INTRODUCTION TO SECTION 7
Physics Education: Influences Outside of the Classroom

Aim: This Section explores the range of factors outside of the classroom that influence the decisions made by young people. These factors include:

1) The ethos of the institution
2) Family background
3) The importance of role models
4) The representation of scientists in the media

Contents:

Methodology: This study recognised that despite all of the initiatives to improve the quality of physics teaching and the support from a range of external initiatives, there are further influences that directly or indirectly affect the career decisions made by young people. In the first part of the report, I have discussed the type of establishment as a factor that could influence students' choice of course or subject. Whilst it was not surprising to find a social class influence upon choice of A level provider, it was more surprising to find that there was a small, but clear class bias upon A level subjects. (JCQ, 2010). The ethos of the sixth form provision within the FEC was discussed in that the architecture and culture of these smaller centres are specifically designed to appeal and attract young people.

The report explored the influence of home background upon the learning process and future decisions made by young people, presenting the findings from a survey conducted with my second year A level students in 2009. Due to the small group, the responses cannot be generalised to represent all girls who study physics A level, this was simply a 'snapshot' picture of my A level physics class at the time.

The study also discusses the influence of role models, as this was found to be a very important factor for girls. Within Section 1 of the portfolio, it was found that pharmacy is a very popular degree course for (FEC) students who have studied science A levels. Most of the students who study this subject have participated in a work placement with a pharmacist. Role model theory explains why it is important that young people can project an image of themselves in the future, when selecting particular careers, and hence the importance of meeting role models in a particular field. The final part of the report explores the representations of scientists in the media, where a range of sources from literature, television and film were reviewed. It was supported by citing research such as 'The (In) Visible Witness Project' (2008) conducted by the UK Resource Centre for Women.

Conclusions: Whilst these external factors are outside of the control of the classroom teacher, there is still a considerable amount that a teacher can do to ensure students are well informed. It is crucial that educational establishments provide sound information for parents, and involve them as much as possible. By encouraging visiting speakers or students to participate in work experience can ensure they meet positive role models. By discussing the representations of science in the media and highlighting the range of careers with science, we can have some impact upon these external factors.

Dissemination of this study: The report was shared with the Head of Academic Studies, whose original subject area was computing. The report was also shared with a lecturer in cultural studies, who was particularly interested in the influence of the media. Within the science team, we have tried to explore each of the strands in the report, such as academic ethos, home background, role models and the media to see if there are ways in which we can overcome some of these potential barriers. We are currently planning an open evening at the local university for next year (2012), where parents will be invited as well as students. This will provide the opportunity for parents to find out about tuition fees, course structure and career opportunities afterwards.

Physics Education: Influences outside of the Classroom

Marianne Hill

Introduction

Despite working with an enthusiastic and forward thinking Science Department, we have found that there are several barriers to learning that are outside of the influence of the classroom teacher. This does not mean that we must accept these obstacles, but if we have a greater insight and understanding of the external influences upon young people then we can devise ways to support our students in a more appropriate manner.

This report will investigate the wider influences outside of the classroom environment and their effect upon the student learning process. Hattie (2003) discussed the various factors that affect students' achievement, which were primarily the students themselves and the quality of the teaching. He did acknowledge, however, that other factors such as home background, the school, the principal (head teacher) and peers could have an influence. In his paper 'Teachers make a difference' he claimed that these four external factors could affect up to 40% of the variance in student achievement. (Hattie, 2003, p.2)

This report is specifically concerned with physics education, exploring the wider influences that affect the student learning process and shape the decisions made by young people. It is acknowledged that the teacher has the most powerful influence upon students' attitudes and achievement, and that interest and relevance are also important factors (Murphy and Whitelegg, 2006). This report will focus upon the external influences by exploring factors such as the ethos of the institution, the influence of family and then wider cultural influences such as role models and the media. The report will also have a particular interest in the extent to which these influences shape the decisions made by girls, as there are still a disproportionately low number of females who study physics in post-compulsory education. Within this report, the college will be referred to as

the FEC and the sixth forms, which are part of the college organisation, will referred to as B, S and U.

Part 1: As suggested by the study by Hattie, the school environment is one of the factors that contribute towards student achievement, although he claimed that this was only about 5 to 10% of the variance (Hattie, 2003, p.2). In this section, the college environment will be discussed to determine whether this can make a difference to post-compulsory physics education.

Part 2: This section will evaluate the influence of home background, particularly with regard to the decisions that are made about choice of sixth form and higher education. From surveys and interviews with students, it emerged that a large proportion of the parents of students at the college do not have any experience of higher education. Many parents feel that they do not know enough about universities to advise their sons or daughters. Some of the local universities have taken this factor seriously and have developed brochures, fact sheets, web pages and open days that are specifically designed for parents.

Part 3: There are two further factors that influence the decisions made by young people: role models and the influence of the media. Within part three of this report, we will assess the influence of role models and why this is important for science. When conducting an evaluation into the choice of degree courses by students from the college, the most popular undergraduate subject related to science is pharmacy. It could be argued that students are choosing this subject as it is vocational and leads directly to a clear career path, yet another reason could be that all of the applicants concerned had undertaken work experience with a pharmacist. Through these placements, students can then gain a practical insight into the type of work involved.

Part 4: This section will consider the representations of science and scientists, within the media. It will consider the personal as well as professional qualities that are represented and suggest that young people may, or not, be influenced by the media.

Part 1: The Sixth Form Environment

This section will explore some of the significant influences that foster an academic and scholarly ethos at the FEC. This college is a widening participation college, committed to accepting students for level 1, 2 and 3 courses. The college also offers a range of adult courses at all levels, from foundation level up to higher education degrees, which are franchised with the local university. The main Sixth Forms are B, U, and S, with a fourth planned centre (H) which has identified potential students but future building is currently restricted.

In recent years, the focus of education for the 16 – 19 year olds has changed, with an increasing emphasis upon vocational education. The following data relates to the number of enrolments for the various post-16 educational courses within the college. The vocational courses are offered at levels 1, 2 and 3, where the level 3 courses are equivalent to an A level programme. Over the past four years, the proportion of vocational students has increased, whereas the number of students on AS courses has decreased. Students for the AS programme generally enrol for either three or four AS subjects, depending upon their GCSE results. The data below relates to the whole college, comprising all four sixth forms.

TABLE 1: The number of 16 year old students enrolled on different college courses

YEAR	AS Enrolments Academic	Number of AS Students	L1 Vocational	L2 Vocational	L3 Vocational	Total number of vocational students
2006/7	4,175	1,217	111	120	417	648
2007/8	2,737	782	164	227	636	1027
2008/9	2,342	670	494	518	1,347	2,359
2009/10	1,856	531	110	428	1,633	2,171

Whilst senior management have shown a strong determination to create an over-arching corporate identity for the college, having three distinct Sixth Forms and two vocational centres has led to a different atmosphere and ethos in each centre. The buildings, the internal environment and the local

catchment area all play a significant role in creating a sixth form identity. All three Sixth Forms are located in areas that have a wide spread of socio-economic backgrounds, with no centre having any monopoly on a particular social class. Each Sixth Form produces a separate prospectus, with the separate identities distinguished by colours (B is blue, U is red, S is green and H is turquoise).

Photograph of Sixth Form B
(FEC Website)

Sixth Form B is located in an affluent suburb and has a very prominent location in the city. The Tudor-Gothic style Edwardian buildings are a landmark within the town and highly regarded by the population. The quadrangular design purposefully evokes the colleges of Oxford and Cambridge. With its historic reputation as a former grammar school, the centre has prestige and is still flourishing. The design of the space facilitates a specific learning style and scholarly ethos. Sixth form B has partner schools in the centre of the city but has two single sex Roman Catholic schools which can attract prospective A level students. The two school sixth forms have places for up to 50 additional A level students from non-Catholic schools in the city.

Sixth Form U is located at the far north west of the town, in a former village which was engulfed by the expanding town in 1974. The design of the Sixth Form U is modern, light and open, having a central atrium feature and ‘voids’ in the centre, creating a totally different and separate identity

from Sixth Form B. The centre has won an award from RIBA (Royal Institute of British Architects) for its design, competing against 15 other buildings (Further Education Awards, 2008). The building was designed by Dewjo'c Architects and their website offers Sixth Form U as a case study:

> 'A glass roof, creating a light and 'airy' street scene at ground level, tops wide circulation corridors at each level. Upper levels have large openings in the floors that allow light to filter to lower levels and through the glass walls of internal rooms. The 'street' is landscaped with trees and also houses an 'open air' café where staff and students can meet and socialise.'
>
> Joint Winner of LSC and RIBA Further Education Design Excellence Awards 2008
> Winner of the 2006 Landmark Awards, Public Sector Building of the Year Award.
>
> (Dewjo'c , 2010)

This information is quoted from the website, but it does beg the question as to when did a 'street scene' and 'open air café' become conducive to an academic and scholarly ethos? Sixth Form U is located near to a mixed Roman Catholic school which has recently expanded its sixth form provision to take up to 300 students, with 150 year 12 pupils from other schools.

Photograph of Sixth Form U

(FEC Website)

Sixth Form S opened in 2008, with another modern building, this being designed by Browne, Smith and Baker. The location is near the centre of town and adjacent to the university. This building was also nominated for an award with RIBA (2009).

Photograph of Sixth Form S
(FEC Website)

By offering three separate sixth forms, the FEC allows prospective students to have a choice of environment. As long as a student is prepared to travel, each one of the sixth forms is accessible by public transport. The buildings can create an external environment but inside of each sixth form, the provision remains the same as there is a very strict adherence to a 'one-college' policy. The teaching should not differ between each centre, so it is difficult to compare the internal ethos of the sixth forms.

The college differs to the three local school sixth forms in that it does not require students to wear uniform, it does not have any religious structure (although all centres have prayer rooms) and there are no sanctions in place for students who do not fulfil their commitment towards their studies. The school sixth forms concentrate upon level three courses, such as A level and some BTEC Diploma opportunities, whilst the college has a range of learners of different abilities. Thus the social mix of the students in the college differs to a school sixth form, with the schools being

mainly interested in the more academic aspects of post-compulsory education.

The range of courses offered by the college is broader than a school sixth form, yet there is also a variance in the popularity of different A level subjects. The Joint Council for Qualifications produces an analysis each year of the proportion of A level candidates from different types of educational institution and it is interesting to see that there are certain subjects that are more likely to be studied in a Further Education/Sixth Form College than in a school.

TABLE 2: The proportion of A level candidates from different types of educational establishment (by subject)

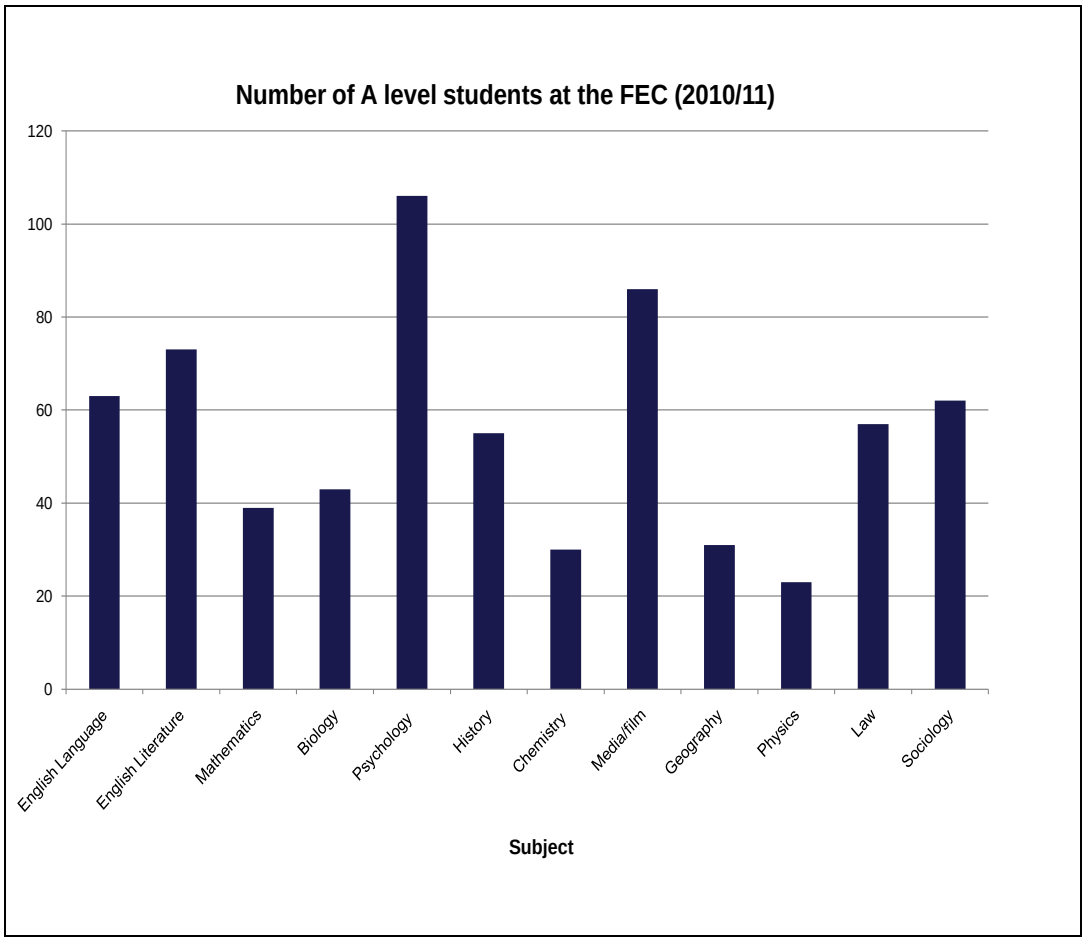
SUBJECT	Comprehensive	Secondary modern	F.E./ Sixth Form College	Selective/ Maintained	Independent
ALL SUBJECTS	**42.6**	**1.4**	**29.2**	**12.1**	**13.5**
Mathematics	39.3	0.8	25.3	14.4	18.6
Further Mathematics	31.0	0.3	23.7	13.9	29.0
Physics	40.7	0.7	20.9	16.3	20.3
Chemistry	39.6	0.8	23.7	16.8	18.2
Biology	42.4	1.1	23.9	16.5	15.2
Law	29.2	1.3	64.4	2.4	1.0
Media/Film	47.0	3.1	41.4	5.0	2.3
Psychology	46.6	1.5	36.6	8.3	5.8
Sociology	46.3	2.4	42.2	6.1	1.5
Computing	32.8	0.2	50.2	9.9	5.5

(JCQ, 2010)

From the table, it can be seen that for all three sciences, as well as mathematics and further mathematics, the proportion of A level candidates from ‘FE/Sixth Forms’ are less than the national average. A level subjects such as psychology, sociology, media/film, law and computing show a greater proportion of candidates coming from the FE/Sixth Form sector. This could be explained by the fact that establishments in the independent/selective/maintained categories do not offer the same range of subjects as those offered by the FE/ Sixth Form sector therefore this simply

reflects a restriction of choice. If we now consider the number of students who are studying A levels at the FEC 20010/11, the data can be presented in the chart below:

CHART 1: The number of A level students who study different academic subjects at the FEC (2010/2011)



From Chart 1, it can be seen that the most popular A level is psychology, closely followed by A levels in media and film, which are counted as one group by JCQ. A levels in sociology and law are also popular, along with both English literature and language. The number of students who are studying A level physics is less than either chemistry or biology, which is of concern, but clearly mirrors the national trend according to JCQ.

It is important to monitor the provision offered by different educational establishments in order to ensure that there is not a class division of subjects emerging. The issue of social class and educational

choice is beyond the scope of this report but underpins so many of the decisions made by young people. The influence of home background is very important, yet this need not necessarily be related to income. Working class parents want their children to succeed as much as middle or upper class parents, but simply do not have the resources to help support achievement in the same way.

Part 2: The influence of home background

As a widening participation college, many of our students are the first generation from their family to go to university. Whilst the vast majority of parents support their son or daughter in achieving this ambition, there is a wide spectrum of difference in the financial support that parents are prepared to provide. Within tutorials, it is important to approach the issue of finance in a sensitive and cautious manner, as it is essential that students discuss what parents expect from them during their studies at university, particularly if students are living at home.

Despite all of the initiatives that teachers and other agencies provide in order to encourage students to consider higher education, one of the most crucial factors is the attitude and influence of parents. There have been countless occasions where students have been by enthralled by a particular subject or inspired by a course, only to find that once the student has discussed this interest with a parent, the student can be seriously deterred from fulfilling this ambition.

In a separate report that I have conducted into the progression of students from the FEC into higher education, I found there was a great reluctance of students who were willing to move away from home in order to pursue a university education. In 2009, fewer than 15% of a cohort of 666 students chose to study away from home, with the majority of those who remained in this area choosing to study at the local University.

Whilst conducting this report, I found that the data was in strong correlation with a study conducted by Reay (2001), which found that working class families, with girls in particular, have invisible family ties that prevented them (whether financially or psychologically) from moving away

from home. (Reay, 2001, pp.855 – 874) This research was not based upon any specific subjects, as there has not been any published research into home background or parental involvement with science education.

Reay (1998). found that with working class families, the importance of children being with their friends, and the locality of the institution, were significant factors in school choice (Reay, 1998, p.2). Reay explained that working class families place a stronger importance upon community, choosing options that are local and familiar. Working class families also involved their children in making the choice, whereas middle class parents 'guided' children into making the 'right decision'. Middle class parents were more interested in social demography and the educational policies of the schools. This research was specifically concerned with parental choice for secondary schools, however, the findings can be applied towards parental choice for post- compulsory education.

In the report 'Attitudes to Education and Choices at Age 16: A brief Research Review (April 2002)', Payne outlined some of the factors that affect young people when making choices about their post-compulsory education and the research that has been conducted into these areas:

> 'There is less work on parents' attitudes than on young people's attitudes, presumably because it is more difficult and more expensive to collect data from parents.'
>
> Payne (2002, p.1)

The report claims that there was considerable research conducted on home background and parental attitudes in the 1960s and 1970s, yet little research on this topic in recent years. In Section 6, the report quotes one particular survey that determined that when pupils were asked who they talked to about their future career plans, parents were named before friends, teachers or careers advisers. The report claimed that 'it is unusual for parents to impose a decision on their child' based upon a survey of 3,610 students who were on post 16 courses, as only 1% ticked the box for parental pressure as their reason for staying on in education (Payne, 2002, p.14).

The report also explored some of the other factors that influence young people's choice, such as school culture, friends, local area, and wider youth culture. Further reference to parental choice has been made by Foskett and Heskett:

> 'The decisions [that pupils] make are made within frames of reference defined by their parents. Some options, whether of an institution, course or career aspiration, will be excluded as possibilities by parents, but pupils will be able to make relatively unconstrained choice within non-excluded options.'
>
> Froskett amd Hesketh (1997,p.308)

A report by Desforges and Abouchaar (2003) claimed that the extent and form of parental involvement is 'strongly influenced by family social class, maternal level of education, material deprivation, maternal psycho-social health, single parent status and to a lesser degree, family ethnicity' (p.4). The report also found that the extent that parents became involved in a child's education was largely determined by how well the child was achieving, in that the higher the level of attainment, the more the parents were involved in the educational process. The report outlined that good parenting can take many forms and that 'at home good parenting' has a significant positive effect upon children's achievement. It also states that parenting has its influence indirectly through shaping a child's self concept as a learner and through setting high aspirations. (Desforges and Abouchaar, 2003, p.4)

The issue of gender and parental involvement was explored in a report by David, Ball, Davies and Reay, (2003) The report claims that 'gender is threaded through the process of choosing higher education in the UK' and explains how gender affected all aspects of the research, from those who volunteered to participate in the survey, which parent was chosen to participate and the difference between the involvement of mothers and fathers (p.21).

This research was conducted in London, by interviewing 98 young people from a range of five socially and ethnically diverse schools. All of the young people in this aspect of the survey were aged between 17 and 20

years of age, although there were some mature students involved in a wider study. Gender became significant early in the project when more girls volunteered for the project than boys, then girls asked if they could be interviewed in pairs rather than individually. It was then found that girls were more willing than boys to involve their parents in the survey (two thirds of the parents eventually interviewed were of the girls), and the parent chosen was usually the mother. The gender balance of the parents was three mothers to one father. Of the students who did not wish their parents to be involved, the main reason given related to ability to be involved and work commitments. Some of the working class students felt that their parents did not have experience of higher education to draw upon (p.26). The report found that girls, as well as their mothers, preferred to work collaboratively, whereas the boys preferred to be more independent.

A further exploration of how parents influence student choice can be found in Rachel Brooks' paper 'My mum would be as pleased as punch if I actually went, but my dad seems a bit more particular about it'(2004). This research explores the differences between the involvement of mothers and fathers in selecting courses in higher education.

The report states that previous surveys have shown that parents are the most commonly consulted group of people when young people are making choices about higher education, with over 90% of respondents claiming that they had discussed their choices with their parents (p.495).

Brooks investigated the difference in the roles of the mothers and fathers by a study of fifteen young people who attended the Emily Davies College (a pseudonym that Brooks invented for the project). The young people were interviewed from starting their course in 1999 until they received their results in 2001. The students were studying either A levels or GNVQ qualifications and for the purpose of Brook's study, she classified the social class of their parents into fractions, by detailed exploration of each of the parents' occupation and level of education.

The report points out that it would be wrong to assume there was a direct correlation between level of involvement and level of influence (Brooks, 2004, p.501). Brooks also makes reference to the previous report, which was based upon students living in London, claiming that in

metropolitan areas, the middle classes are very active ‘choosers’ within educational markets and suggests that ‘research outside of London reveals a more mixed picture’ (p.507).

Brooks found that few of the young people’s families had been involved in ‘the active processes of educational choice’ prior to making decisions about higher education, with most of the students in the study having attended the local secondary school and then gone on to the local sixth form college (p.507).

Within this study, there was little mention of the actual subject disciplines studied by the fifteen students, although subjects such as law, English and media studies are mentioned. It was interesting to note that all fifteen students came from two-parent families, although some of parents were step-parents (p.498). Brooks’ methodology of interviewing a small number of students and determining parental involvement in choice provided a useful basis to explore the involvement of the parents of my second year A level students.

Survey of Parental Involvement with Physics A level students.

This survey was conducted with a questionnaire and then discussing the reasons with eight of my second year A level students in May 2009. As the group was small, and some of the students were in my tutor group, I knew a substantial amount of information about family background prior to conducting the interviews. There were six boys in the survey and two girls, all were aged between 17 and 18 years of age.

Table 3: Table to show background information of students in survey

Student	Gender	Estimated grade at A level	Parental experience of university	Chosen course at university
A	F	D	NO	Engineering
B	F	B	YES	Mathematics
C	M	A	NO	Mathematics
D	M	A	NO	Computing
E	M	B	YES (father engineer)	Engineering
F	M	D	NO (father accountant)	Accountancy
G	M	D	NO	Engineering
H	M	D	YES	Law

1) The first questions related to why the students had chosen to study at Sixth Form U and if they had considered any other post-sixteen provider for their A level studies.

One of the girls (B) had not considered any other provider as her sister had attended the same Sixth Form and progressed to university, so it was a natural decision to come to the college. The other female student (A) had considered the local Catholic sixth form but it was simply an option that she had not followed through (she did not attend the open day). The main reason that the girls gave on the questionnaire was ‘convenience’ and ‘nearest to where I live’.

When the same question was put to the boys, two of the six students had considered the Catholic sixth form and one had considered another centre at the college. However none of these students had attended any open days or sought information from other providers. The reasons given by the boys for attending Sixth Form U were:

Strong school and sixth form link
Good selection of courses, no uniform, convenient
Friends had applied, convenient

Good school and sixth form links, no uniform, no religious education
Adult environment (not like school) and friends had enrolled

2) The next question related to whether their parents had been involved in selecting a post-sixteen provider.

Both of the girls had discussed their decision to study at the college with their parents and said that they had involved their parents throughout. Student A said that it was important to her parents that she was 'happy', whilst student B said that it was important to her parents that she was 'comfortable'. B, whose parents had been to university, brought her parents to enrolment and they have been involved with the tutor throughout the course. Student A, whose parents did not attend university, did not bring her parents to enrolment nor have they had much involvement during the two years of sixth form.

Of the boys, F said that his parents were very concerned that Sixth Form U was a new college, and felt that the institution may not have the 'experience' or a track record of examination results. F's parents have not attended university but have relatively middle class careers and a strong regard for education. F's parents attended enrolment, every parents evening and provided a telephone contact for the tutor. Of the other five boys, all said that their parents had no concerns with decisions to study at the college.

Within this particular group, the two strongest students academically were C and D, who both came from working class families and both had experienced family breakdowns. Neither set of parents were involved with any aspect of their son's education whilst at the college.

3) The third question related to parental involvement with decisions about higher education.

Both girls had discussed all of their decisions with family as well as friends. They had attended open days and conducted research on the internet. They said that their parents were interested in learning more about higher

education and would like to be more involved, saying that the idea of an open evening for parents would be most welcomed. Both girls said that their parents were concerned about finance.

Student A said that her parents worried over whether she had chosen the right courses, whether she would be happy and if she would get the grades to go to university. Student B said that her parents were anxious about her achieving the right grades and getting a place at university. Both of the girls' parents are fully supportive of them considering careers in science, and believe that their university course will lead to a wide range of exciting career opportunities in the future.

The responses from the male students to questions about parental involvement in higher education were different, although this may not necessarily reflect the opinions of the parents themselves, but simply the perceptions of the students, or the responses that they wished to convey. Student F said his parents would be interested in university open days for parents, but they had no concerns whatsoever and 'could only see the benefits of a university education'. He said that he had discussed his career intentions with his father regularly ('all the time').

Students G and H both replied similarly in that their parents would be interested in more information and if there were any opportunities for parental visits. E said that his parents' main worry was whether he could look after himself properly, such as keeping his accommodation clean and remembering to cut his hair!

Student C said that his parents have not been involved in any of the decisions, but they are worried that he might face problems with his finances when he gets to university. D, whose parents have been divorced in the past year, had discussed his decisions with his parents but is going against their advice by choosing to study away from home. This student is making all of his decisions quite independently as he feels that his parents do not really understand university. G had not involved his parents in making his decisions university but said that they were worried about finance and whether he could cope with the course.

Some of these eight students have had to work part time in order to supplement the family income, but there has never been any pressure

whatsoever for the students to drop out of full time education in order to find employment and all of the parents concerned want their sons or daughters to progress to university.

The middle class parents all have concerns about higher education, although they may not have had concerns about sixth form provision. The working class parents, who are all fully supportive of their sons/daughters going to university, have not been involved to the same extent. All students thought that more information for parents about university would be extremely helpful. It appears that parents would like, and perhaps need, more information about higher education and would like to be more involved in the process but may not have the confidence or experience to become involved.

Despite the fact that there were only two girls, the survey corroborated the work by David et al (2003) suggesting that the girls collaborated more in their decision making whereas the boys made decisions more independently. My research did not support the point made by Desforges and Abouchaar in their report into parental involvement in education (DfES, 2003, p.4) that parental involvement was dependent upon achievement, as the two most gifted students in the group had very little parental involvement in their education. The investigation does support Brooks point where she found that most of the students in her study had attended the local secondary school or sixth form, with selection of a university course being the first explicit decision about education that they had encountered.

Parental Involvement with Universities

Universities are becoming increasingly aware of the importance of providing information for parents. Whether information is aimed at reassuring middle class parents that the university is a well organised and structured institution, or whether it is to provide a source of support and reassurance for working class families is debatable, but it demonstrates that universities are aware of the tremendous influence of parents upon the decisions made by their children.

UCAS have a section on their website which is specifically for parents. The site contains information such as student finance, the explanation of important terms, as well as the opportunity to receive a 'UCAS Parents Guide' by registering online. Parents can then choose to receive quarterly email bulletins that will help them to understand the UCAS procedures. (UCAS, 2010).

Within the region, there are four universities which are all within easy access for students from the FEC, of these four universities, two are Russell Group universities, which shall be referred to as 1 and 2, the other two universities are former polytechnics, which shall be referred to as 3 and 4. Of the four universities, the first has the highest entry requirements and is the oldest university in the region. University 4 is the one which is located within the city in which this study is based, and has the lowest entry requirements.

University 1 features a section for parents on their website that provides information on student finance and 'the student experience'. This latter section provides information on Health and Welfare issues such as registering with a doctor, safety issues and services for students with disabilities. There are further sections that include information on accommodation, sports facilities and 'entertainment and culture', so that parents have a sound understanding of what is provided for students. (University 1 website, 2010)

University 2 produces a booklet that can be downloaded from their website. This guide starts with information about choosing the right subject and university. This pack explains the application process in '*A step by step guide*'. There is a section on the website outlining the history of the university and its reputation for academic excellence (University 2, 2010). The second part of the booklet deals with issues such as: student finance, accommodation, investing in the future (information on the teaching facilities as well as graduate success) and campus life (Student Union, tutorial system, safety, disability support). There are also sections entitled: The City (world class culture, social activities) and Welcoming Our Students (Pre-arrival information, freshers' week). Rather than pages on a website, this is a colourful brochure that contains much more information for parents, and

would be particularly useful for those parents who had not been to university themselves.

University 3 provides more information for parents than either of the Russell Group universities and the information is easier to find, having the link on the main webpage. (University 3, 2010) The Parents Section has subsections on: money matters, accommodation, the application process and starting at university. There is a Parents Brochure ('nuparent'), an academic calendar, information on parents' days, as well as student open days, as well as information on the city of Newcastle. (University 3, 2010)

University 4 now has a 'parents' area' on their website, however when I first began investigating information for parents in April 2009, I noticed that this was the only local university that did not present information for parents. I contacted the Admissions team and raised my concerns, particularly as a large cohort of students from the FEC progress to this university. The parents' area on this website is relatively weak compared to those of the other three universities in the region. (University 4, 2010)

Of the four local universities, the information provided by University 3 is the most clear and accessible for parents, particularly for those parents with no university experience themselves. The university has clearly recognised the importance of welcoming parents by the parental open days and presenting clear, straight forward information.

Part 3: Scientists as Role Models

There have been many prominent scientists who have inspired generations of young people to study science. However, those who achieve celebrity status often have traits of eccentricity (e.g. Einstein). Whilst some of the photographs of Einstein are now iconic representations of genius, do they accurately project the image of a real scientist? With regards to female scientists, there are fewer to draw upon, with Marie Curie being the most famous.

Schiebinger (1999) in '*Has Feminism Changed Science?*' discussed the image of a scientist as that of a person who is so immersed in the

subject that they forget about other worldly issues. She claimed that Marie Curie, despite being a strong role model and an inspiration for women to study science:

> '…conformed to the image of a lonely, introspective scientist, clothed in a simple black dress and with severely pulled back hair. In her youth, as a poor, driven student, she led a monastic life, becoming so lost in her studies in her cold room that she stopped bothering to light her stove or even eat.'
>
> Schiebinger (1999, p.75)

Schiebinger's argument is that the image of a dedicated woman may not appeal to the majority of children and claims it 'can create a barrier for women'. She states that these images are 'precisely the reason why many women choose certain fields in science'.

With regards to role models of real life scientists, they have achieved prominence due to a distinguished career and are exceptional rather than typical. I would strongly argue that genius pervades all academic disciplines and is not confined to science. The image of the eccentric genius could be the same for a writer, artist, musician or any other discipline.

Whilst it is important to teach young people about the scientists who made important discoveries, I believe that 'role models' or significant influences are from other sources which have a more direct effect upon young people. The importance of role models was investigated by Albert Bandura (1961) with the Bobo Doll experiment, which demonstrated that children learned behaviour patterns rather than genetically inheriting these factors. In the 1960s, the nature-nurture debate was a very heated contemporary issue, with numerous research departments trying to show which of these factors were the most important in child development.

Social Learning Theory was developed in the 1960s, which claimed that behaviour is learned through observing and imitating others. The Bobo Doll experiment showed that children learned aggressive behaviour from adults and the experiment was extrapolated to show that children learn by observing adults. There were several criticisms of the experiment and the way in which it was conducted; however, the important conclusion that children learn from adults is of particular significance (Shuttleworth, 2008).

Bandura extended his studies of social learning to produce his second book '*Learning and Personality Development*' (1963), which further asserted that role modelling was a very powerful influence in how children developed. Whereas the Bobo Doll experiment was based upon mimicry, Bandura showed that role modelling was also important for developing attitudes, competencies and creating value systems in children.

One particular experiment conducted by Bandura was the effect of self-reward. In this experiment, children played a bowling game where the children could reward themselves at any point where they felt they deserved a reward for their performance. The children observed adults who had set themselves either high standards for a reward or low standards. Bandura found that whichever role model that the children observed, the children would adopt the same standards. In a further study of this topic, Bandura found that children who observed a role model forego a short term reward in favour of a larger long-term reward, would then copy this behaviour themselves.

The importance of professional role models was noted as being particularly significant for careers in medicine, according to a paper in the 'British Medical Journal' (Cruess et al., 2008 pp. 757-847) It states that role models are 'individuals admired for their ways of being and acting as professionals'. Whilst this paper is clearly focused upon medical careers, it can be extrapolated to encompass scientific fields. It states that strong role models have good competence, teaching skills and personal qualities. However, it explains that: 'The informal curriculum, which consists of unscripted, unplanned and highly interpersonal forms of teaching and learning are very powerful' (Cruess et al. 2008, p.719)

An earlier study into the importance of role models within the medical profession was conducted by Althouse, Stritter and Steiner (1999), in which they explored the factors that made good role modes. During their research, they asked the students to name role models who had been most influential during their training. The role models who were the most frequently cited by the students in the survey were then interviewed to explore the qualities of a good role model. (Althouse, Stritter and Steiner, 1999, p.111). The research is significantly linked to Bandura's social learning theory and states that:

‘modeling is one of the most powerful means of transmitting values, attitudes and patterns of thought and behaviour to students’.

The role models who were identified in the research demonstrated certain styles of teaching that can be largely extrapolated and applied towards science teaching within a school or college. For example, teaching students by direct questioning and the use of Socratic dialogue emerged as a popular method of teaching with the students. Some of the personal qualities that the role models exhibited were enthusiasm for teaching and showing students that they enjoyed their work (p.116). From the research, it also appears that role models who are patient and allow students to learn from their mistakes, as well as those who encourage the students to strive for high standards are also appreciated by students.

A study into women in the Merchant Navy revealed some of the problems that women face in a male-dominated career, where women constitute approximately 2 % of the workforce (Walker, Gleaves and Peart, 2003). Despite a range of problems encountered by women working at sea, one of the most significant influences that encouraged the women to take up careers in the Merchant Navy was having close family members who had been in either the Navy or Merchant Navy (p.295). The women in the study who did not have any family experiences of this type of career found difficulties with the harsh realities of life at sea. This findings of this study can be related beyond careers in the Merchant Navy to careers in science, since both are traditionally male dominated careers.

Within the Netherlands, it has been found that female role models can have a significant influence upon attracting girls towards science. A project that allowed girls to meet female scientists revealed that ‘girls have hardly any perceptions of SET jobs and careers, and if they do, their perceptions are unrealistic or outdated’ (Booy, 2009).

One aspect of the project was a Girls’ Day at Eindhoven University of Technology, with female students acting as guides. It was found that girls asked different questions to boys as they require different information. Another aspect of the project involved girls meeting female professional scientists in a ‘speed-date’ format, where a group of girls can talk to a role

model for approximately twenty minutes in order to learn about careers in science and technology.

An American study by Bettinger and Long (2004) explored the impact of the gender of the teachers (instructors) on female students. This paper used a data set of 54,000 students and found that female instructors have a positive effect upon course selection in some disciplines, due to the fact that teachers of the same gender act as role models. The results were particularly strong for mathematics and geology, however due to the small proportion of women in fields such as physics, engineering and computer science, it was difficult to determine the effects of the female instructors in these subjects. The study was later extended to consider men as role models in female-dominated disciplines, such as education. It was found that male students with male 'professors' were more likely to select that particular subject.

If we apply the concept of role models towards the FEC, then the science department has several strong female teachers who are enthusiastic, professional and highly committed teachers. This is good for those students who wish to pursue a career in education, and it is certainly most heartening that we have produced numerous young and talented science teachers. Finding role models who work as scientists is far more problematic, particularly finding role models with careers in physics or engineering. STEMNET have a bank of science ambassadors but these tend to be biology related, for example a geneticist made an excellent presentation to our students, outlining how she progressed from a research scientist to organising her own genetics business.

The importance of the family for providing direct role models can not be over-estimated. When conducting an investigation into the progression of students from the FEC to university, it emerged that there has only been one young lady who has studied for a physics related degree, between 2004 and present. The young lady concerned, R, who studied Physics with Astrophysics at a Russell Group university (2006 to 2009) has a father who is a lecturer in Mathematics at a local university and a brother who also proceeded to study physics at university. Therefore it could be claimed that

since this young lady had a middle class, well educated family background, that she was not typically representative of the majority of our students.

It could be argued that this young lady inherited her numerical ability from her parents, yet her family also provided a strong, supportive and encouraging environment for her to develop academically. Therefore a combination of both nature and nurture provided the foundations for R to pursue her scientific studies. The majority of students within the college do not have parents that have experienced university education, therefore they do not know what to expect from university. This fear can be applied towards any academic discipline, however it is most unusual that any of the students at the FEC have family members who work in science related careers.

For the majority of our students, perceptions of scientists are largely relayed by representations within the media. The following section will discuss some of the investigations that have been conducted to evaluate children's perceptions of scientists, leading into a discussion of the representation of scientists in the media.

Children's representations of scientists

In 1957, Margaret Mead and Rhoda Metraux conducted research into what the average American high school student expected a scientist to look like. It was a significant investigation which is quoted in almost all texts on the representation of women in science. Mead and Metraux's research was conducted with 35,000 students at more than 120 schools in the United States, producing a 'shared image' of a typical scientist. It is interesting to note that one of the questions given to the students was:

> 'If you are a boy, complete the following statement in your own words:
>
> *If I were going to be a scientist, I should like to be the kind of scientist who……..*
>
> If you are a girl, you may complete either the sentence above or this one.

> *If I were going to marry a scientist, I should like to marry the kind of scientist who……* ‘
>
> (Mead and Metraux, 1957, p.385)

This may have been a valid question in 1957, yet seems archaic when reading some 50 years later. The ‘shared image’ of the scientist was as follows:

> ‘The scientist is a man who wears a white coat and works in a laboratory. He is elderly or middle aged and wears glasses. He is small, sometimes small and stout, or tall and thin. He may be bald. He may wear a beard, may be unshaven and unkempt. He may be stooped and tired.’
>
> (Mead and Metraux, 1957, p.387)

The positive image of the scientist was:

> ‘He is a very intelligent man….long years of expensive training….He is careful, patient, devoted, courageous, open minded. ….He is a dedicated man who works not for money or fame or self-glory, but – like Madame Curie, Einstein and Oppenheimer – for the benefit of mankind and the welfare of his country….The scientist is a truly wonderful man, where would we be without him.’
>
> (Mead and Metraux, 1957, p.387)

The negative image of the scientist produced results that indicated his work was dull, tedious and time consuming; that a scientist works alone in a lab and may neglect his family. He has no social life or interests outside of science. Mead and Metraux claimed that ‘across the country, there is a reflection of the mass media image of the scientist, which shares with the school materials, the responsibility for the present image.’ (Mead and Metraux, 1957, p.388) They recommended that the media should portray the more human aspects of science and show scientists working together in groups, rather than alone.

Other recommendations were that schools should teach science at an earlier age, develop group projects in science, as well as showing how science has made great advances for mankind. An interesting suggestion was to de-emphasise the contributions of individuals, such as Einstein, as many students know that they could never reach such a level of genius.

This investigation was later modified by Chambers during the early 1980s, with the 'Draw a Scientist' exercise. His survey tested 4,807 school children between 5 and 11 years of age in Quebec. Each drawing was analysed using indicators of 'the standard image of the scientist', which was developed from the earlier work by Mead. These features included items such a lab coat, facial hair, equipment, captions and symbols, however gender did not feature as part of this research. Chambers showed that the representations that emerged from Mead's survey were still valid over 25 years later, with the stereotypical view of a scientist being a male in a white coat. Of the 2,000 girls in the survey, only 28 women were drawn. (Frayling, 2005, p.14).

Sir Christopher Frayling discussed the image of scientists in a feature for the Daily Telegraph entitled 'All boffins are bonkers'. In this feature, Frayling discussed the earlier work of Mead and Metraux, as well as Chambers, and how he had conducted a similar investigation himself in a junior school near Bath in 2003. He found that the same stereotypical image of a scientist exited in the UK, although he noted that the number of girls who drew female scientists had increased significantly from previous studies. (Frayling, 2006, p.1)

The 2008 '(In)visible witness' project was conducted by Elizabeth Whitelegg (et al.) for the UKRC which developed the 'draw a scientist' investigation in order to see whether there were any differences in the twenty first century. The project involved 45 children aged between 8 to 15 years. (p.20). Using the same criteria for assessing the drawings as in previous studies, this investigation found that the children were much more open to the idea of female scientists than in the previous studies. Most of the drawings showed a male scientist, however, unlike the previous studies, it was found that there were now 6 drawings of female scientists (all drawn by girls).

The (In)visible Witness project also included an investigation into how science was represented in children's television and evaluated the content by analysing two sample weeks, one in October 2005 and the second in March 2006. They recorded 302 programmes in the first week and 364 in the second week. The researchers then viewed each of the

programmes to assess for STEM content. It was a difficult task in that it was unclear in deciding what counted as STEM and what did not, particularly in the area of medicine, architecture or communications technology.

Following the assessment of STEM content in the sample programmes, the researchers interviewed the children in the project regarding the images of scientists. They concluded from the children's responses to the questions about animated cartoons that whilst a range of positive and negative images are presented, the children interpret the images 'correctly'. (p.26) They noted that the cartoon character Lisa Simpson from US animated series '*The Simpsons'* presented a positive image of a girl who excelled at science and mathematics, as well as being popular with the children in the survey.

The report recommended that there should be a greater emphasis on the representation of technology, engineering and mathematics in children's television 'with a view to increasing the visibility of these subjects' (p.35). They also suggested that there should be more women portrayed in these disciplines and that such representations should be 'diverse and authentic'.

Part 4: The Representation of Scientists in the Media

One of the most significant influences upon young people in the twenty first century is that of the media. Unlike previous generations, when television was confined to three channels and the internet not yet invented, young people now have access to a wide range of different media, utilising the technology that is being developed at a rapidly expanding rate. The number and range of the different forms of mass media have increased significantly over the past three decades, with young people having access to much more information than ever before. The patterns of representation need to be explored in order to determine how they influence young people.

The influence of the media in representing science, particularly with women, was explored in a report by Professor Jenny Kitzinger, in which she outlines why the mass media 'have a crucial role in either reinforcing, or challenging such gender segregation and inequalities' (2008, p.1). In this

report, it is suggested that the media have a significant impact upon children's occupational knowledge and role identification. The influence of the media is not an entirely new concept, however, and in this section, we will explore the various representations of science and how they have evolved in popular culture.

Within literature, we see scientists such as Dr Jekyll and Dr Frankenstein, who personified the concept of the 'mad scientist'. Roslynn Haynes conducted a study of the representations of scientists in Western literature, starting from Johannes Faust in the 1530s and categorised the different types of scientist portrayed in literature:

- The alchemist (late sixteenth century) - this scientist works alone or with a single assistant, he is driven by mania and tends to be intellectually arrogant.
- The absent minded professor (mid-seventeenth century) – this scientist is obsessed with the pursuit of his scientific interests to the extent that he forgets about domestic or social responsibilities.
- The inhuman rationalist (early nineteenth century) – this scientist has such a dedication to work that emotions are suppressed.
- The heroic adventurer (late nineteenth century) as portrayed by the author Jules Verne in literature, to be later transformed into cinema with heroes such as Indiana Jones.
- The helpless scientist (mid twentieth century) who is well intentioned but his discoveries are taken over by government or corporations.
- The social idealist (mid twentieth century) who is a scientist with a social conscience.

(Haynes, 1994)

Haynes analysed the images of scientists portrayed in 500 years of literature and believed that they instilled in the reader a fear of science itself.

If we consider the representation of scientists in film, then the text: *Mad, Bad and Dangerous* (2005) by the cultural historian Christopher Frayling provides an interesting insight. He critically analysed the portrayal

of scientists, starting from some of the early films, such as the first adaptation of Frankenstein in 1910 to contemporary sources. Fritz Lang's dystopian science fiction film *Metropolis* (1926) introduced the 'evil genius' Rotwang, whom Frayling claims is 'the most influential scientist in the history of the cinema' in a German Expressionist style vision of technological cityscape of the future (Frayling, 2005).

Warner Brothers produced a series of biographies of scientists from the late 1920s to the mid 1930s, although it was *The Story of Louis Pasteur* (1936) that is most remembered. This film presented Pasteur as 'a saintly, generous and humanitarian man' (Frayling p.135) although there were significant differences between reality and the film in order to make the story more entertaining for the audience. *Edison, the Man* was produced in 1940 by MGM, presenting Edison (Spencer Tracy) as a lonely scientist who worked hard with humanitarian intentions.

In 1943, *Madame Curie* was released starring Greer Garson in the title role. Having spent years in pre-production, the scientific aspects of the story had been forged into more of a love story between two scientists in order to suit the wartime audiences. The 1950s saw the portrayal of Dr Barnes Wallis in the *Dam Busters* (directed by Michael Anderson, 1955) in which he is portrayed as a quiet, introverted and driven man. Science Fiction became a popular Hollywood genre in the 1950s with films such as *The Day the Earth Stood Still* (1951), *War of the Worlds* (1953), *Them!* (1954), *Invasion of the Body Snatchers* (1956) and *The Fly* (1958).

In an article 'How many female scientists do you know?' Robert A Jones explores the representations of female scientists in cinema and discusses their 'subordinate' role. Jones claims that women scientists in films are shown performing tasks that are below their level of education such as taking notes or typing. Despite the fact that the article was written in 2005, Jones draws upon a selection of British films that were made in the 1950s and 1960s, which perhaps are reflection of the attitudes of the times towards women in science.

In the 1960s, the James Bond series of films usually had some aspect of technology inherent to the plot. A story then developed in which James Bond had to ensure that the technology did not fall into the wrong

hands. *Dr No* (1962), *Goldfinger* (1964) and *Thunderball* (1965) deal with aspects of nuclear power. Q is the scientist who invents the gadgets for James Bond to use, whereas Dr No was the evil scientist who wanted to use science and technology for his own ends. Meanwhile, science fiction evolved into a more philosophical style with films such as *Fahrenheit 451* (1966), *2001: A Space Odyssey* (1968) and *Planet of the Apes* (1968). These latter three films are all set in the future and perhaps do not show scientific advances in a favourable manner.

The 1970s introduced Star Wars, a popular film that was financially successful. Other (financially) successful films that featured 'science' were *Close Encounters of the Third Kind* (1977) and *Star Trek, the Motion Picture* (1979). Ridley Scott's *Alien* (1979) was a particularly successful science fiction film that featured a very strong female lead character (Ellen Ripley played by Sigourney Weaver), who was portrayed as being intelligent, independent woman and not there as part of a 'love interest'. Whilst this was a positive representation of a female working in a scientific environment, the Scientific Officer turned out to be an evil android, serving the interests of a sinister company.

More recent films that feature science in some context are: *Gattaca* (1997) in which Uma Thurman plays Irene Cassini, a scientist at Gattaca, a space programme. *Contact* (1997) features Jodie Foster playing Dr Ellie Arroway, an astronomer, and *I, Robot* (2004) in which Bridget Moynahan plays Dr Susan Calvin, a robot psychologist.

An article in the Sunday Times in 1999 by Victoria Coren highlighted the fact that women scientists in some films, for example, *Mimic* directed by Guillermo del Toro, (1997); *Outbreak* directed by Wolfgang Petersen, (1995); *Volcano* directed by Mick Jackson, (1997); *Twister* directed by Jan de Bont, (1996) and *Batman Forever* directed by Joel Schumacher, (1995) featured women who were incredibly young and good looking for the role that they were playing. (Coren, 1999). She claimed that these women, who looked about 25 years old, simply would not have the education or experience to be 'world experts'. For the feature, Coren interviewed several female scientists who were all much older than their equivalent representations in film. They believed that the films trivialised the position of

women in science and were there to add glamour. However, they did think that it was a step forwards to portray women as scientists in major films.

Television provides the most accessible arena for demonstrating representations of scientists, particularly with the number of television channels available. When evaluating the programmes that influence children, I have concentrated upon the main evening programmes that can be watched by the whole family rather than assess children's television, mainly as I believe that children are more likely to think that the representations portrayed in 'grown up' programmes are more realistic than the those of children's television.

Throughout the past decades, there have been many television programmes that have shown scientists at work, although the majority appear to be related to the work of forensic science (*Silent Witness* is a very popular contemporary series about forensic pathology). *CSI (Crime Scene Investigation)* is a popular American television series about forensic investigations and has led to a further two 'spin off' series *CSI: Miami* and *CSI: New York.*

During the second week in December 2010, *CSI Miami* was the most popular programme for Channel 5, with an audience of 2.55 million viewers. This was closely followed by *CSI*, with 1.52 million viewers, *CSI New York* with 1.48 million viewers and *NCIS* with 1.41 million viewers. These American crime investigation series popularise forensic science and are very popular with the public. (BARB, 2010).

The influence of the media upon the decisions made by young people can be shown by considering the UCAS statistical data. As the popularity of television programmes featuring forensic science has increased, so has the number of applications to study forensic science at university. The UCAS data shows that in 2002, there were 822 applicants for subject group F4 (Forensic and Archaeological Science), whereas this increased to 1794 in 2009, showing an increase of 118% over a seven year period. (UCAS Statistics, 2010) Whilst this sounds very positive, it must be compared to the fact that the top BBC1 programmes that week were *Strictly Come Dancing* with 12.04 million viewers and *Eastenders* with 10.2 million viewers. ITV featured the *X factor* with 16.5 million viewers. (BARB, 2010)

The Guardian website featured an article about the top 10 TV scientists (July 18th 2008) and whilst the list has been created for amusement, it provides an insight into the public perception of scientists (Pickard, Guardian, 2008).

1) Gil Grissom (*CSI*)
2) Beaker (*The Muppets*)
3) Mr Spock (*Star Trek*)
4) Dana Scully (*The X files*)
5) Dr Sam Beckett (*Quantum Leap*)
6) Professor Farnsworth (*Futurama*)
7) Gaius Baltar (*Battlestar Gallactica*)
8) Brains (*Thunderbirds*)
9) Heinz Wolff (*The Great Egg Race*)
10) Abby Sciuto (*NCIS)*

The long running American television series, *NCIS*, features a scientist who is played against stereotype and provides a refreshing change from the usual television scientists. The character of Abby Sciuto is portrayed as a methodical and meticulous scientist, yet she is a very warm-hearted and affectionate person. Abby's Goth dress sense is played against the stereotypical scientist image, portraying her as a very independent, as well as intelligent individual.

The X files (1993 to 2002) featured a very strong female lead character, FBI agent Dana Scully who is the more rational and logical partner of Fox Mulder. Scully has degrees in both medicine and physics, which is a rather unusual combination of qualifications, yet portrays a lead character who is well-educated in addition to being attractive and interesting. (BBC, 2010)

Brainiac is a popular show where zany and often dangerous experiments are conducted (with the tag line 'so you don't have to!'). A significant number of the experiments are not at all scientific and are conducted simply for entertainment. The show is engaging and amusing,

but as a science teacher, I think that the show has an irresponsible way of representing science.

Professor Kitzinger of Cardiff University conducted an investigation by collecting and analysing the views of 86 women who have established careers in science, technology and engineering. The research consisted of questionnaires, interviews and focus groups and the aim was to determine the extent that the media had influenced their decisions to pursue a career in these disciplines.

From the research, it was found that *Tommorow's World* was perhaps the most inspirational, with 17 of the 26 interviewees recalling it as being a significant programme for them whilst they were growing up. The programme ran for 38 years, from 1965 to 2003, eventually being dropped by the BBC due to a fall in audience numbers. (Kitzinger, 2008, pp.11 - 12) Ironically, *The Gadget Show*, which started in 2004, has proved to be a very popular series for Channel Five. Judith Hahn was one of the presenters of *Tomorrow's World* (from 1974 to 1994), and being a scientist herself, she could explain topics in an intelligent, knowledgeable and articulate manner. Judith was definitely a strong, positive role model for young people at the time and this was identified from Professor Kitzinger's research (2008, p.12).

From the women who participated in the research, they claimed that the media portrays the women in science to be either 'frumpy' or 'ultra-feminine'. They believed that some of the female science presenters were 'terribly fluffy', with Carol Vorderman being quoted as an example. Many of the interviewees wanted to see women presenters engaging with science and not 'there to be eye candy' (p.19). The report identified a need for more scientists to be represented in the media in order to inspire future generations, and Professor Susan Greenfield was quoted as an example of an inspirational role model (p.15).

Frayling conducted a survey of science coverage within Radio 4's *Today* programme over a six month period. He found that most of the science features relied on 'shock, awe or anxiety'. (Frayling, 2006, p.2) He claimed that the challenge is to engage public interest so that people have a greater understanding of the processes, which would prevent 'panic over

the outcomes'. Frayling widens his debate, however, by considering the British attitude towards academics in general, suggesting that we need more Indiana Jones characters to show academics in a more favourable light.

Within the past year or so, Professor Brian Cox has emerged as a popular television presenter of science programmes. With his youthful appearance, enthusiastic and engaging personality, he has won a large audience of viewers for programmes such as *The Wonders of the Solar* System. He does not represent the image of a typical scientist, notably for his strong northern accent as well as his background in popular music. His programmes are popular due to his ability to communicate scientific concepts in a very accessible manner, making science interesting and enjoyable to people from a wide range of ages and backgrounds.

Tom Clarke, writing for the Guardian (June 4th 2007) argued that 'modern scientists and engineers have an image problem' and discussed the fact that science tends to have a rather 'geeky' image. He explained: 'science, in fact intellectual endeavour in general, will never sell as well as *Heat Magazine* and *Celebrity Big Brother'*. The report went on to outline a project 'Nesta Famelab' in which young scientists participated in a competition to explain complex topics to a panel of judges. Clarke believed that apart from the media image of scientists, the ability for scientists to communicate their ideas was essential, and furthermore necessary, for the promotion of science within the media.

For many young people, the media is the only way that they can visualise what scientists do outside of a school laboratory or classroom. The images created by the media, whether stereotypes or against type, can have a strong influence upon young people. For some students, this can be a very positive experience, as many students look to Brian Cox as a strong role model. It is clear that we need more female scientists on television who can act as role models for a wider audience.

Conclusions

This report has outlined some of the wider factors that influence the decisions made by young people. These factors include the ethos of the establishment, the parents or family background, along with the representations of science in society and the media.

In part one, the nature of the college environment was explored and it was shown that A levels are only a small part of the vast range of courses offered by a large tertiary college. In part two, the influence of home background was discussed, as many of the students at the college are the first generation from their families to progress to higher education. Many parents do not feel sufficiently informed to guide their sons or daughters through the choices for higher education. Some university admissions departments have realised that it is important to reassure parents, so have devised parent packs and web pages specifically to overcome parental anxieties about higher education.

Within part 3, the influence of role models was explored and it was found that it was important for young people to have an insight into particular career paths. In some cases, this can be intertwined with family background, for having role models within the family is a particularly formative influence.

In part 4, the representations of science within the media were discussed, since for many of our students who do not have scientists within the family, this is the only means of knowing what a scientist does. The popularity of television programmes featuring forensic science may have contributed towards the dramatic increase in the number of UCAS applicants for forensic science over the past ten years. One of the conclusions of the (In)visible Witness project (2008) was that there should be a greater emphasis on the representation of technology, engineering and mathematics in children's television programmes 'with a view to increasing the visibility of these subjects' (p.35).

These factors can not be changed by individual teachers, but through good classroom teaching, we can raise these issues with students. Within

our classrooms, the way that we portray science is important and it is our task to make science interesting and inspirational. We can work with parents to ensure that they have a greater knowledge and understanding of what students are learning, as well as the range of career opportunities that are possible from the study of science. We can actively look for science programmes on television and the role of science within other forms of media and use this to our advantage, with classroom displays, discussion boards on the Virtual Learning Environment and as part of lessons.

We can not change the way in which scientists are represented in the media but good teachers should encourage all young people to challenge stereotypes, strive for the highest standards and be the best that they can be.

References

Althouse, L.A, Stritter, F.T. and Steiner, B.D. (1999) 'Attitudes and Approaches of Influential Role Models in Clinical Education', *Advances in Health Science Education,* 4, pp.111 -122.

Archer, L., Hutchings, M. and Ross, A, (2003) *Higher Education and Social Class: Issues of exclusion and inclusion*, London: Routledge Falmer.

Ball, S.J., and Vincent, C. (1998) 'I heard it on the grapevine: Hot knowledge and school choice'. *British Journal of Sociology of Education* 19:3 pp. 377 - 400.

Bandura, A. (1995) *Self-Efficacy in Changing Societies*, Cambridge:Cambridge University Press, UK.

BBC (2009) *Cult Scientists* [Online] Available at:http://www.bbc.co.uk/cult/scientists/ (Accessed: 12 August 2010)

BBC (2010) *X Files* [Online] Available at: http://www.bbc.co.uk/cult/xfiles/ (Accessed: 20 December 2010)

Bettinger, E.P. and Long, B. T. (2004), 'Do faculty serve as role models? The impact of instructor gender on female students', *American Economic Review*, 5 (2) pp.152-157.

Booy, C. (2009) *Female role models make a difference* [Online] Available at:

http://www.sefi.be/wp-content/abstracts2009/Booy.pdf (Accessed: May 28 2010)

British Audience Research Board (BARB) (2010) *Top Weekly Programmes* [Online] Available at: http://www.barb.co.uk/report/weeklyTopProgrammesOverview?_s=4 (Accessed: 20 December 2010)

Brooks, R. (2004) 'My mum would be as pleased as punch if I actually went, but my dad seems a bit more particular about it: Paternal involvement in young people's educational choices', Brooks R., *British Educational Research Journal* Vol 30(4) pp.495 – 514.

Clarke, T. (2007)' Goodbye to the Geekish image' *The Guardian*, 2 June 2007.

Coren, V. (1999) 'How many female scientists do you know? *Sunday Times* 7 January 1999

Cruess, S.R., Cruess, R.L. and Steinert, Y. (2008) Role Modelling: making the most of a powerful teaching strategy, *British Medical Journal (*336) pp.757 – 847.

David, M.E., Ball, S.J., Davies, J. and Reay, D. (2003) 'Gender issues in parental involvement in student choices of higher education' *Gender and Education* 15 (1), pp.21 – 36.

Dewjo'c Awards (2009) [Online] Available at: http://www.dewjoc.com/ (Accessed 12 August 2009) Dewjo'c is now part of the Devereux organisation (2010)

DfES (2003) *'The Impact of Parental Involvement, Parental Support and Family Education on Pupil Achievements and Adjustment: a Literature Review'* [Online] Available at: http://www.bgfl.org/bgfl/custom/files_uploaded/uploaded_resources/18617/Desforges.pdf (Accessed: 18 November 2010)

Durham University, (2010), *Information for Parents* [Online] Available at: https://www.dur.ac.uk/parents/ (Accessed: 20 December 2010)

Foskett, N.H. and Heskett, A.J. (1997) 'Constructing Choice in contiguous and parallel markets: institutional and school leavers' responses to the new post-16 market place' *Oxford Review of Education* 23 (3) pp.299 -319.

Frayling, C. (2005) '*Mad, Bad and Dangerous: The Scientist and the Cinema'*, London: Reaktion Books, UK.

Frayling, C. (2006) 'All boffins are bonkers: Scientists need an Indiana Jones image to make their subjects more popular' *The Daily Telegraph* 9 May 2006

Further Education Awards (2008) [Online] Available at: http://www.architecture.com/UseAnArchitect/PublicBuildings/FurtherEducationClientForum/FurtherEducationAwards/FurtherEducationAwards2008.aspx
(Accessed: 12 August 2010)

Hattie, J. (2003) '*Teachers make a difference: What is the research evidence?*' Paper presented at the Annual Conference on Building Teacher Quality, University of Aukland, New Zealand.

Haynes, R.D. (1994) *From Faust to Strangelove: Representations of the Scientist in Western Literature*, Balitmore: John Hopkins University Press, USA

JCQ (2010) *GCSE Results 2010* [Online] Available at: http://www.jcq.org.uk/attachments/published/1304/Handout%20-%20GCE%20Results.pdf (Accessed: 20 January 2011)

Jones, R. A. (2005) 'How many female scientists do you know?' *Endeavour*.29 (2)

Kitzinger, J., Haran, J., Chimba, M and Boyce, T. (2008) Role Models in the Media: An exploration of the views and experiences of women in Science, Engineering and Technology. UKRC Research Report Series No 1. UK [Online] Available at: http://www.cardiff.ac.uk/jomec/resources/Kitzinger_Report_1.pdf
(Accessed: 28 November 2010)

Mead, M., and Metraux, R. (1957) 'The Image of the Scientist among High School Students: a pilot study (USA)' *Science* 126 pp. 384 – 390.

Murphy, P and Whitelegg, E. (2006) *Girls in the Physics Classroom: A Review of the Research on the Participation of Girls in Physics,* London: Institute of Physics.

Newcastle University (2010), *Parents Guide* [Online] Available at: http://www.ncl.ac.uk/undergraduate/parents/index.htm (Accessed: 20 December 2010)

Northumbria University (2010) [Online] Available at: http://www.northumbria.ac.uk/
(Accessed: 15 December 2010)

Northumbria University (2010) *Parents Brochure* [Online] Available at: http://www.northumbria.ac.uk/static/5007/markpdf/nuparent.pdf
(Accessed: 20 December 2010)

Payne, J. (2002) 'Attitudes to Education and Choices at Age 16: A brief Research Review' Report to the DfES Advisory panel on Research Issues for the 14-19 Age Group, Policy Studies Institute, UK.

Pickard, A. 'Take 10: TV Scientists' (2008) *Guardian*, 18 July 2008 [Online] Available at: http://www.guardian.co.uk/culture/tvandradioblog/2008/jul/18/taketentvscientists (Accessed 10 November 2010)

Reay, D., and Ball, S. (1998) 'Making their minds up: family dynamics of school choice'. *British Educational Research Journal* 24 (4)

Reay, D., David, M.E. and Ball, S. (2005) *Degrees of Choice: social class, race and gender in higher education*, Stoke-on-Trent:Trentham books, UK.

Reay, D., Davies, J., David, M. and Ball, S. (2001) 'Choices of Degree or Degrees of Choice? Class, Race and the Higher Education Choice Process', *Sociology,* 35 (4) pp.855 -874.
Schiebinger, L., (1999) *Has Feminism changed Science?*, Cambridge, Mass: Harvard University Press, USA.

Shuttleworth, M. (2008) *The Bobo Doll Experiment* [Online] Available at: http://www.experiment-resources.com/bobo-doll-experiment.html (Accessed: 1 November 2010)

Sunderland University (2010) *Parents Area* [Online] Available at: http://www.sunderland.gr/index.php?page=In_English (Accessed 20 December 2010)

UCAS (2009) *Information for parents* (2010) [Online] Available at: http://www.ucas.ac.uk/parents/ (Accessed: 22 December 2010)

UCAS Statistical Services (2010) [Online] Available at: http://www.ucas.com/about_us/stat_services/stats_online/ (Accessed: 10 December 2010)

UK Resource Centre for Women (2009) *The UK Resource Centre for Women* [Online] Available at: http://www.ukrc4setwomen.org/html/about-ukrc/ (Accessed: 10 August 2009)

Vincent, V. (2000) *Including Parents? Education, Citizenship and Parental Agency,* Buckingham: Open University Press, UK.

Walker, C., Gleaves, A and Peart, D. (2003) 'Problems in the construction of gender and professional identities for women in a UK Merchant Navy Training School', *Research in post-compulsory education* Vol 8 (3)

Whitelegg, E., Holliman, R., Carr, J., Scanlon, E. and Hodgson, B. (2008), '(In)visible Witnesses: Investigating gendered representations of scientists, technologists, engineers and mathematicians on UK children's television, UKRC Research Report Series No. 5 [Online] Available at: http://www.theukrc.org/files/useruploads/files/resources/report_5_whitelegg.pdf (Accessed: 15 November 2010)

Report Evaluation Form

REPORT:

Physics Education: Factors outside of the classroom

Position:

Head of Academic Studies, FEC

Comments on the report:

This is a comprehensive and detailed report on the investigation of the wider influences outside the classroom and their effects on student learning processes.

Marianne has looked at four main areas: school environment; home background; role models and the media. She has explored each section in depth and has included many relevant examples and references from a wide variety of contemporary sources to support her research. Marianne has also considered how attitudes and perspectives have changed over the years and drawn relevant and valuable conclusions.

Are there things that could be added or removed to improve it?

In what way could the contents of this report influence the wider profession?

As referred to in the conclusion, it is crucial for all scientists to be aware of how science is portrayed in everyday life and how important the influence of the media in particular is on the choices made by our young people. This report can serve to raise awareness of these issues so that we do not lose the scientists of the future.

Signature:

Supplied

Report Evaluation Form

REPORT:

Physics Education: Influences outside of the classroom

Name of Reviewer:
Lecturer in Cultural Studies

Comments on the report:

Marianne has identified some of the key factors that influence student choice of subjects. It was interesting to read the section on learning environment and how the design and configuration of space varies between the different sixth form centres that form the larger FEC. As the funding of college is determined by the number of students enrolled, it seems that design of the space is to appeal to students.

Parents are clearly a major factor in deciding where or what to study. It is important that parents are provided with clear information so they are not afraid of their son or daughter going to university. The choice of local institution applies to this university, as we have a large proportion of students who live at home for the duration of their studies.

Marianne has also considered the influence of the media and how science is represented by stereotypical images. Historically, scientists have been portrayed as rational, unemotional men so it is pleasing to see that there have been some challenges to this image. we need to see stronger female role models in television and film, although as mentioned in the report, the media sometimes have impossibly young female scientists to add glamour rather than character to a film.

Are there things that could be added or removed to improve it?
It would be interesting, yet probably beyond the objectives of this study, to investigate the social class aspects, which are contained within the ethos of the establishment, choice of subjects and parental involvement.

In what way could the contents of this report influence the wider profession?
The university where I am employed is currently reviewing literature for parents and inviting parents to open days. The problem of students attending local universities is not confined to this region, but over the entire country. The majority of working class students attend local universities, whereas choice is for students who are from higher social backgrounds.

Signature:
Supplied