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Factors that influence student pursuit of science careers; the role of gender, ethnicity, family and friends

Susan Rodrigues,
Northumbria University, England
Divya Jindal-Snape,
University of Dundee, Scotland
Jonathan B. Snape,
Mylnefield Research Services Ltd., Scotland

Abstract

This study adds to a body of research reporting on pupils' choices and outcomes in relation to science. The article reports on 536 Scottish pupils' perceptions regarding reported intention to choose careers in science, with further analysis in terms of family, friends, gender and ethnicity. The pupils, aged 14-15, from 5 schools in one Scottish education authority, thought that science is important and scientific careers are good. Pupils had evenly balanced views and attitudes towards science, but just over one third (38.7%) of all respondents indicated that they were considering a career in science. The major factor influencing pupils' career choices in Scotland seemed to be their perception of whether their parents want them to pursue a career in science.

Keywords: Science careers, gender, ethnicity, school

Introduction

Many groups and individuals have signaled a concern about declining numbers of students pursuing the sciences and consequently the dwindling numbers of science graduates (Scott, 2005; Sjøbeg & Schreiner, 2005). Some researchers have tried to ascertain why the science career pipeline appears to be failing in particular societies. Many researchers have tried to explore and understand the reasons for pupils' choices at key stages in schools with regard to science and science careers (see Frost, Reiss, & Frost, 2005; Gilborn & Gipps, 1996; Reiss, 1998). As a consequence various reasons to explain why students are opting out of science and out of the science career pipeline have been reported. It would appear that there is a complex interplay between the different elements of the decision-making process. The reported reasons considered to have some influence in stifling the pipeline include: the perceived usefulness of science for a range of careers, a perceived lack of relevance, a lack of practical work in school science, a negative attitude to science, a disjunction between school science and science careers, the perceived employment scope in science, an inappropriate pedagogy, a low student self-efficacy, student gender identity and role formation, inadequate career information and perceived subject difficulty and popularity (see Carlone & Johnson 2007; Colley & Comber, 2003; Eccles 2009; Hyde & Linn, 2009; Hughes, 2000; McCrone, Morris, & Walker, 2005; Lyons, 2004; Simpkins, Davis-Kean, & Eccles, 2006; Wikeley & Stables, 1999).

Frost et al. (2005) have argued that underachievement in science and technology by particular groups is strongly connected to the ways that individuals and society view members of the groups. Most pupils thought that it was mainly men who became scientists (Hatchell, 1998). In textbooks and science materials, women and black scientists are under-represented (Reiss, 1993). “The portrayal of science and engineering therefore creates an image that selectively models white people” (Frost et al., 2005, 107).

For years it has been suggested that boys and girls, from about age 11-12 years have different expectations about science careers (Jones, Howe, & Rua, 2000). In general research suggests that boys are slightly more inclined than girls to think they would like a career in science but this research finding does not apply to all countries (OECD, 2009). Masnick, Valenti, Cox and Osman (2010) suggest that boys and girls may hold similar, sometimes entrenched, conceptions of science careers and consider these careers to be antisocial and not creative. However, a study by Hassan (2008) involving Australian university and school students noted no gender difference in aspirations toward careers in science.

Regardless of gender, research suggests there is a relationship between early career aspirations on subsequent decisions. For example, the Tai, Qiliu, Maltese and Fan (2006) 12 year longitudinal study of the work and study trajectories of American high school students showed that 13-year-old students who said they anticipated doing science related work when they were 30 years old were twice as likely to have completed a science degree in comparison with those who had not claimed such aspirations. This finding was endorsed by Schoon, Ross and Martin (2007). In the UK, the Schoon et al. (2007) longitudinal study found that women form career aspirations early and there were relationships between those early aspirations and later occupation. Given the research indicating the relationship between age, aspiration and career, we suggest that sociocultural aspects, including parental influence need to be considered.

McCrone et al.’s (2005) literature review suggested that earlier research was divided as to the extent of parental influence over pupils’ subject choices. A study on parental perception (Engineering and Technology Board, 2010) indicated that parents felt that children were often attracted to jobs that they perceived to be very well paid. These parents also felt that teachers or friends had a more direct influence on pupils’ subject choices. Though there is some well-documented research on pupils’ choices and outcomes in relation to science, there is almost no published research reporting specifically on Scottish pupils’ reasons for subject choices. The study reported in this paper focussed on the Scottish pupils and explored the influence of various factors on their intention to choose careers in science. Further analysis was done on the basis of ethnicity and, within that, gender.

Methodology

Our main objective in this paper is to present data that

- explores pupils’ perceptions regarding science career options
- explores patterns between their perceptions and decisions regarding science career aspirations in the context of ethnicity and/or gender.

The data in this paper stems from completed surveys generated by 536 pupils, aged 14-15, from 5 schools in one Scottish education authority. In Scotland pupils at this age make educational and career choices by considering their subject and exit level options. The schools were informed about the project and volunteered to participate. From a Scottish perspective,

two out of the five schools had a noteworthy ethnically diverse population (approximately 20%). Each school was asked to involve all pupils in one grade level.

A questionnaire with predominantly four point Likert scale statements was used to explore their perceptions and attitudes toward science. The questionnaire used as its base, items from surveys used in previous studies such as the ROSE project (Sjøbeg & Schreiner, 2005) or generated specifically for this project. The survey generated data on pupils' interest in science topics and themes, and the factors that influenced their attitudes toward science education and careers in science. The differences in data were explored using parametric analytic techniques as seen in previous comparable studies (Woolnough et al., 1997). In this paper we present the findings on career intentions and some of the sociocultural factors that influence the pursuit of a science career.

The findings are presented to also enable gender and ethnicity comparisons. Pupils identified themselves as Scottish-British and Asian (Indian, Chinese, Pakistani and Bangladeshi) as well as other. Once data was collected within the local authority area it became apparent that the majority of the Asian students were of Pakistani origin. The numbers within the sample from the other Asian groups were smaller and hence to make the data more meaningful, and in recognition of the fact that Chinese and Indian pupils are thought to achieve well and are represented in higher education, the various ethnic groups were brought together under four main categories, namely Scottish British, Pakistani-related, Other Asian and Others.

The four categories were formed as follows:

Scottish British (n=478: male-220, female-258) - includes Scottish, British

Pakistani-related (n=26: male-15, female-11) - includes Pakistani, Bangladeshi

Other Asian (n=11: male-9, female-2) – Indian, Chinese, Other Asian

Others (n=21: male-9, female-12) – includes Other European, Afro-Caribbean

We advise caution as the numbers for some categories are very small. In this paper we present our discussion in terms of percentage of total pupils responding to a statement, followed by breakdown in terms of ethnicity and gender. The percentage of each subgroup has been calculated on the basis of the responses to the Likert scale statements divided by the total number of students in that given subgroup responding to that particular statement. The percentages are presented to the nearest whole number.

Findings

General overview

The data showed that 67% of the total pupils strongly agreed or agreed that science is important to them. Pupils reported mixed views regarding whether the benefits of science were greater than the harmful effects it could have. When looking at whether science can solve nearly all problems, 48% of the total pupils strongly agreed or agreed. This is representative of the picture in all groups. Similarly 49% of the total number of pupils agreed and strongly agreed with the statement that science can eradicate poverty. However, when looking at whether science can make our life healthier, easier and comfortable, a total of 78% pupils strongly agreed or agreed with the statement. A very large majority across all the gender and ethnic groups believed that science should be used to protect the environment from pollution (90% of all pupils) and used to give the elderly a safe living environment (88% of all pupils).

Despite a large proportion of pupils (67%) indicating that science was important to them. However, the picture changed when asked if they were considering a career in science for only 39% of all pupils were considering a career in science. This is interesting, for ten years

ago, the general public perception in the Dalziel and Lambley (2001) study suggested that 78% of Scots thought that a career in science was a good option.

Furthermore, although some pupils in the present study thought that science is important and the jobs in this area are good, they also indicated that these careers were not for them. Although the numbers are evenly split in terms of the pupils' perception of science being for clever people (for example, 48% of the Scottish British males think science is for clever people while 52% think that is not the case), the views regarding the difficulty in understanding science differs across the ethnic-gender groups. For example, 68% of the Scottish British female and 60% of the Scottish British male pupils reported thinking that science was not easy to understand, while 69% of the Pakistani-related male and 70% of the Pakistani-related female pupils reported that it was easy to understand. The relationship between career choice and perception of the ease of subjects was analysed. There was no correlation between these two statement responses ($R^2=0.0411$). Our study shows no link between how easy science subjects were perceived to be and the likelihood of a pupil choosing to study it.

Perception of scientists and science related jobs

A total of 66% pupils disagreed or strongly disagreed that scientists know what's best for us, and 51% disagreed that scientists don't listen to us. However when we consider the pupils' perception of scientists' jobs, some interesting views emerge. Most pupils hold positive views; 76% felt that the science jobs are paid well, 63% felt the jobs are not boring and 83% indicated that they thought scientists did not just work in labs.

Amongst the Scottish British male pupils 80% thought that scientists are paid well and 62% thought that their jobs are not boring. However, only 40% said that they were considering a career in science. There is a similar picture for Scottish British female with 75% reporting that scientists earn well and 60% that scientists jobs are not boring, but only 32% considering a career in science. Therefore for this cohort, perceived good pay and the job being interesting has not influenced their decision to choose a science career.

In the case of Pakistani-related male pupils, 85% think scientists are paid well and 92% think that their jobs are not boring, and 85% said they were considering a career in science. The Pakistani-related female cohort presented a different picture with a significant percentage (80%) thinking they earn well and thinking the jobs are not boring, but a low percentage (22%) were considering a career in science. Another interesting picture emerges for 'Other Asian males' with just over half (56%) thinking that scientists earn well, and over three quarters (78%) thinking that science jobs are not boring, and even more (89%) indicating their intention to pursue a career in science. There was a weak and negative correlation between perceptions regarding science jobs being well paid and intention to undertake science jobs ($R^2=-0.2788$). In terms of subject difficulty, 38% of all respondents thought that science was easy.

There was no correlation ($R^2=0.04$) between wanting to pursue a career in science and the perceived difficultness of science. Similarly, it was hypothesised that pupils who perceived science careers as being financially lucrative would be more interested in pursuing a career in science than those that did not. However, it was found that the converse was true. There was a weak ($R^2=0.28$) negative correlation between the percentage of respondents from ethnic gender groups who thought that scientists were well paid and the percentage of respondents from the same groups who were considering a career in science.

Perception of parental and peer attitudes

A total of 52% of pupils perceived that science is important to their family and 47% thought that their parents are interested in science. Interestingly, in comparison, 67% of the total number of pupils had strongly agreed or agreed that science is important to them. This suggests that the pupils' viewed science more positively than they thought their parents and family did. The survey data shows that 24% pupils believe that their parents think science careers are the best and 21% believed their parents wanted them to follow science careers. However an analysis of the data from a gender and ethnicity perspective shows that while very few Scottish British male and female, perceived their parents thought science careers were the best, for other ethnic and gender groups, the picture was more complex. For example, the following shows the importance each subcohort thought their parents placed on science careers; Other Asian male (89%), Others female (64%), Pakistani-related male (62%) and female (60%). It is interesting to note that some Pakistani-related male pupils and Other Asian male pupils thought that their parents thought science careers were best despite also thinking that the family did not consider science to be important and that their parents were not interested in science. More importantly the relationship between the statements 'Parents want me to follow a career in science' and 'I am considering a career in science' showed a strong positive correlation ($R^2=0.839$). This suggests that pupils are strongly influenced in their decisions to follow science careers on the basis of their perception of whether their parents want them to do so or not.

A linear relationship ($R^2=0.84$) was found between the two variables: the percentage of respondents in a particular ethnic/gender group indicating that they were interested in choosing science as a career, and the percentage of respondents in the same group indicating that their parents wanted them to follow a science career was investigated. There was strong positive correlation. From this data it is not possible to explain whether this relationship is due to parents having a strong influence on their children's career choices or if parents are supportive of whatever their children decide to do. What is clear, however, is that any strategy aimed at increasing participation in science should consider the role of parents.

Next we looked at the influence of peers by asking if their friends think science careers are the best.

A total of 45% of all pupils thought that science is important to their friends, 39% thought their friends were interested in science and 13% thought their friends thought science careers are the best. The survey showed that 73% Scottish British male pupils said science was important to them compared to 55% saying they thought it was important to their friends; 50% Scottish British females said science was important to them compared with 34% who thought it was important to their friends; 86% Pakistani related male said science was important to them compared with 50% who thought it was important to their friends; 80% Pakistani related female said it was important to them compared with 70% who thought it was important to their friends; 100% Other Asian male, said science was important to them compared with 44% who thought it was important to their friends. The Other Asian female cohort contained two respondents, both of whom said it was important to them and one said it was important to her friends. The only two cohorts who differed were Others male, where an equal percentage said it was important to them and their friends (67%) and the Others female cohort where 40% said science was important to them compared with friends 55% who thought it was important to their friends.

In the case of Scottish British male pupils, 40% said that they were considering a career involving science and 11% had said that their friends thought that science careers were the best. In the case of Scottish female pupils, 32% said they were considering a career involving science and 12% said that their friends thought that science careers were the best. In the case of Pakistani-related male pupils, 85% indicated they were considering a science career and 31% reported that their friends thought science careers were best. In the case of Pakistani-related female pupils, these figures stand at 22% and 10% respectively. There was a moderate positive correlation between the percentage of respondents in a group who thought that their friends thought that science careers were the best and the percentage of respondents from the same group who were considering science as a career. However, for all groups, the link between parents' views and career choice appears to be stronger than the link between friends' views and career choices.

Conclusions

Overall, in this study the data suggests pupils hold balanced views and attitudes towards science. They saw the value of science to society and their views suggest that they saw that science had a role outside school. Over one third (39%) of all respondents indicated that they were considering a career in science. However, when the data was considered on the basis of ethnic groups and gender, it was apparent that pupils from ethnic minorities were more likely to be considering a career in science than their Scottish British counterparts. The only exception to this is Pakistani female pupils, of whom only 22% were considering a science career. In contrast, 85% of Pakistani males and 78% of other Asian males were considering science as a career. Most of those who identified themselves as Pakistani females and Scottish British females did not intend to pursue a career in science. In this study, the perceptions of pupils regarding their parents' wishes strongly influenced their career choices, and their perception regarding the importance their peers placed on those careers had a medium influence.

Our data simply indicates differences in various ethnic and gender groups' perceptions regarding career aspirations. Future research needs to look at the reasons behind the differences in pupils' perceptions. The body of research available identifies several measures that science classrooms could adopt to improve pupil enjoyment of science. However, it is not simply enjoyment of science that requires further consideration. Hipkins et al. (2006) show that secondary school pupils now face making more decisions with long term consequences about subject pathways and qualifications, much earlier. Vaughan, Roberts and Gardiner (2006) suggest that pupils are able to distinguish between careers and jobs, seeing jobs as necessary but careers as a dynamic life process. Indeed it has been suggested that culture, including family input shapes options (Higgins, Vaughan, Phillips, & Dalziel, 2008). Therefore, while conversations about careers, between pupils and teachers are important, our findings suggest there is also a need for parental education with regard to science career possibilities. School based interventions will have little impact if parental influence dictates further education direction or if pupils are influenced by their perception of parental wish-list.

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