and evidence of the efficiency and effectiveness of a faculty.

Attitude to teacher (17). Six students indicated that their attitude to a teacher negatively impacted on their perception of a subject. They said it is easier to obtain better marks in subjects they enjoyed and this was influenced by their experiences with how a subject has been taught. When speaking about their science subject choice specifically, 19 students made negative comments regarding their science teaching experiences compared with three positive comments. Given students had reported a link between the teaching they received, the marks they obtained, and their enjoyment of a subject, their expectations of their future teaching experience may be an important consideration in choosing a subject.

Subject Characteristics (214)

The *Subject Characteristics* parent node contains 214 comments on student perceptions regarding the characteristics of subjects and how these influence their subject selection. The *Subject Characteristics* parent node contains the child nodes of *Logistics*, *Difficulty*, *Usefulness* and *Career.* The *Career* node contains a set of sub-nodes: *Knowledge of career*, *ATAR and scaling*; *Career information*; *Career advice* and *Career or study need*. Fig. 4 shows the structure of the *Subject Characteristics* parent node.

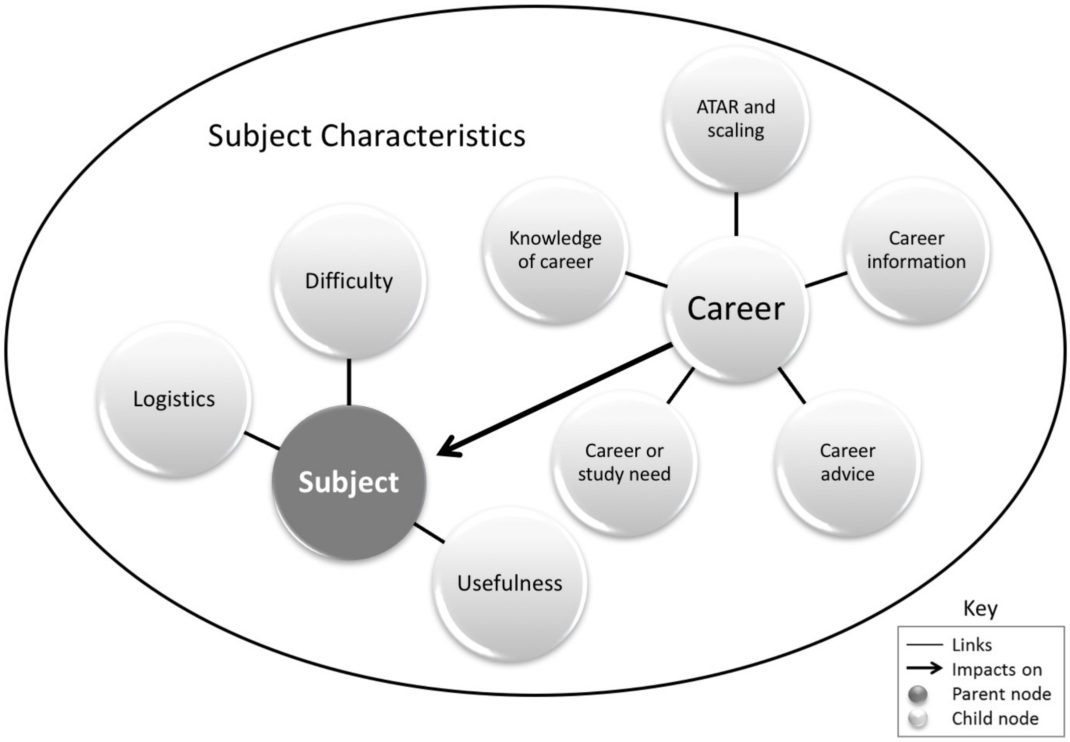

Fig. 4 Structure of the *Subject Characteristics* parent node

Logistics (26). The logistics of the subject relates to the availability of subjects and their assessment. Schools in this study constructed timetables to accommodate student subject choices. Only one student cited timetabling as a problem for him but commented that he wanted to do more than the maximum number of subject units allowed by his school.

Five students commented that the format of assessment of a subject was a consideration in subject selection. Three students wanted to avoid 'major works', one student said she avoided essays, while another said he looked for subjects with essays. As science assessment does not normally require the production of a major work or frequent essays, assessment style may not be a reason to avoid science.

Difficulty (29). Students considered subjects in terms of their perceived difficulty. Students (16 against 7) reported that science is harder than other subjects, with one Year 10 boy remarking that science is only difficult for "the parts that don't make sense".

Perceptions of the difficulty and nature of science learning varied. Some students saw science subjects as more demanding because they had large amounts of content to be remembered. Countering this general view were five students who stated science is simpler to understand and study than other subjects because it was factual and they found this style of subject preferable. Students indicated that they did not seek less challenging subjects per se, but simply said that the subjects should be of sufficient value to their career or future university study needs to warrant such effort.

Usefulness (17). Students associated the usefulness of a subject with its utility in a future study path or career. Those who were unsure of their future career paths and had not developed a dislike of a subject may consider keeping the subject to maintain a broad range of subjects. Students repeatedly commented that science subjects are needed for stereotypical science careers such as engineering and medicine, but found it difficult to identify any general use for the subject. When students in one focus group were specifically questioned about whether science was generally useful in life, no student in this focus group could suggest a use for science outside of preparation for a science-based career. In contrast, students commented on nine occasions that mathematics was a subject that was necessary after school and two students stating that they would do mathematics despite not enjoying it.

Career Factors (142). Career considerations impact on subject choice. The *Career* child node was coded into five sub-nodes: *Knowledge of career*, *ATAR and scaling*, *Career information*, *Career advice* and *Career or study need*.

Knowledge of career (36). Most of the 50 students stated they were unsure of their career path. Only three students indicated they had a clear idea, and three said they had no idea, of what they would do after school.

ATARs and scaling (35). Students spoke at length about ATARs (the student ranking used for admission to most Australian universities) and the scaling of subjects that plays a role in calculating the ATAR. Students commented that they had received advice from teachers not to choose subjects based on subject scaling and expressed conflicting views as to scaling's importance in calculating an ATAR.

Career information (7). Students received general information about the range of careers available but they could find career information unhelpful if they were undecided on their career choice, with some students finding the information, "a bit of an overload" (Year 11 girl).

Career advice (19). Students received career guidance from their schools. Students commented that this was general information about career options and it was, "pretty broad" (Year 10 boy). Four students chose to individually discuss career options with the school Careers Adviser, with three of them finding it useful and the fourth commenting she found the advice from the Adviser and teachers was inconsistent.

Career or study need (45). Students said they considered their future career or study needs when choosing subjects. Those unclear of their future career or study path stated that this made subject choice more difficult. They also recognised they might change their minds about their future study plans and the options available to them may be limited by the subjects they chose.

Choice Process (170)

The *Choice Process* parent node contains 170 comments on how students chose subjects for further study, the information sources they consulted, and the people who provided advice. The factors influencing the *Choice Process* node were: *Choice of subject method*, *Subject information*, *Parental influence*, *Peer or sibling influence*, *Complexity of choice* and *Teacher advice*. Fig. 5 shows the structure of the *Choice Process* parent node.

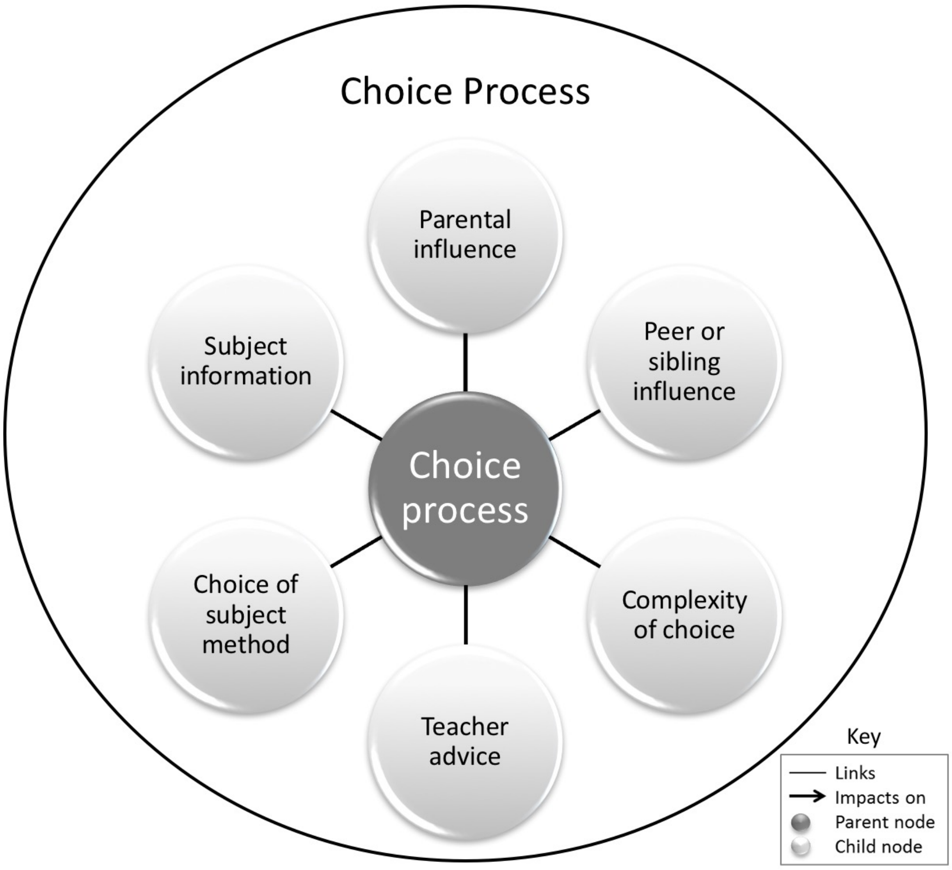

Fig. 5 Structure of the *Choice Process* parent node

Choice of subject method (45). The subject choice process was consistently described by students as a staged process. In the first stage students appeared to judge subjects on an affective basis. Most students described rejecting subjects that they "hate and never want to see again" (Year 10 girl). Students then chose the subjects they considered to be 'base' or 'core' subjects that they thought they would enjoy or need in the future.

In the second stage, students adopted a more analytical approach and researched the subjects they did not feel strongly about to determine which of the remaining subjects could fill their required allocation of subjects. The approach for students at this stage was spoken of in terms of finding either additional subjects to study or subjects to reject. Students are limited in the number of subject 'units' they can take, and they approached this decision stage from the viewpoint of either needing to "build up units or trying to cull" (Year 11 girl).

Choosing subjects was usually cited as a difficult process for students unless they had a clear idea of their likely future career or study needs. The extensive range of subjects available complicated the choice process for most students as expressed by a Year 11 Boy who did not choose science who said, “Well, like science for example, I wasn’t doing badly, I was doing quite good. It was just that there were so many options.”

Subject Information (17). Students in all focus groups indicated they felt they were well informed by their school about subject choice.

Parental influence (26). Parents were normally consulted during subject selection but the advice was generally about how to choose subjects rather than which subjects to choose. Twenty-one students commented that the advice from parents about subject selection was general rather than specific although five said that their parents had recommended they study mathematics.

Peer or sibling influence (39). Twenty-three students indicated they consulted with older siblings and friends in higher year groups about subject choices. Specific advice on what subjects to take or avoid was common, particularly with respect to the ATAR and scaling. Almost all comments regarding the *ATAR and scaling* node were also coded to the *Peer or sibling influence* node, suggesting that these factors are closely related. In general, girls stated they discussed their subject choices with friends, whereas boys reported it was “not a favourite topic” (Year 10 boy).

Teacher advice (30). Teachers were perceived by students as a biased source of information because they were promoting their own subjects. Notwithstanding this suspicion, students recognised the expertise of teachers and said they listened to general advice about how to choose subjects.

Complexity of Choice (13). Students made varied comments regarding the complexity of the subject choice decision, with most saying they experienced some difficulty in choosing their subjects.

Discussion and Implications

This study examined the process of subject selection by high school students in their final years of school. Fig. 6 provides a model describing a two-stage process used by students to choose their subjects. The model shows an affective decision-making process followed by a rational evaluation of subjects that depended on whether the student had too few or too many subjects they were interested in studying.

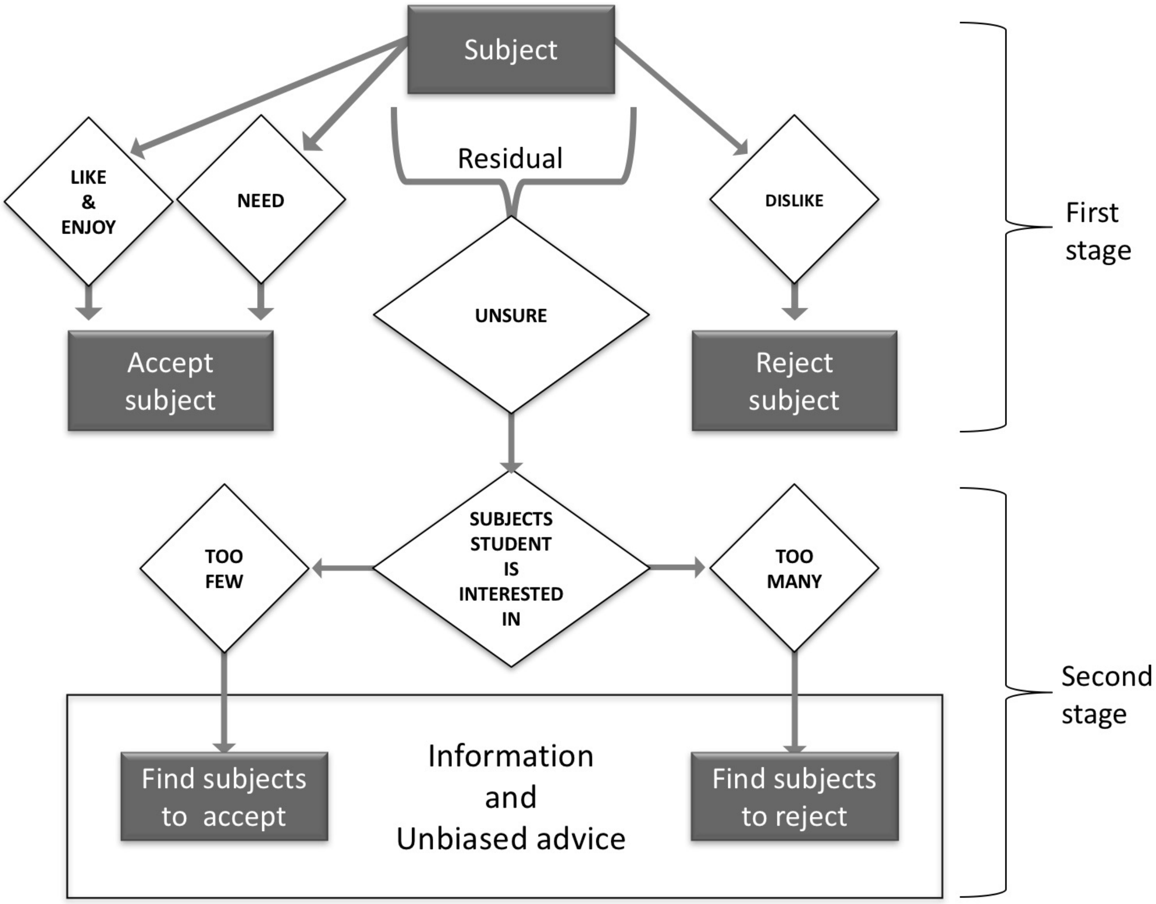

Fig. 6 Model of the decision process students use to choose subjects for their final years of school

If students make their subject choice decisions in two stages, as suggested by this research, then the bases for their decisions may be very different in each stage. In the first stage of decision making, students choose or reject subjects they feel strongly positive or negative about. This immediate acceptance or rejection was spoken of in affective terms and appeared to be the result of a firm view of a subject, possibly built up over some time. The affective domain can be just as important for students as their cognitive ability when choosing science (Alsop 2005). If students have strongly held dispositions towards science – either positive or negative – then it appears that a promotion strategy based on changing this view at subject selection time will be unsuccessful. Research to determine what proportion of students hold such positive and negative feelings about science at subject selection time and why they feel so strongly about a particular science subject would be instructive in developing longer-term strategies to encourage science choice.

In the second stage of the decision-making process students described their engagement in more detailed and rational evaluations of their options. The more practical aspects of choosing subjects, for example, its use to obtain marks for university admission, appear to become more important. They also spoke of either looking for additional subjects to choose or subjects to reject. During this stage, students may be open to re-evaluating the need for studying science and teachers could use this opportunity to encourage science choice by addressing its benefits for a future career and the risks of rejecting science based on perceptions of its difficulty or lack of usefulness.

From a decision perspective, the perception that science is inherently more difficult than other subjects means it may be viewed as a riskier choice of subject. Students may doubt their ability to succeed in a subject and this will make the subject less attractive. Changing these perceptions of difficulty could potentially be accomplished by designing students' experiences in science during the months prior to subject choice in ways that help them feel capable of succeeding in the subject. For example, immediately before subject selection teachers might choose not to teach particularly difficult topics, to set realistic rather than overly challenging assessments, and show students how they will be supported to succeed. Such strategies may influence a student's intention to choose science by altering their cognitive assessment of the value of science and their emotional response to choosing it.

There was a widespread perception among the focus group participants that science is only useful for traditional science-based careers such as medicine or engineering. The use of science generally as a means for developing analytical and argumentation skills and the value of these skills in a range of occupations was not obvious to these modern adolescents. The model suggests students focus on how much they need subjects for their future careers and so students may be influenced by hearing examples of science's use in a broad range of occupations and how science skills are prized by employers. This research indicates that the fear of missing career opportunities in the future was enough incentive for some students to persevere with a subject even though they did not like it.

The sources of information that students receive regarding science choice is important. Students evaluate advice with suspicion if it comes from a source they consider biased; notably, if such advice comes from a teacher recommending their own subject. In line with research that modern adolescents prefer to be treated as individuals who receive their information from a friend (Elliott et al. 2010), students in focus groups stated that they listened to advice from older peers whom they identified as impartial sources of information. Thus, peers may represent an opportunity to inform students about the benefits of science. Engaging older students and graduates of their schools to talk to about their own indecision regarding science and their subsequent discovery of its wide-ranging value may influence more Year 10 students to study the subject. This may be particularly successful if these older peers appear individualistic and independent and display a more relaxed attitude to career – in line with the values of the current generation (Ivanova and Smrikarov 2009; McCrindle Research Centre 2015). A logical extension of this study would be research into how older peers might encourage Year 10 students to choose science.

The generalisability of results from this study is limited by the narrow geographical region and socio-economic group from which the sample is drawn. Students from schools in this study typically continued their education at university and this is likely to influence their decision-making process. It would be advantageous to expand the study to include a more diverse student population.

This study suggests that in terms of return on effort some students perceive science as poor value as it is considered more difficult than other subjects and only useful in a narrow range of careers. The broad value of science to provide critical thinking skills and processes to participate in our modern society was not evident to these teenagers. Where this is the case, an opportunity exists at the time subjects are chosen to address these perceptions where they are incomplete or inaccurate and encourage students to either choose science or at least consider it in the second stage of their decision process.

Conclusion

The choice of science at school is a critical step in the pathway to producing individuals with the scientific skills needed for a prosperous modern society. Two decades of research into the problem of unsatisfactorily low enrolments in science has explored a wide range of factors that may affect students' choice of science. This study provides critical evidence that this knowledge does not show a complete picture of how science is chosen and rejected. The missing element is the impact of events at the time subject choice is made; the proximal antecedents that influence behavioural intention (Fishbein and Azjen 2010). This study is unique as it explored the subject decision-making process at the time students were making their choices. Given students who like science are known to reject science at subject selection time (Venville et al. 2010) it is important that we consider how and why students make their choices.

This study provides evidence that students considering subjects for post-compulsory study can perceive science to be a subject that is both more difficult and less valuable than other subjects they might choose. These students see science as a poor investment of time and effort and consequently reject it in favour of subjects perceived as better value. Students expended considerable effort in choosing their subjects and subject-selection time, and the months immediately preceding choice present an important opportunity to impact these perceptions of value. Viewing this issue as a decision process where students are considering the value of science against other subjects resulted in evidence-based strategies for influencing students' perceptions of science to be developed. The strategies suggested in this paper are novel and low cost and present a new way of encouraging science choice at school. It would not be appropriate to seek to influence students to choose science if it is 'not right for them', rather the focus of any intervention to influence science choice should focus on helping students make a well-informed decision. Promoting science in a way that reflects the affective and cognitive aspects of decision-making holds promise in helping students revalue science and decide that it is worth their investment in time and effort.

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