Action Research Project 2015

Why is there a gender imbalance in economics and physics at A-Level?

How do we motivate female students to take economics and physics at A-Level?

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Rationale

One of the major social issues in the UK today is the pay gap between men and women. UN statistics show that women earn, on average, 23% less than men in[1] part because of a lack of representation in STEM subjects. The choice of A-level and degree subjects is recognised by many schools and universities as being a key factor in the career that young people ultimately pursue and although taking a change in career is becoming more common, there is still a strong correlation between a graduate's degree and the industry into which they enter (See appendix 1 and 2). Some of the most well paid graduate jobs in the UK today are engineering or finance related[2], careers which are often accessed through the study of physics and economics respectively. However there are simply not enough female graduates in these subjects, resulting in only 9% of the engineering workforce in the UK being female[3] and males dominating the managerial/professional roles in the finance industry[4]. It stands to reason then that if we are going to improve this situation we must encourage participation in these subjects at A-level. Even if students to not wish to pursue these career paths, these subjects provide extremely useful analytical skills highly valued by universities. At Rainham Mark Grammar School in 2015/16 females make up almost 50% of the year 12 intake but account for only 20% and 24% of economics and physics students respectively, with similar figures for the two previous intakes. This raises the question of why female students do not want to take physics and economics at A-Level, and perhaps more importantly what can be done to change this?

[1] Rodionova, *Independent,* 2016
[2] Osborne, *Independent,* 2015
[3] Metcalf & Rolfe, National Institute of Economic and Social Research, 2009 (p32)
[4] Anon, Women's Engineering Society, 2016

Methodology

In order to collect data as efficiently and as accurately as possible, we decided to use a range of techniques. Primarily, we decided to use focus groups as they are an effective data collection method useful for finding detailed information about people's feelings and opinions towards subjects. This allows better clarification with a broader range of information to analyse. Following this, we created statements for a diamond nine exercise and a questionnaire based on the ideas from the focus groups. Diamond nine exercises are beneficial to use because they show the priorities of the respondent but also restrict the responses to allow us to collect the most relevant data. The questions for the questionnaire on the other hand, allow for the respondent to expand on their opinions. We decided that our next step would be to do interviews, with year 12 girls who had decided not to pick economics or physics for A level. We used specific questions but with prompt words so that the responses would be in detail and that the answers were open-ended. This format meant that there was a wider scope for data analysis and for finding ways to correct the problems that have surfaced through our other data collection methods. Based on our results, we decided that the last data collection method would be to observe some lessons. This was a useful step because we saw first-hand the types of techniques and teaching styles that were used by teachers highlighted as good practitioners by the female students we interviewed. We also discussed these observed lessons with the students as well to get a second opinion. Using this range of methods allowed us to triangulate our research such that we can be more confident in the validity of our results.

Focus groups

We arranged groups of between four and five people by using the school database so that we had several groups of males, female and mixed groups from year 12 and 13. We chose this age range because they had already made their A-level choices and we wanted to know their reasoning behind their decisions and the opinions of both economics and physics students at A-level. We decided to use separate gender groups because our question is about females so we wanted to see if the females' opinions differed from their male colleagues. The question asked was: 'What are your opinions around the subjects: physics and economics?' In order to expand further on the initial ideas given, we arranged a second set of focus groups with year 11 who hadn't chosen to do economics or physics at A level to see if similar reasons as the older groups were repeated. We questioned the students' answers so that they could develop and expand on their opinions, giving us more specific data to work with. (See appendix 5)

Diamond Nines and Questionnaire

For this type of data collection, we picked sample of year 11 girls to put nine statements in order of importance (See appendix 4) - we decided to do these anonymously so then they would be as truthful as possible, which has hopefully led to the data being less biased. (See appendix 6). On the back of the Diamond Nines we placed a questionnaire, where the students were then able to write their own opinions based on several questions. By asking the students to complete the questionnaire we were able to get more refined results and potential solutions to solving the gender imbalance seen in economics and physics at A level. For example, one of the research questions was 'How do you think subjects could be made to appeal more to year 11 girls?' The results from this would give us a better insight to the solutions but also would allude to the original problems as well.

Interviews

We decided to interviews year 12 girls who had decided not to pick economics or physics to help us understand their reasoning behind their choices and whether they think their gender was a large influence on their decision. The importance of this face-to-face interview with someone of their own age may mean that they were willing to be more truthful. We planned to use their responses as our starting points to finding solutions to the problems that have come to light.

Observations

After receiving the feedback from the interviews with pupils, several teachers were mentioned as to who makes lessons noticeably enjoyable for female students such as Miss Gale and Mrs. Walker. From this we decided to arrange to observe their lessons. Our preferred age group to observe was year 10 and 11 because they would be deciding on their A level choices so were the most fitting in relation to our question.

Data Analysis

When carrying out the different methods of data collection stated above there were some specific themes that reoccurred in the responses of each person.

One view among female students was that both economics and physics were "boring" subjects based on their previous experience, especially at GCSE; and therefore they would expect this to be the same at A-Level. An example of this was seen during the Diamond

Nine exercise, as the majority of students placed "boring at GCSE/expect it to be boring at A-Level" at the top of their diamond. This was then reinforced during the questionnaires and interviews as a large number of the female students interviewed used the phrase "boring" to describe the subject at some point during the interview and all but two students used the same phase to answer the question "Why do you think that there is a big difference between the number of girls and boys that chose economics and/or physics?". However, these views, i.e. the difficulty of the subject and the fact they saw it as boring, appear to be shared by both males and females.

The theme of difficulty was also very common throughout the duration of the research project, when asking both male and female students. The common link between maths and both economics and physics was something that almost all of the students that took part in the research were aware of. During the interviews all the interviewees had made the link between the subjects, especially physics, and the fact they have high maths content. This was usually followed by the recognition that physics and maths would be classed as challenging subjects. It is possible that there is a link between this and the fact that the teachers which were then suggested as having enjoyable or interesting lessons did not teach subjects which were commonly associated with maths. It is for this reason that it needs to be questioned what exactly the reasoning is for Economics and Physics being deemed as difficult or boring in many student's eyes. It is also possible that the idea of difficulty stems originally from GCSE, as when asked how they went about choosing the subjects to study at A-Level some female students explained how they chose the subjects that they achieved highest in at GCSE.

One of the issues raised which was only mentioned by the female students was the issue of the quality of teaching. During the focus groups this response was the main factor that

differentiated the all-female groups from the all-male groups, and when asked during the diamond nine exercise, this also scored highly with the students asked. Although it is unclear exactly what makes the teaching quality viewed as poor by the female students some information can be gained from the results of the observations. One common theme between all the teachers whose lessons we observed was that they had significant levels of interaction with their students; ranging from one to one discussions to whole class discussions that were initiated by the teacher. It is possible that this links to the positive energy that all the teachers appeared to have. This attitude from the teachers involved helped to create a warm atmosphere within the classroom with what appeared were often subtle things; such as how they would often expand on points in class, even if the responses given were not relevant. This causes the students to feel that they all had something to contribute to the lesson and that they were equal with their classmates. It is also possible that the creation of this learning environment is achieved through the conversational tone of the teacher, allowing students to relax in the lessons. Overall, it was clear that through these observations students felt comfortable to raise questions in class. The variety of different teaching techniques used was another feature that was common through the observations. An example can be seen in one teacher's lesson where the students were encouraged to discuss topics further using A3 sheets of paper to 'thought-shower' their ideas on their tables.

In contradiction to one of our original thoughts on why female students may be put off taking economics or physics as an A-Level subject we found that during the diamond nine exercise; none of the students asked, placed 'Male-dominated' in the top few places. This was also further emphasised in the interviews, where one student commented that they believed there was no gender bias; and when asked the question: 'Do you feel that there needs to be a larger female influence in the subject?' they believed that the cause is a

biological reason, "that males are just naturally better at these subjects than other candidates.". It was these comments that highlighted that the proportion of male to female students taking a subject is not an important factor when choosing A-Level subjects. As part of the interviews it was also apparent that although it may not be the reason for a female student not choosing either subject, students interviewed did state that they felt there needed to be a larger female influence when learning the subject, whether this be from female teachers, mentors or role models.

The final factor that appeared to have an effect on a student's selection of A-Level subjects was their career aspirations. This was first raised during the focus groups and during the questionnaires", when asked: 'For the subjects you chose what do you think was the main factor influencing your decision?' the majority of the students linked it either to the subjects they were good at, or their future career prospects. This was further highlighted during the interviews, where most students claimed that economics in particular was simply not relevant enough to what they wanted to do. It was also illustrated that most of the students asked felt that aside from being boring their career prospects put them off choosing the subject, even as an AS option.

Evaluation

It is clear from the results that our original hypothesis, stating that: female students are less likely to choose to study economics or physics at A Level than their male counterparts, due to the stereotype of the subjects being masculine, or male dominated, has been disproven. This was clearly illustrated in the early stages of the research, mainly during the

Diamond Nine stages. However, it was also indicated during the original mind mapping stages as it was not a point that came up within the majority of the female groups.

It is well known that stereotypically, male and female students learn best in different conditions and usually have different methods of working. It is possible that this is part of the reasoning behind the idea of both physics and economics as being boring or difficult subjects, as well as possibly explaining why female students felt that the quality of teaching in these departments is partly to blame. However, from the results gained it is not yet clear what is meant by either of these responses as when questioned further on this point, students' responses tended to be vague and contradictory – ranging from resources, to style of teaching to the decoration of the room. It may be that further research is therefore needed to explore this further.

However there are some causes of the gender disparity seen in these subjects that are clear from the results gained. One example is the fact that the majority of both male and female students involved throughout the study explained that, at least part of their motivation for choosing the subjects is based on career aspirations. It is possible to suggest that more needs to be done to emphasise the variety of career opportunities a degree, but more importantly an A-Level, in either physics or economics can lead to. In theory this can allow female students to become more aware of the act there are opportunities outside of the stereotypical career paths associated with these subjects. It may be helpful to expand the roles of female senior students in these subjects to provide more visible role models for their younger colleagues.

Ethical Issues

Students were informed of the purpose of the research and gave their explicit, informed consent by completing the questionnaires and interviews. The individual identities of those who were involved during each stage of our research have been kept confidential. Therefore we believe there were no ethical problems.

Methodological Issues

Throughout our research we have used both quantitative (diamond nines) and qualitative (focus groups) methods, which meant that we were able to gain a large amount of data. We would consider our data fairly reliable as we managed to gain access to a large amount of students ranging from year 10 to year 13. However we did come across issues of representativeness, as some students were unable to take part in the earlier stages simply due to the logistical and communication problems inherent in organising groups of students in a working school environment. It must also be noted that students varied on how seriously they took our research, especially on the earlier stages such as the focus groups; furthermore, their own views may be influenced by their peers. However on the scale of our research we would argue that our data, on the whole, is valid and consistent as students reciprocate similar views in every stage of our research, even when asked individually away from their peers.

Conclusion

Whilst this research project has been unable to definitively answer our first question i.e. why there is such a gender imbalance, it has provided enough of an insight to allow us to form several key suggestions as to how we might address the issue. Firstly a greater focus on strategies to boost cooperation and communication in lessons e.g. Kagan techniques. Secondly a concerted effort to inform students of the potential career paths available to economics and physics students (and the rewards available). Finally, providing young female students with more inspirational role models that they can identify with, perhaps utilising female senior students in both the sixth form and year 11 to, for example, mentor younger students or lead all female study groups. This last measure should help to overcome the bias of female students who have come to believe, even if only subconsciously, that economics and physics are 'boy's subjects' and that taking them is contrary to societal norms[5].

It is important to recognise however that the differences in the conditions and environments that best suit female and male students' learning is stereotypical. Therefore care needs to be taken to ensure that any changes made do not alienate female students that are already interested in or currently studying, A-Level physics or economics.

[5] Cartwright, *The Telegraph,* 2013

References

1. Zlata Rodionova (2016) *Gender pay gap*, Independent, [online] Available at: http://www.independent.co.uk/news/business/news/gender-pay-gap-fuelled-by-perceptions-of-motherhood-and-the-lack-of-women-in-tech-report-finds-a6874941.html [Accessed 27 Feb 2016]

2. Samuel Osborne (2015) *Top ten degree subjects,* Independent, [online] Available at: http://www.independent.co.uk/news/uk/the-top-10-degrees-subjects-to-study-for-the-highest-paying-jobs-10509024.html [Accessed 28 Feb 2016]

3. H. Metcalf & H.Rolfe (2009) *Employment and Earnings in the financial sector: A gender Analysis,* [online] Available at*:* *http://www.equalityhumanrights.com/sites/default/files/documents/download__finance_gender_analyis_research.pdf* [Accessed 27 Feb 2016]

4. Women's Engineering Society (2016) *Useful statistics,* [online] Available at: http://www.wes.org.uk/statistics [Accessed 15 Feb 2016]

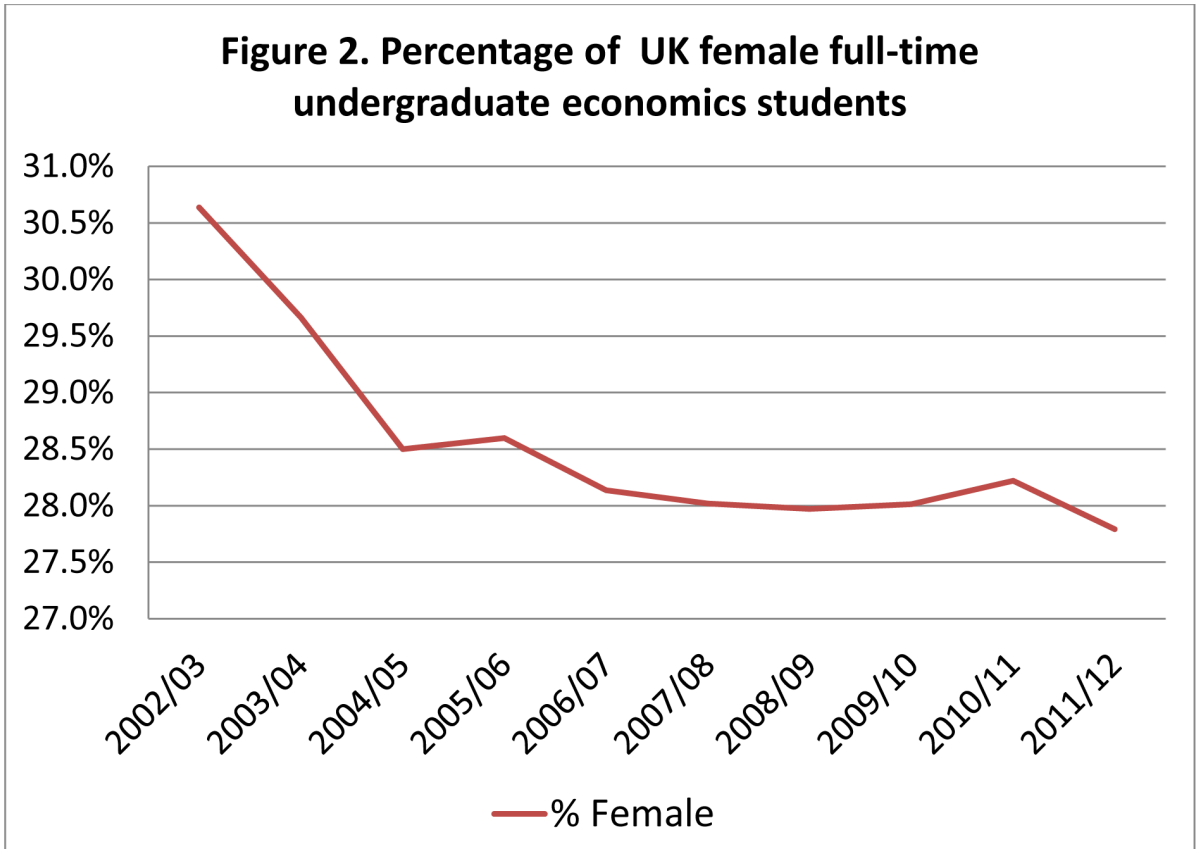
5. Jon Cartwright (2013) *Why don't more girls study physics?*, The Telegraph, [online] Available at http://www.telegraph.co.uk/education/secondaryeducation/9929672/Why-dont-more-girls-study-physics.html [Accessed 27 Feb 2016]

6. Res.org.uk (2016) *More on the gender gap in economics - Royal Economic Society*. [online] Available at: http://www.res.org.uk/view/art2Oct14Features.html [Accessed 12 Feb 2016].

7. *Institute of Physics* (2016) [online] Available at: https://www.iop.org/publications/iop/2012/file_54949.pdf [Accessed 12 Feb 2016].

Appendices

Appendix 1:



Appendix 1: Figure 2 highlights that the fall of 2.8% of female students partaking in an Economics degree, this may be due to the uptake at A-Level in Economics (only 32.4 per cent of the students studying A-level economics in 2014 were girls), and also Maths (only 38.7 per cent of the students studying A-level economics in 2014 were girls) as that is a subject which is often needed to enrol into Economics at university. These figures are particularly low in comparison to the 54.5% of all 2014 A-Level students are girls.

It is also worth noting that the girls studying economics at A-level were more successful than the males (with 35 per cent getting A or A* grades, relative to 29.9 per cent of the males).

Res.org.uk, (2016). *More on the gender gap in economics - Royal Economic Society*. [online] Available at: http://www.res.org.uk/view/art2Oct14Features.html [Accessed 12 Feb. 2016].

Appendix 2:

Degree	Gender	Physics	All subjects
Enhanced first degree	Male	1610	14,485
		78.8%	67.3%
	Female	430	7020
		21.2%	32.7%
Bachelor degree	Male	1525	213,455
		79.0%	45.1%
	Female	405	259,405
		21.0%	54.9%

Appendix 2: The distribution of full-time first-year students between enhanced first-degree and bachelor-degree courses in Physics by gender 2009/10.

It is evident from this table that the uptake in Physics is much lower than males in Enhanced first degree and Bachelor degree. Although it does almost mirror the divide between male and female in the Enhance first degree; in comparison, with the Bachelor degree there should be an uptake of over double the amount of females in Physics than there already is, to mirror the 54.9% of uptake across all subjects.

Anon, *Institute of Physics*, (2016). [online] Available at:

https://www.iop.org/publications/iop/2012/file_54949.pdf [Accessed 12 Feb. 2016].

Appendix 3:

Action Research Questionnaire

Please note that whilst your responses may be used in our final report, any comments will be kept anonymous.

1. Were you influenced by anyone when making your options choices? If so how and by whom?

2. For the subjects you did choose, what do you think was the main factor(s) influencing your decision?

3. Do you think that your decision would change if any of the factors discussed during the diamond nine exercise were addressed?

4. How do you think subjects could be made to appeal more to year 11 girls?

5. Why do you think that there is a big difference between the number of girls and boys that chose economics and/or physics?

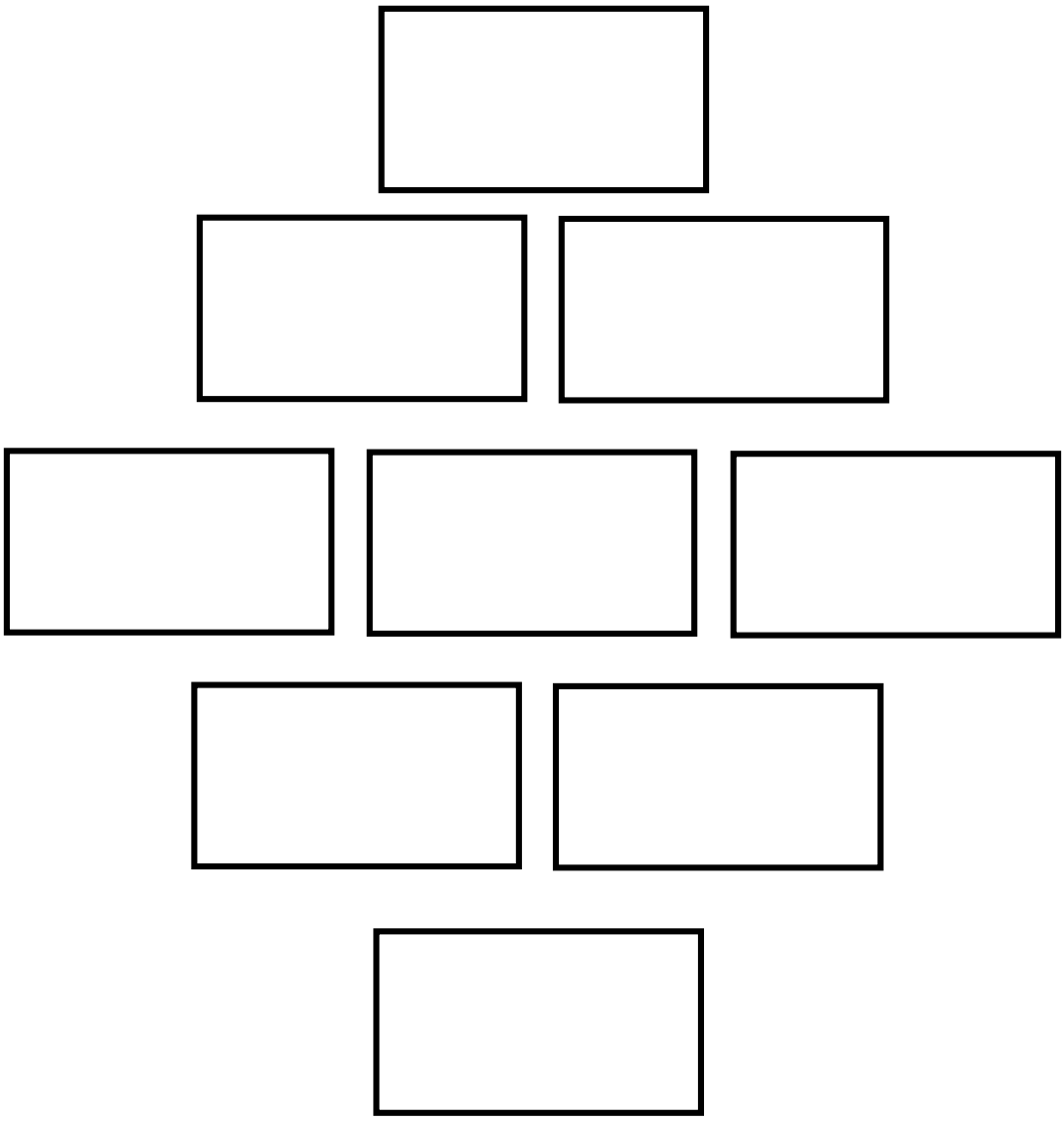
Appendix 4:

Why did you decide not to select Economics or Physics as one of your main option choices?

Answers to diamond nine exercise:

Organise the statements into a diamond shape with the factor that had the greatest influence on your decision at the top.

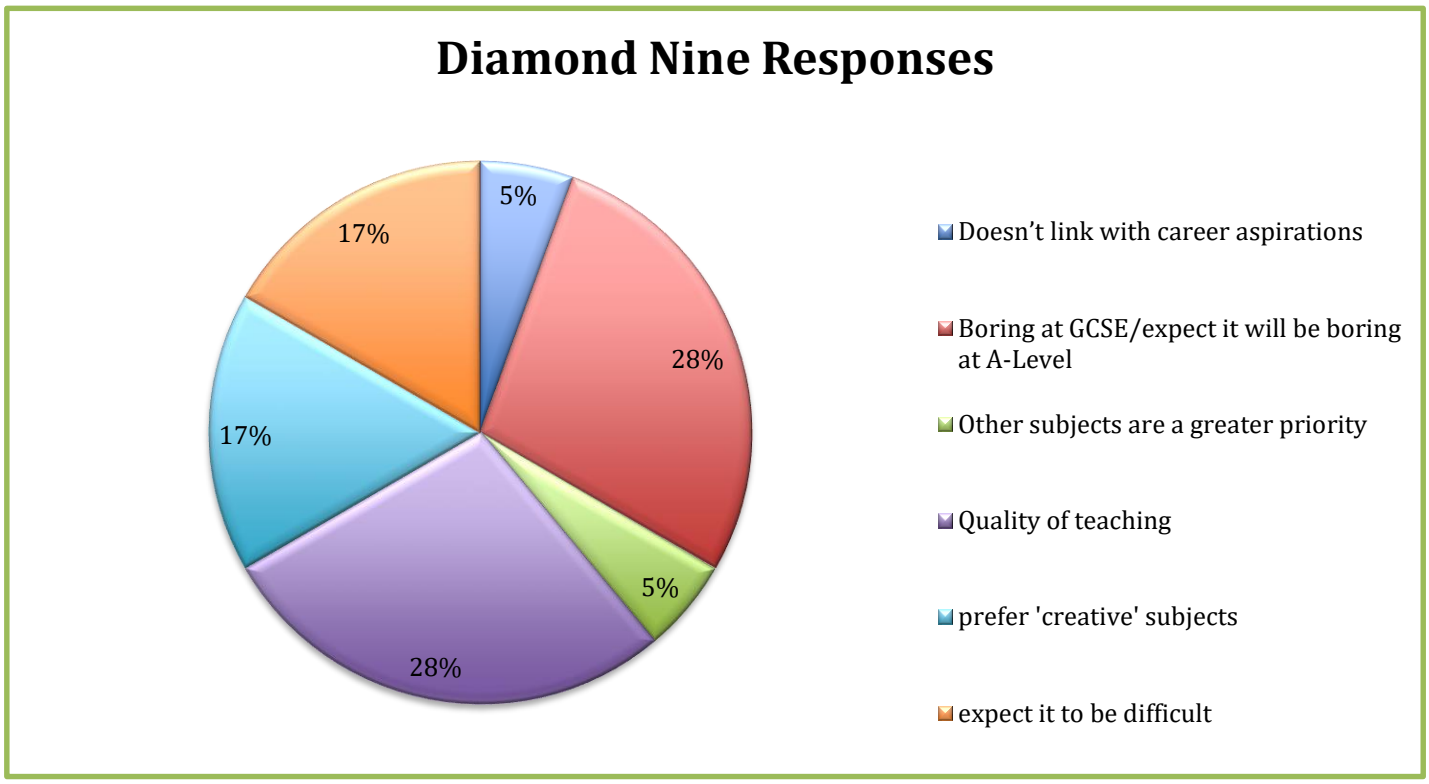
- Quality of teaching
- Boring at GCSE/expect it will be boring at A-level
- Doesn't link with career aspirations
- Other subjects are a greater priority
- Didn't know what the course involves
- Expect subject to be difficult
- It is a male dominated subject
- Prefer 'creative' subjects
- Contains too much maths



Appendix 5:

Appendix 3: As shown in this Wordle, the most frequently occurring results were ideas surrounding the teaching, careers , difficulty (or perceived difficulty) of the subjects and that they expected them to be boring at A-level.

Appendix 6:



Appendix 4: This Pie Chart shows that both the quality of teaching and that the subjects will be (or are perceived to be) boring were the two most important reasons as to why students did not choose the subjects as they- they both share the highest percentage of 28%. Preference and priority were the least popular reasons.

Appendix 7:

Interview Questions –

1. Why do you think that the subject is often described as boring?

   Prompts – difficulty/environment/material/teaching methods/not 'creative'?
2. Which teachers lessons do you most look forward to and why?

3. How did you make your decision as to which subjects to take for A level?

   Prompts – influence of parents/friends etc. **current grades and aspirations**
4. Do you feel you had enough information about subject options to make an informed decision?

   Prompt - career opportunities

5. Do you feel that there needs to be a larger female influence in the subject?

   Prompt – mentors/teachers/role models?

Appendix 8:

Year 12 female intake:

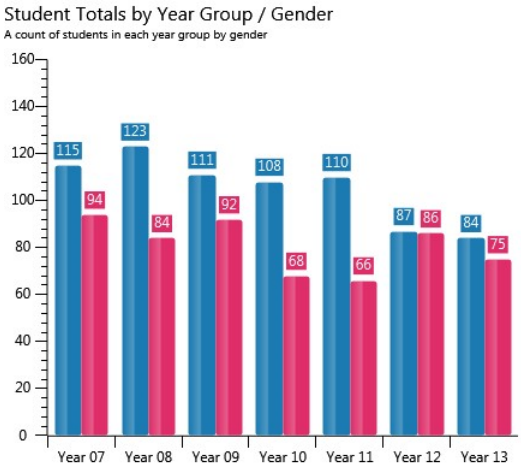
2015/16:
Total 50%, economics 20%, physics 24%

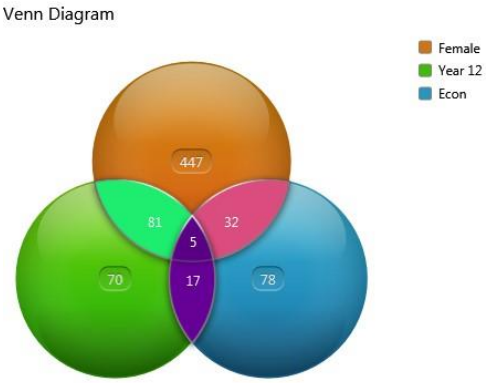
2014/15
Total 44%, economics 21%, physics 23%

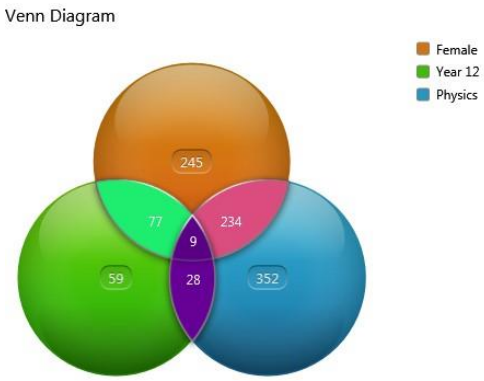
2013/14
Total 48%, economics 30%, physics 20%

Graphs *(taken from RMGS SIMS Discover)*

2015/16:





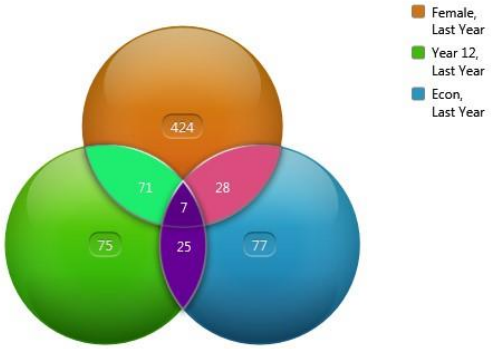


2014/15

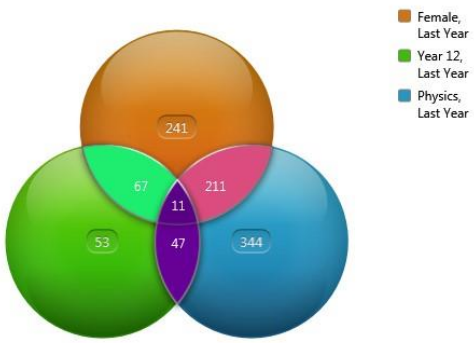
Student Totals by Year Group / Gender [Last Year]

A count of students in each year group by gender

Venn Diagram [Last Year]



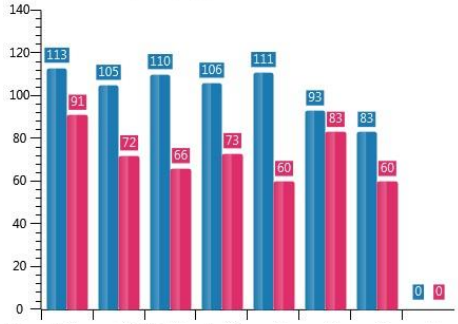
Venn Diagram [Last Year]



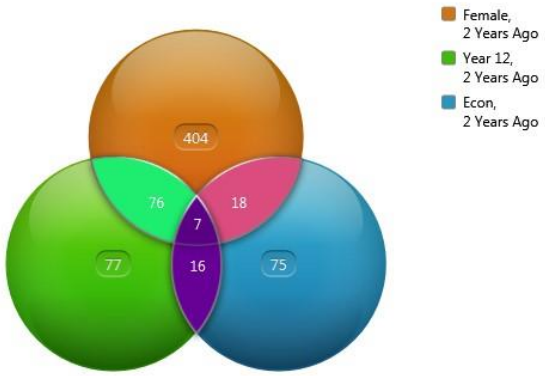
2013/14

Student Totals by Year Group / Gender [2 Years Ago]

A count of students in each year group by gender



Venn Diagram [2 Years Ago]



Venn Diagram [2 Years Ago]