INTRODUCTION TO SECTION 2

The progression of A level students into physics degree courses

Aim: To consider the proportion of A level physics students who then proceed to study this subject at university.

Contents: Report

Evaluation from the Head of Sixth Form

Evaluation from the Stimulating Physics Consultant

Methodology: For this Section of the portfolio, I have conducted a study into the number of young people who proceed to study physics as an undergraduate degree subject, and I have presented this in the form of a report with two evaluations.

The first part of the report cites papers from government and societies regarding the importance of attracting young people to study STEM degree courses. The second part of the report explored the number of applicants for university degree courses in the UK, using information provided by the UCAS statistical services website. I also contacted each of the four local universities to determine why physics was only offered at one of these universities.

The third part of the report analysed primary source data, obtained from the college, on the students who had progressed to university to study for science related degree courses. The evaluation of university destinations for students from the FEC revealed that fewer students opted to study physics than other sciences, and it was clear that the students who had chosen to study for physics degrees had moved away from home for their chosen course. The proportion of students who chose to remain at home for their degree course was far greater than I had expected (In 2009, there were 88/666, 13.2% of applicants from the college that chose to study away from home).

In order to understand why students appear reluctant to move away from home to study for their degree courses, I conducted wider research into some of the more sociological aspects of the problem. The issue of social class and selecting degree courses has been explored by Diane Reay in ‘Degrees of Choice: Social Class, Race and Gender in Higher Education’ (2005) and Evans (2009).

Conclusions: The main findings of this study were that the factors which influence students’ choice of degree courses differ to those that influence choice of A level subjects. The most significant factor is whether the degree course is offered locally, particularly for working class students. The reasons at first may appear to be financial, however it has been found that other invisible or emotional constraints effect choice, such as caring for relatives within the family unit. The proportion of girls who study physics degree courses remains consistently around 20%, which is an extrapolation of the proportion of girls who study the subject at A level.

Dissemination of this study: This report was shared with the Head of Sixth Form as well as the consultant from the Stimulating Physics branch of the Institute of Physics. Both made some very useful comments and the report was sent to the Institute of Physics.

The progression of A level students into physics degree courses

Marianne Hill

Introduction

This report will consider the progression of A level students into physics related degree courses and evaluate the extent that we need to increase the number of physics graduates, with girls as a particular subset of this group. This report will evaluate information from the larger Further Education College, where I am employed, however in order to ensure anonymity, will be referred to throughout this report as the FEC.

Part 1: This section will outline some of the recent national reports that have been produced that highlight why we need to increase the number of students, both girls and boys, who pursue the study of physics at university. Along with other STEM subjects, physics develops skills that lead to a wide range of employment possibilities for young people. From these reports, the government and other professional organisations acknowledge that there is a problem in attracting young people towards science and many recommendations have been made, yet the situation shows little sign of improvement at both national and regional levels.

Part 2: This section will consider the trends for physics undergraduate degree courses by evaluating data provided by UCAS statistical services. It will consider the number of girls who study physics at university in order to establish whether the under-representation of girls in this subject is still a problem. One of the main findings from this section is that we can increase the number of physicists by addressing the issue of why there still a gender imbalance in physics, particularly considering all of the initiatives, strategies and interventions that have taken place over the last thirty years.

Within this part of the country, only one of the five universities in the region offers physics as an under-graduate degree course, however the entry requirements are particularly high. The availability of degree courses within this area is one of the factors that can, perhaps, affect student choice of undergraduate subject.

Part 3: This section will look at the progression of students from the FEC into science-related degree courses. Analysing the UCAS data from 2004 to 2009 reveals that few students progressed to study purely academic science degree courses at university, although vocational courses such as pharmacy and biomedical science appear to be appealing for our students.

By evaluating data from the College, it appears that relatively few students move away from the region in order to study for a degree course. In 2009, only 88 out of 666 students (13.2%) moved away from the north east region in order to study for a degree. Research by Reay et al.(2001) suggests that working class students have 'geographical constraints' which extend beyond financial considerations. For many students, choice of degree subject is based upon whether the degree course is offered locally. Research by Evans suggests that many working class girls select local universities due to family commitments (Evans, 2009, p.341). Therefore it could be argued that the low number of students who progress onto physics degree courses from the FEC is due to the availability of courses within this region.

Part 1: Why we need to increase STEM graduates

There have been several reports produced in the past ten years that have highlighted the need to increase the number of students who study science, with physics as an important science subject. The '*Set for Success Report*' (2002) indicted a strong commitment towards STEM (Science, Engineering, Technology and Mathematics) education. *The 'Science and Innovation Investment Framework* (2004 – 2014)' (2004) outlined why we needed to increase the number of graduates in STEM subjects, as being essential for driving the future economic growth of the country.

'*A Degree of Concern'* **(**Royal Society, 2006) contextualised the need to increase the number of young scientists as a global matter, evaluating undergraduate provision for 'STM' (Science, Technology and Mathematics) subjects in Higher education and exploring the career options available for

'STM' graduates[1]. The report discussed the main influences for student choices in post-16 education with the main factors being:

a) Curriculum structure
b) Curriculum content
c) Range of subject options (including 'newer' subjects such as psychology, ICT and media studies)
d) Dynamic subject specialist teaching
e) Quality of careers advice
f) Students' and their families socio-economic background
g) Perceptions of science and scientists such as those promulgated by the popular media
h) Relative subject difficulty (Section 4.1.1)

The STEM Review (Smith, 2007) reported on whether the recommendations from '*SET for Success* Report' (2002) had been implemented and explored other initiatives to develop STEM skills at graduates and postgraduate level.

Taking Stock, the CBI Education and Skills Survey (2008) identified that the UK faces potential skills shortages for high level science skills, particularly at graduate level. The report indicated that 59% of firms which employ STEM-skilled staff are having difficulties in recruitment and that some sectors are experiencing acute shortages. Some of the larger firms have to recruit internationally, with 36% of these employers recruiting from India and 24% from China. It anticipated that by 2014, the demand for STEM employees will increase by 730,000 (p.26).

From the survey, it was found that 92% of the firms who participated in the survey employ staff who have STEM skills and value their problem solving skills. 23% of these firms value these skills in sales or marketing and 34% recruit managers with STEM skills, indicating that far from narrowing options, STEM skills have wide applications across every sector of the employment market. (p.26)

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[1] This report specifically referred to STM rather than STEM, omitting the Engineering aspect of STEM

The report expressed concern regarding the low numbers of undergraduates who pursue STEM subjects at university (p.28), with the number of students studying physical sciences falling from 5.5% to 4.1% between 1996 and 2000. It points out, however, that there has been an increase in STEM undergraduates since 2006 with a rise of 12% for physics. The report states: ‘The reasons for these increases are not clear. It could be that young people are beginning to realise that STEM degrees offer good opportunities on graduation but it is not certain whether these are sustained increases or just temporary rises.’ (p.28)

The CBI has identified some of the main issues that must be addressed in order to increase the number of young people with STEM skills, which include good career advice, specialist teachers (particularly for the teaching of physics), up to date laboratories where ‘practical science can fire the imagination and create a passion for the subject.’ It also stated that GCSE Triple Award Science is the best foundation for developing the STEM skills necessary for further study or employment in science-related areas.

The report was not confined to the discussion of STEM skills but also encompassed the need to improve basic skills in the workplace, a need to reform apprenticeships as well as the value of foreign languages in the international market.

The UK Resource Centre for Women (**UKRC)** is a government organisation that has been established to provide advice, services and policy consultation regarding the under-representation of women in SET careers (Science, Engineering, Technology and the Built Environment). The organisation was launched in September 2004 and is funded by the Department for Business, Innovation and Skills. As well as raising the profile of women in SET careers, they collate a wide range of statistics relating to female participation in employment and education. The UKRC funds the WISE campaign and is involved with STEMNET in order to help promote girls into SET careers. The Statistics section of the website provided the following analysis (Table 1), which shows the percentage of women engaged in SET subjects at different levels of education.

TABLE 1: The number of people engaged in 'SET' at each stage of the education ladder

Stage of Education	Female	Male	% Female	% Male
GCSE Awards (England)	262,800	285,900	47.9	52.1
A level Awards (England)	73,315	91,226	44.6	55.4
Undergraduates	40,310	128,020	23.9	76.1
Postgraduates	10,130	31,810	24.2	75.8
University Lecturers	1,445	5,000	22.4	77.6
University Professors	330	4,135	7.4	92.6

(UKRC, 2010)

The 'Key facts and figures' section page of the website contains further information about the number of women in SET careers and refers to 'the leaky pipeline', an expression coined for the loss of women in SET subjects at each stage of the educational or professional ladder. The UKRC provide good practice guides for employers (e.g. SET Fair Standard Campaign) as well as support and training for women at each stage of their career.

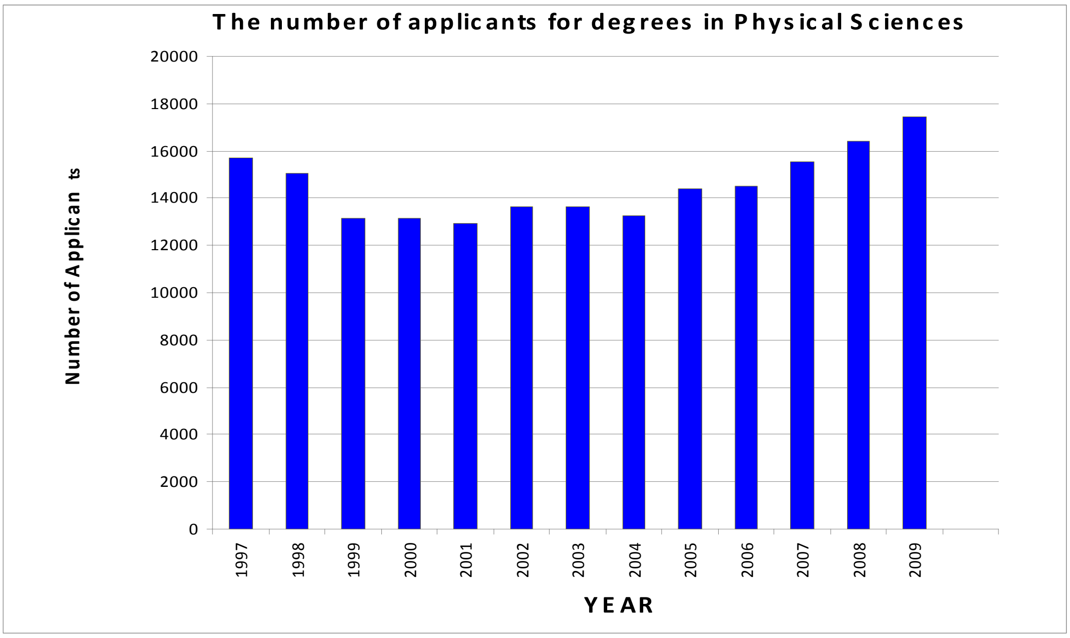
The UKRC for Women is currently conducting research into a number of projects, such as the representation of women scientists and engineers in the media, gender cultures in boardrooms, as well as compiling a European database of research literature about women in SET careers. The UKRC are a lead partner in the JIVE project (Joint Intervention Project) which is sponsored by the European Social Fund, aimed at promoting equal opportunities for women in engineering, construction and technology.

To summarise the findings for part one of this report, it is clear that we need to increase the number of young people who study STEM subjects, whether at GCSE, A level or university. Graduates with STEM skills are particularly employable, yet employers have expressed concern that there are not enough young people in this country who are pursuing STEM subjects up to university level. If we do not address this situation, then graduates from STEM subjects will need to be recruited from abroad in order to address potential skills shortages for employers. At each stage of the educational ladder, the gender imbalance in STEM increases, with women being in ‘a leaky pipeline’ (UKRC website, 2011). One direct way of increasing the number of STEM graduates is to explore the representation of women at each stage of education and ensuring that girls have as much opportunity as possible of fulfilling their potential in STEM subjects.

Part 2: Assessing the progression trends for physics degrees

UCAS provides statistical information on the website from 1996 to present. Since 2002, UCAS have used JACS (Joint Academic Coding System) for classifying subjects, where broad subject areas are represented by letters and then the detailed subject of study is represented by a letter and a number. For example, subject group F represents the physical sciences, which are mainly physics and chemistry. Chart 1 displays the number of applicants for physical science degree courses from 1997 to 2009. It was interesting to see that after a maximum peak of students in 1997, with 15,371 students, this decreased to a minimum in 2001 of 12,995 students, then increasing gradually to a new peak in 2009 with 17,458 students. (UCAS Statistical Services, 2010) We can also compare the number of applicants to the number of accepted students in each subject group, with further analysis of the number of male and female applicants.

Chart 1: The number of applicants (UK) for degree courses in physical sciences (1997 to 2009)



(UCAS, 2010)

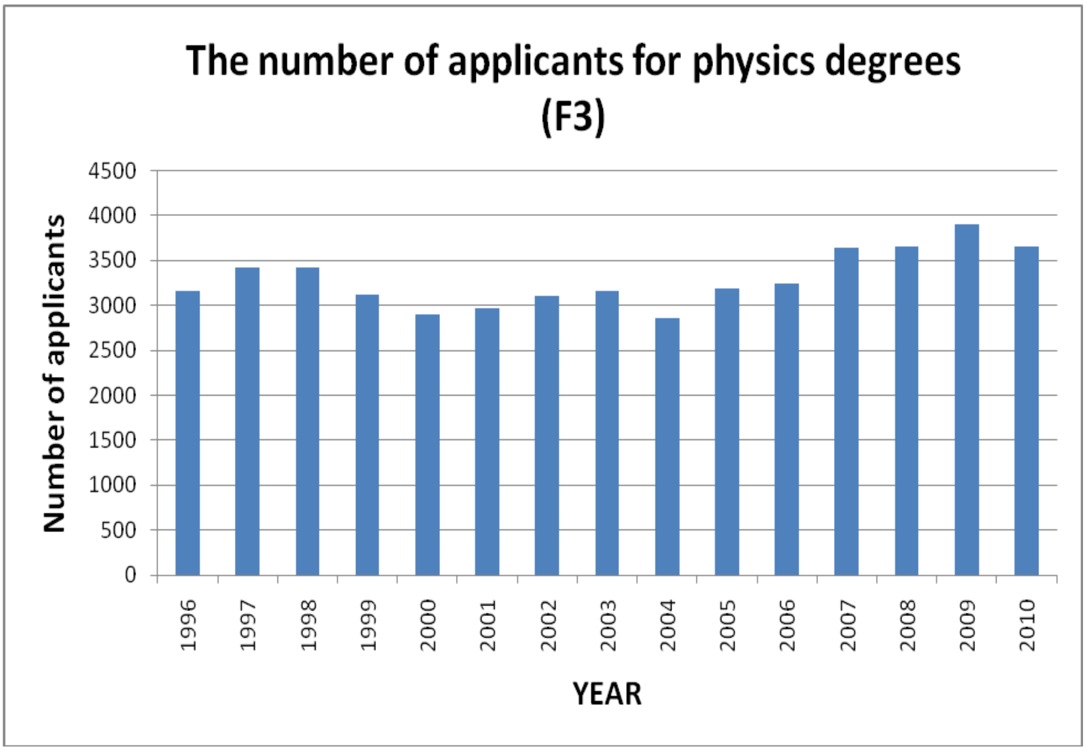
Table 2: The number of applicants for particular UCAS subject groups (2009)

Subject Group	Number of applicants	Male	Female
A Medicine and Dentistry	21,682	9,640 (44.5%)	12,042 (55.5%)
C Biological Sciences	40,805	17,002 (41.7%)	23,803 (58.3%)
F Physical Sciences	17,458	10,572 (60.6%)	6,886 (39.4%)
G Mathematics and Computing	29,362	22,804 (77.7%)	6,558 (22.3%)
H Engineering	28,269	24,833 (87.8%)	3,436 (12.2%)
L Social Studies	47, 511	18,668 (39.3%)	28,843 (60.7%)

(UCAS, 2010)

The table above (Table 2) shows that whilst the proportion of women who pursue degree courses in the physical sciences is rather low at 39.4%, it is not as serious as the under-representation of women in subject groups G (Mathematics and Computing) and H (Engineering). The UCAS data can be analysed further to determine the number of students who have applied for degrees in physics (UCAS code F3).

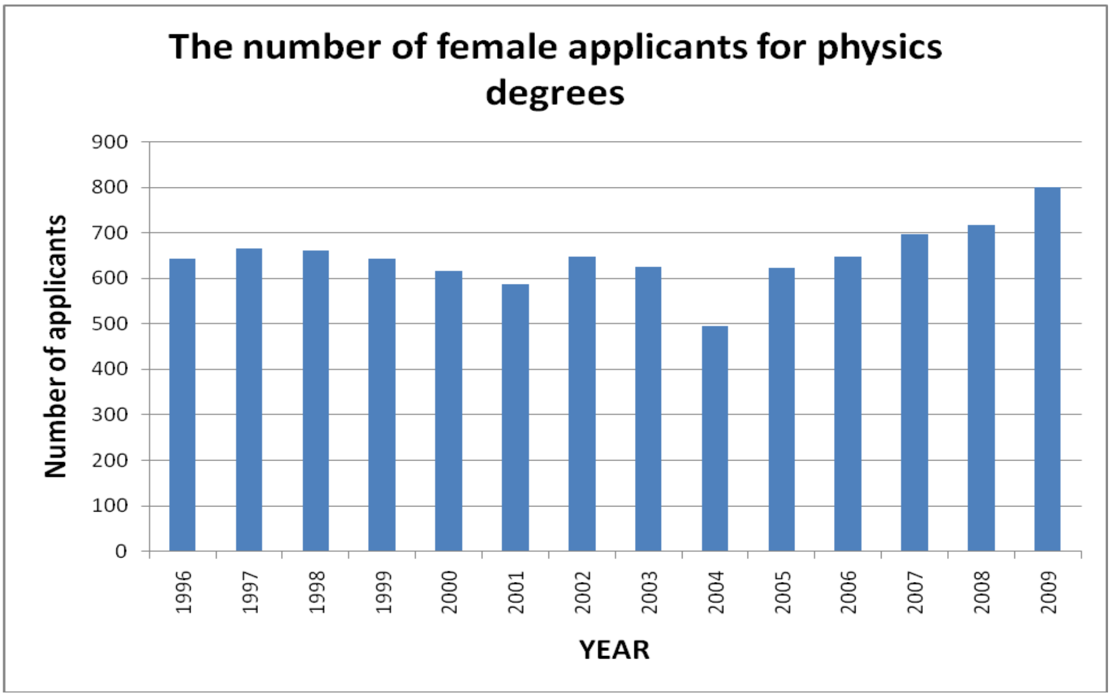
Chart 2: The number of applicants for physics degree courses (1996 to 2010)



(UCAS, 2010)

In 2009, there were 3,900 applicants for physics degree courses in the UK, but recent data (UCAS, December 2010) indicates that the number of applicants decreased to 3,657 in 2010.

Chart 3: The number of female applicants for physics degrees (1996 to 2009)



From Chart 3 above, it could be interpreted that the number of girls is increasing, but when this data is further analysed, the proportion of women remains the same throughout this period at 19% (+/- 2 %).

In 1996, 643 girls applied to study physics out of a total number of 3166 (20.3%)

In 2004, 495 girls applied to study physics out of a total number of 2859 (17.3%)

In 2009, 800 girls applied to study physics out of a total number of 3900 (20.5%)

The data for specific subjects can also be analysed in order to determine the proportion of men and women who have applied for each course.

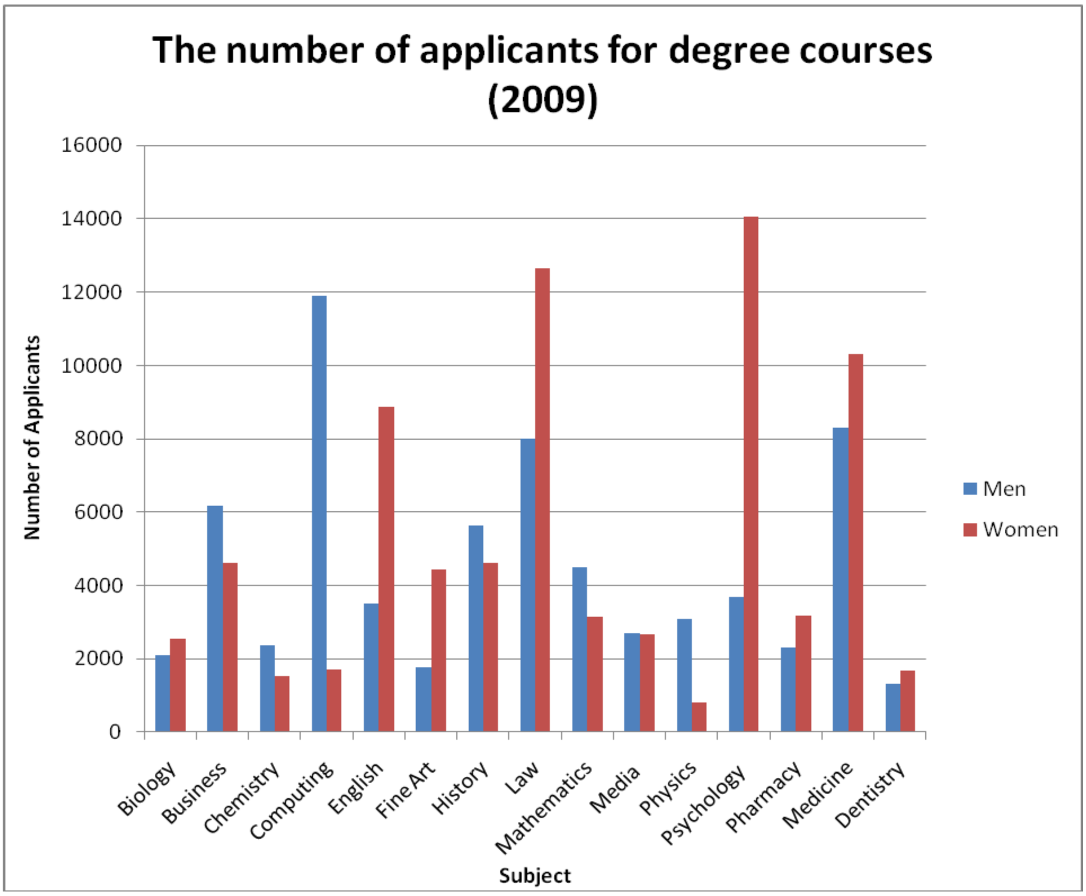
Table 3: The gender balance of the subjects within the physical sciences group (2009)

Subject	Total number of applicants	Number of male applicants	Number of female applicants
Astronomy (F5)	96	67	29 (30%)
Chemistry (F1)	3894	2358	1536 (39.4%)
Forensic and Archaeological Science (F4)	1794	618	1176 (65.6%)
Geology (F6)	1523	1013	510 (33.5%)
Physics (F3)	3,900	3,100	800 (20.5%)
Aquatic and Terrestrial Environments (F7)	1183	645	538 (45.5%)
Physical Geographical Sciences (F8)	3,797	2,063	1,734 (45.6%)

(UCAS, 2010)

The only branch of the physical sciences where there is a greater proportion of women is in forensic or archaeological sciences. The number of applications for the subjects within the physical sciences group must be viewed in context with the number of applicants for other subjects. In 2009, there were a total of 639, 860 applicants for all degree courses in the United Kingdom. Psychology (17,761), English Studies (12,379) and Sport Science (11,894) were some of the more popular subjects for 2009 university applications. The following chart shows the gender bias of different degree courses.

Chart 4: The number of male and female applicants (UK) for degree courses (2009)



(UCAS, 2010)

From the data in Chart 4, it can be seen that from the 'pure' subjects, English, Fine Art, Law and Psychology have a greater proportion of females applying for these subjects. Why is there still a gender imbalance in subject disciplines in the twenty first century?

For this evaluation, I have also included some of the vocational courses which may be studied as direct progression from the study of science at A level. In Table 2 of this report, it was shown that subject group A (all medicine and dentistry courses) have 55% of the applicants being female. As can be seen from Chart 4, there are a substantial number of women who are pursuing careers in pharmacy, medicine and dentistry, so it could be argued that the girls who study science subjects at A level are attracted towards more vocational courses than purely academic science degree courses. According to JCQ, there were 20,571 girls who sat A level Chemistry in 2009. Of these, 10, 323 have gone on to study medicine, 3,166 to study pharmacy and 1,679 to study dentistry, whilst only 1,536 girls chose to study for a degree course in chemistry. (JCQ, 2010)

Despite the progress that has been made over the past fifty years to encourage equal opportunities, with many of the barriers to traditionally male dominated professions (e.g medicine) being removed, it seems that girls are still not attracted towards the study of physical sciences at university, with physics as an important subject within this group.

The '*SET for Success Report' (2002)* and others which have followed, have identified a need to increase the number of students for STEM subjects. It can be seen from the UCAS statistical data that physics is not a popular choice for young people, compared to many of the other options available. It is clear that one of the ways in which we can increase the number of physicists is to address the issue of why there still a gender imbalance in physics, particularly considering all of the initiatives, strategies and interventions that have taken place over the last thirty years.

University Courses in the region

We clearly need STEM graduates, yet in this part of England, only one of the five universities in the region offers undergraduate degree course in physics. In order to preserve anonymity, the local universities will be referred to as Universities A, B, C, D and E. Universities A and B are both Russell Group universities, each approximately ten miles from the FEC, with University A being the most selective and prestigious. Universities C, D and E are all 'new' universities, with C being ten miles away, D being the most local university and situated within the city, and E is approximately forty miles away.

University A has a flourishing, internationally renowned physics department but applicants must have very high grades to merit a place at this university. Physics is no longer offered at any of the other four universities. Upon my query as to why University A could still offer physics at undergraduate level when other local university departments had closed, the Admissions Officer offered the following information:

> 'I think the most important thing here is critical mass – to survive these days, you need to be a reasonably-sized department, I would

> say of the order of 30 academic staff. We have built up from that level to our present number of approximately 50 academic staff over the last 10 years or so.'
>
> (Private email communication, October 2008)

The Admissions Officer explained that if a department is too small, then it is difficult to attract research grant income which then affects the range of courses that a department can offer to undergraduates.

University B ceased offering degree courses in physics in 2004, with the last physics students graduating in 2007. Whilst some physics courses have been offered within the Natural Science degree programme, the course has not been available as a separate degree subject since then. There have been some postgraduate physics research opportunities but only within the Natural Science department. The Science Recruitment Officer for University B replied to my queries:

> 'When the decision was taken a few years ago to downsize the department of physics and reorganise our teaching, this was a result of decreasing demand and admission to the course, coupled with an urgent need for capital investment in the school. The figures just didn't add up and as such the department was forced to significantly downsize and became part of the larger School of Natural Sciences during the last reorganisation of the university in 2003/2004.'
>
> (Private email communication, January 2009)

At University C, physics has not been available as a degree subject since 1999 and it is unlikely to be reinstated in the near future. One of the former lecturers in physics explained that in 1999, the physics department scored 23/24 on the QEA scale of rating university departments and that physics was one of the two best departments in the university (the other was modern languages, which also closed). The courses on offer were Applied Physics and Optoelectronics but the number of UK students who applied for these courses was very low indeed. These courses were strongly subsidised by a cohort of French students who came to England for the last year of their degree programme. In 1999, there were six physics lecturers, four of whom were near to retirement age. Rather than recruit new staff and build up the department, the university saw this situation as an opportunity to cut costs and therefore closed the department. The two lecturers who remained in the department have been transferred to other courses, such as microelectronics and masters programmes.

At University D, certain aspects of physics are taught within the engineering programmes, but it has not been taught as a separate subject for many years. The Head of Faculty explained that one of the constraints is the need to recruit sufficient students in order to make a course financially viable. He further explained that despite a number of initiatives that have been aimed at STEM subjects, he believes that it is questionable whether any of these have made any serious impact (Private email communication, May 2009).

University E offers science degree programmes in biology and chemistry, but not physics. It offers a range of vocational health-related degree courses as well as programmes linked to the environment and engineering.

Therefore, of the five universities in this region of England, only one university offers an undergraduate physics degree course. Whilst this university has a flourishing physics department, the entry requirements are particularly high and may be prohibitive for the vast majority of our students. As many of our students need to live at home for the duration of their degree course, choice of university degree programme may be confined to what is available to study within this region.

Part 3: FEC Progression to university

UCAS provides each institution with a statistical breakdown of the destinations of their applicants. Whilst conducting this research, I was told that the FEC holds data from 2006 to 2009. In order to extract more source material, I obtained the data for 2004 and 2005 from another source within the FEC. The college does not hold any information on the destinations of students prior to 2004, thus preventing a more rigorous or longitudinal analysis of subject trends.

As mentioned in Part 2 of this report, UCAS classifies all university degree courses into subject groups, where Group F is for ‘physical science’ which includes all courses related to physics and chemistry. Group C is for subjects related to biology, but extends to include environmental and sports science courses. Evaluating the data from 2004 to 2009, I determined the number of students who progressed from the college into science courses at university. As can be seen from the table below, the number of students who appear to study science seems rather low, so a second table (Table 5) was produced to consider some of the wider vocational courses that can develop from the study of A level science subjects.

TABLE 4: The number of UCAS applicants from the FEC for science degree courses

YEAR	BIOLOGY	CHEMISTRY	PHYSICS	TOTAL APPLICANTS FROM C.O.S.C.
2004	3	4	2	348
2005	5	10	0	467
2006	1	7 *2 Natural Science	2	611
2007	7	4	1	606
2008	0	3	3	683
2009	1	6 * 2 Natural Science	0	666

In Table 5, we consider progression to subject groups A (medicine), Group B (medically-related courses such as pharmacy, biomedical sciences and specific health related careers) and Group H (engineering).

TABLE 5: The number of UCAS applicants from the FEC for vocational degree courses related to science

YEAR	MEDICINE	PHARMACY	BIOMEDICAL SCIENCE	HEALTH PROFESSIONAL	ENGINEERING
2004	1	8	4	0	2
2005	3	12	3	1	1
2006	0	8	3	0	0
2007	3	6	6	0	2
2008	1	3	7	0	1
2009	0	1	5	3	4

From this table, it can be seen that vocational courses such as pharmacy and biomedical science are particularly popular with students from the college. It could be argued that having a university in close proximity which has an international reputation for these subjects may be one particular factor, as most of these students progressed to University D (as defined in part two of this report). In 2004, all 12 of the applicants for pharmacy and biomedical science progressed to University D.

For the pure science degree courses, physics is the least popular subject for students from the FEC, however, one of the reasons that students decide upon their choice of future degree course is the local availability of courses. At present, physics degrees are only offered at University A, where students are required to achieve three A grades as the normal entry requirement for the course. For those students who will not achieve three A grades, many decide to study an alternative course rather than study physics away from home. In 2009, only 88 out of 666 (13.2%) students from the college moved away from home in order to study for a degree course, which is evidence of students' preference to stay in the region for their under-graduate degree studies. If we now consider the number of the students who moved away from home in order to study 'pure' science courses:

TABLE 6: UCAS applicants who have moved away from home in order to study science degrees

YEAR	BIOLOGY	CHEMISTRY	PHYSICS
2004	1	1	1 Male
2005	2	5	0
2006	3	6	2 1 Male 1 Female
2007	1	0	1 Male
2008	0	2	3 Male Male Male
2009	0	1	0

During this period, there has only been one girl who has chosen to study physics at university (2006 to 2009, to study Physics with Astrophysics). This girl was brought up in a middle class academic environment with a father who lectured in mathematics at a local university (University D). For this young lady, education was an expectation, not an aspiration. She explained that she had grown up in an environment where she received the support, experience and academic confidence of her family which helped to foster and encourage her desire to study science.

As the FEC is a Widening Participation College, many of our students come from backgrounds that have no experience of university. The college employs an excellent Aim Higher team, with three members of staff whose full time occupation is to arrange events in order to raise the aspirations of our students. For many students, however, it is not necessarily their own fear of moving away from home but the influence of their parents, who may hold deeper fears about the values of a university education.

Research conducted by Reay, Davies, David and Ball (2001) indicate that social class (as well as race, however this factor is outside of the scope of this study) is a predominant factor in choice of university course. They claim that there are 'various mechanisms of social closure which operate to reproduce existing inequalities within the higher education sector'. They discuss the fact that since 1947, there has been a huge increase in the number of places at universities, with the Robbins Report in 1963 encouraging university education based upon ability not social class. By

1996, ‘first time participation’ in higher education had exceeded 33% compared to the 1960s when this rate was below 10%. Reay claims that despite the enormous expansion of higher education over the past sixty years, there has been only ‘a tiny decline in class inequality’ (Reay et al. 2001, pp.855 -874).

Reay (2001) claim that this is due to the fact that since more people are achieving university degrees, this is becoming a standard qualification for many jobs which in the past, did not require a degree qualification. Thus, higher education has played a progressively greater part in the reproduction of the occupationally based class structure. So it is not surprising that class inequalities have persisted (Reay et al., 2001 p.856).

Despite the fact that there are more working class students entering university than ever before, they are entering different universities to their middle class counterparts (p.858). The report claims that despite the growth in university places, a hierarchy of institutions has emerged, with the prestigious research universities at the top. These universities remain ‘overwhelmingly white and middle class in composition’ (p.858).

From the research, Reay found that many working class students have geographical constraints. When interviewing students, they found that working class students ‘were saturated with a localism that was absent from the narratives of more economically privileged students’. (p.861) They also found that students from working class backgrounds were more likely to be engaged in part time employment in order to supplement their income.(p.861)

An interesting point from the research was that while students readily discussed the material constraints upon choice, there were hints of emotional constraints as well. They found that some working class students were afraid of applying to some of the more prestigious universities for fear of ‘not fitting in’ with other students. (p.863)

Reay, David and Ball (2005) extended this study by publishing ‘*Degrees of Choice’*, which outlined some of these factors in greater depth. In the introduction, they claim: ‘We may have a mass education system of higher education in the twenty first century but it is neither equal not common for all’ (p.vii).

Recent research by Sarah Evans (2009) shows that despite the increase in university places over the past decade, there are class based variations according to subject and institution. Evans' research was conducted between 2005 and 2006, and showed that despite the number of university places increasing since 1997, with the middle and upper classes almost all progressing to university, the situation for working class girls posed particular problems: 'for many working class girls, entry into HE is structured by family ties and loyalties' (Evans, 2009, p.341). For many of the working class girls in this category, care for other family members was a particular concern. Evans suggested that many working class girls specifically selected post-1992 universities so that they could live at home and fulfil their family commitments. Evans claimed that students from middle classes did not show the same need to care for their family (Evans, 2009, p.351)

These findings could be applied to students from the FEC, where there are a significant number of students who are the first generation to apply to higher education within their families. Research suggests that caution is taken by working class students, who would prefer to stay local, whether for financial or emotional reasons.

As the entry requirements for a physics degree course at University A are particularly high (at least 3 A grades at A level, possibly higher with the introduction of the A* award in 2010), this degree course is aimed at exceptional, rather than average students. For good students who will achieve strong A level results, but not high enough for entry into University A, then there are no alternative physics degree courses in the area.

This then leads to some students changing their choice of degree course in order to stay in the area. A number of my students have, over the years, applied to University A to study physics as their first choice, but having their second and third choice courses as natural sciences at the other local universities, rather than applying to universities out of the region to study physics. As a teacher who demonstrates enthusiasm and passion for teaching physics, I would like to see more of my students enjoy this subject at degree level but understand that leaving the region is out of the question for many students.

When I first encountered this apparent reluctance to move away from home, I had originally believed that it was a product of the close-knit working class communities within this region. When I contacted the Institute of Physics about this problem, the National Co-ordinator of the Stimulating Physics Network (and editor of Physics Education) informed me that this was a national concern. At the institute of Physics, they use the expression ‘the physics deserts’ to describe areas of the country where there are a lack of physics degree courses being offered. They explained that reluctance to move away from home extended to all areas of the county and that if physics was not offered locally, students would select other options instead (private email communication 9/3/09).

Moving away from home is of particular concern for girls, and this could account for the reason why there has only been one girl who has chosen to study physics in the past few years. The majority of the initiatives that have been developed to encourage more students to study physics, with girls as an important subset of this group, have focussed upon pedagogical practice, yet there are wider factors outside of the control of the classroom that influence the decisions made by young people.

These external influences are the subject of a separate report, which include factors such as peer pressure, parental influence and role models. There are other contributory factors such as the local economy of the region and the wider influence of the media and society.

Conclusion

This report has considered the progression of A level students into physics degree courses at university. In part one, it was outlined why we need to increase the number of STEM graduates, with physics as an important subject within this group of disciplines. Skills in STEM subjects can contribute towards industry and education, contributing towards the future economy and employment markets of the future. The government (as well as other organisations such as the CBI) have acknowledged that we must encourage more young people to study STEM subjects, or we will need to recruit scientists from other countries in order to ‘fill the skills gap’. In order to address the problem, the government has implemented a range of initiatives such as Science Learning Centres in order to improve continuous professional development for science teachers.

The report '*A Degree of Concern' (2006)* recognised the various factors that influence student choice in post-16 education, with the main factors being:

a) Curriculum structure
b) Curriculum content
c) Range of subject options
d) Dynamic subject specialist teaching
e) Quality of careers advice
f) Students' and their families socio-economic background
g) Perceptions of science and scientists such as those promulgated by the popular media
h) Relative subject difficulty (Section 4.1.1)

From this list, d is the most relevant to the practising classroom teacher, although good teachers can contribute towards factor e by providing informed careers advice, as well as factor h, by ensuring young people receive correct information. The other factors on this list may be beyond the control of an individual teacher, but it is important to be aware that there are many factors to consider and there is not a simple solution.

In part two of this report, the national progression rates of students into physics degree courses was considered, showing that one of the most significant ways of increasing the number of physics graduates is to address the issue of why women are still under-represented in physics degree courses. Whilst women have increased participation in many traditionally male dominated professions such as law, business and medicine, careers in physics and engineering are still male dominated. Whilst the proportion of women who study physics degrees remains at a consistent level, there are a greater proportion of women who study other physical sciences such as chemistry, geology and astronomy. Within the north east of England, only one university offers undergraduate courses in physics (University A), as this subject has ceased in other local universities.

Within part three of the report, the progression of students from the FEC was discussed. Whilst there are a small number of students who pursue science at university, the number of students who chose to study physics is an even smaller subset of this group. The reasons could stem from a simple extrapolation of the low number of students who study A level physics at the college, to other factors such as the choice of a more vocational subject at university. Pharmacy, in particular, is a popular option for science students. Another factor could be that most of our students find it difficult to move away from home in order to study for a degree course. For a range of reasons, whether financial or family commitments, choice of degree subject is strongly influenced by what is offered at local universities.

Despite the fact that science leads to excellent employment opportunities in the future, we need to increase the participation of young people with A level and degree courses in science. Whether this involves working with our partner schools, utilising external initiatives such as STEMNET or reflecting upon our own classroom practice, we must endeavour to increase the participation of young people with science. Despite all of the initiatives and incentives that can promote science, there are many wider influences which must also be addressed, such as the influence of family, peers, and the media.

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Report Evaluation Form

REPORT:

The progression of A level students into physics degree courses

Position:

Head of Sixth Form, FEC

Comments on the report:

It would be useful to consider the vocational science courses, for example pharmacy, in your discussion of university courses.

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

Do pupils in our partner schools ‘like’ physics?
Could it be that the high grades required at university are a barrier?
What about career / job prospects with physics?

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

The reasons that apply to students from the FEC could also apply to other colleges in the area.

Marianne has been working with the IOP consultant to explore ways of encouraging more young people to study physics.

Marianne has arranged several university events to encourage A level students to consider studying physics as a degree subject. We held a research roadshow earlier in the year, where PhD students from a local university came to train our students in the use of university apparatus.

Signature:

Supplied

Report Evaluation Form

REPORT:

The progression of A level students into physics degree courses

Position:
Consultant from the Stimulating Physics Network
Institute of Physics

Comments on the report:
This is again a comprehensive review of literature and an interesting report of progression from A-level to university for physics students from the FEC. Again the report raises questions (detailed below) not all of which are easily answered, and some of which may be outside the scope of this report.

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

In the first draft of your report, you mention the four universities within fifteen miles of the FEC, however if you include (University E) in your study, this will outline the courses available in the north east of England. This makes more of a point, since (University E) does not offer physics degrees. Therefore there is only on university in the whole of the north east of England (University A) and this university asks for extremely high grades.

Although pure science degrees are considered there are course such as engineering which require prior physics qualifications. Do any students progress to these courses?
It would be useful to know the specialisms of teachers in the 11-16 schools. How many are physics specialists and by whom and how is physics teaching delivered? Again, as in the related report, it would be useful to have some insight into the careers advice delivered in schools.

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

I have passed the report (with Marianne's permission) to members of the education department at the Institute of Physics.
I have also asked the editor of *Physics Education* if he would be interested in an article based on this report.

I would like to discuss with Marianne the possibility of staging a physics careers activity at the college for local 11-16 schools and also a the hosting of an event for heads of science and other teachers from local schools to look at physics resources and particularly careers material.

Signature: Supplied