Study of government backed initiatives to promote female participation in physics...

Sociology, Women

Introduction

This essay aims to explore the UK based initiatives designed to promote female participation withinScience, Technology, Engineering and Mathematical (STEM) disciplines focusing predominately on Physics. The essay will consider the different teaching techniques and styles that have been researched and implemented in order to appeal specifically to a female audience and their relative success in terms of encouraging females to pursue both highereducationin STEM based disciplines and careers.

It is noticeable within numerous records and statistics that women in STEM based subjects are under-represented which has lead to an absence of females actively employed within STEM careers. In 2008, women made up only 12. 3 per cent of the STEM workforce. This is, however, an increase of 2. 0 percentage points since 2003 (Kirkup, et al., 2010. Women and men in science, engineering and technology: the UK statistics guide 2010. Bradford: the UKRC) showing that there has been some successful work towards encouraging females towards STEM careers. This under-representation is no more apparent than within the science discipline of Physics, which displays the persistent problem of a lack of girls continuing to study physics beyond the age of 16 (physics is a compulsory part of the GCSE curriculum). It has been recognised that a significant number of girls actually out perform boys at Key Stage 4 within science, but this is not transferred into the desire to study physics into Key Stage 5 (post-16). In 2005, only 14% of girls who were awarded an A* or A for GCSE Double Award Science or physics progressed to A level physics (Hollins et al., 2006). The Institute of Physics have released figures indicating an incremental yearly increase in the number of A level physics candidates between 2006 and 2008 but there has been little change in the proportion of girls that have taken the subject post-16. In 2008, only 22% of the entries for A-level Physics were female (Institute of Physics, 2008). These statistics can be seen clearly in the appendix where the number of female entries in 2008 actually illustrates a decrease in female uptake in comparison to 2007 of -0. 3%. In addition, recruitment to biology has remained relatively stable with more females than males being entered for A-level examinations. Chemistry entries for both male and females are relatively equal andmathematicsstill sees a top-heavy male count, although less dramatically than physics.

There has been an extensive amount of research into the potential reasons behind the consistently low numbers of females within Physics. The development of institutionalised education in England was based on principles of class and gender differentiation (Purvis, 1981) and many scholars attribute existing genderculturetoday to their historical roots where it was the norm for middle class girls to undertake roles as wives and mothers of society's privileged gentlemen. Consequently, physics, with its high mathematical content and often abstract ideas, was a subject thought suitable only to males with girls focusing on the more subjective areas of science such as the moral aspects including religion and how science can be used to improve domestic life. Many still believe connotations of this attitude exist today and while it is important to recognise that although ' educational policy may change, what students, their parents and their teachers have come to understand as appropriate ways for girls and boys to be, to know and to behave, will continue to reflect the historical roots of the culture' (Murphy, P., Whitelegg, E ., 2006). In addition, research by Alison Kelly (1987) identifies three factors that appear to account for a lack of interest by women in science, namely women see it as likely to be difficult, masculine, and impersonal. A number of modern day initiatives and specific teaching techniques have been coined to address these misconceptions and will be explored, with their relative success critiqued, in the remaining body of the essay.

Many initiatives to encourage female participation in science try to address the causes of the phenomena known in academia as the ' leaky pipeline'. The phrase has been devised to illustrate what statistics clearly show, much like a ' leaky pipeline', women steadily drop out of the science educational system, which carries students in secondary education through to higher education and then onto a job in STEM.

Figure 1 illustrates the risks that may be experienced by women already in the science pipeline upon commencement of a STEM basedcareer.

Figure 1: An example of The Leaky Pipeline

Source: International federation of university women [image online] Available at:< http://www. ifuw. org/imgs/blog/blog_leaky_pipeline. jpg> [Accessed 16 April 2011].

Pell (1996) acknowledges that much of the selection between men and women has taken place even before academia is entered arguing that critical phases in the selection towards anacademiccareer include earlychildhood, adolescence, school years and the job entry period. Pell gives development of self-esteem in early life-course, student-teacherinteraction in classrooms leading to lower aspirations amongst girls, fewer female role models, and conflicts withfamilyresponsibilities, as some of the reasons for the ‘ leak’ in the pipeline. Blickenstaff. J (2005) argues alternatively that ‘ no one in a position of power along the pipeline has consciously decided to filter women out of the STEM stream, but the cumulative effect of many separate but related factors results in the sex imbalance in STEM that is observed today’. Many believe the ‘ leakage’ from the pipeline requires a multi-faceted solution, and time is needed to allow modernisations in teaching and learning to take effect, only then will this be evident within the statistics often used to prove such initiatives have failed. It can be questioned whether the merit of such initiatives can so quickly be analysed and concluded as failures if they have not had sufficient time to evolve. For example, the increase of girls choosing to study physics may only see an increase in numbers once teaching practices, academic relevance of the syllabus and functional support networks are truly aligned together and are sustainable. This issue has been further addressed by Cronin and Roger (1999) who debate the focus of various initiatives aiming to bring women and science together. They conclude that many of these initiatives are flawed as they tend to focus on one of three areas: attracting women to science, supporting women already in science, or changing science to be more inclusive of women and hence the other(s) areas are ignored. A. Phipps (2008) reasons that the ‘ important initiatives designed to address the problem are under-researched allowing little opportunity for educational practitioners, activists, policy-makers and scholars to analyse and learn from the practices and policies that were developed over the past decade’.

Outside of the classroom, many initiatives and organizations have been set up to encourage, support and engage women within STEM careers. One of the most well-known and long running initiatives, Women In Science and Engineering (WISE) was founded in1984. The aim of WISE, as it is more commonly known, is to encourage the understanding of science among young girls and women and achieve an overall impact capable of promoting STEM based careers as both attainable and stimulating for women. WISE deliver a range of different options and initiatives in order to achieve their inherent strategy and openly work with other organisations, where appropriate, in a bid to accomplish this. They provide many resources for girls, teachers and parents. These various resources and much more can be found on their website . It has been noted that there is inadequate work appraising the impact of WISE policies since the organization began. Phipps (2008) suggests that ‘ although school visits by WISE did have a positive effect on girls’ opinions of science this was not translated into long term change in their career ambitions’. Alternatively, WISE claim that an increase in female engineering graduates, from 7% in 1984 to 15% today, can be attributed to the success of the campaign believing that the WISE programmes inherent accomplishments can only be measured using the proportions of engineering students and engineers who are female (WISE, 2010). To date, however, there has been no onward tracking of participants from the WISE outlook programme. This leads others to be more critical with Henwood (1996) claiming WISE have ‘ inadvertently limited the ways in which girls and women could discuss the challenges they faced’ and with no detailed research evaluating whether various actions and policies by WISE have produced the impact, it can be hard to attribute the growth to WISE without questioning whether these were a result of other elements present at the time. Phipps (2008) echoes this uncertainty stating ‘ it is difficult to definitely conclude that WISE policies have been the decisive or contributory factor in encouraging female participation in scientific careers’.

The UK government is committed to remedying the current situation assisting with the launch, in 2004, of the UK Resource Centre (UKRC) for Women in SET (science, engineering and technology). This organisation aims to provide practical support and help in order to encourage more women to take up a career in STEM (UKRC, 2007; Wynarczyk, 2006, 2007a). It must be noted that the UKRC is principally concentrated on the participation of women in STEM careers and itsresponsibilitydoes not include education. The UKRC is prominent in collecting evaluative data to allow the programmes attainments to be monitored, this includes recording the numbers of women with whom it has engaged in its work, in addition to statistics on the outcomes for returners in its programmes (UKRC, 2010).

Many have criticized the large number of non-governmental organisations and initiatives involved in the STEM sector stating that the process is disjointed and ungainly with the consequence that some policies and initiatives may be unable to reach their full potential. The STEM Cross-Cutting Programme also concluded that ‘ at the current time there are far too many schemes, each of which has its own overheads’.(DfES, 2006a: p. 3). Despite this, the Government has markedly increased its STEM education budget and the activities in which it supports, in an attempt to reverse the current STEM trends. This includes cash initiatives to encourage more physics trained teachers, (Jha, A,. Guardian online 2005 ‘ New incentives for maths and physics teachers’ [Available online]).

Within the current UK educational system, educators have been promoting programmes like Girls IntoScience and Technology(GIST) and Computer Clubs for Girls (CC4G) for many years in an attempt to get more girls into science. The later is and organisation led by employers and it is not run for profit. The government issues its licenses with the Department for Children Schools and Families (DCSF) currently funding it. Furthermore, the UK Government is providing support for schools to encourage more girls to study physics and to help them to become more confident and assertive in the subject. Methodologies for teaching physics with an emphasis on physics as a ‘ socially relevant and applied subject has led to higher attainment for both males and females’ conclude Murphy and Whitelegg (2006). Previous research has also indicated that girls are motivated to study physics when they can see it as part of a ‘ pathway to desirable careers’ (Murphy and Whitelegg, 2006). Successful approaches to making physics more relevant to girls included, as presented in the government commissioned ‘ Girls into physics-Action research’:

Source: Daly. A et al 2009, Girls into physics- Action Research, Research brief. Page 2. [Available online] << http://www. education. gov. uk/publications/eOrderingDownload/DCSF-RB103. pdf>

However, several challenges are related to these approaches. Some students, especially those of a younger age group, struggle to articulate their careers aspirations and there may also be a knowledge deficiency on behalf of the teachers about possible career options suitable for students that partake in physics courses. This could add pressure onto the teacher as they feel the need to research and bring these elements into their lesson planning and schemes of work (SoW). It is already well documented about the time constraints many teachers experience with regards to sufficient planning and marking time. It could be suggested that with the low number of trained physics teachers available within the educational system at this time and their high demand (Institue of Physics, Physics and: teacher numbers, 2010), that additional content beyond that of the curriculum could put viable trainees off this career and potentially push them into other subject areas where there is less additional material to deal with. Availability of school resources could also be a problem.

The ‘ Girls into physics action research’ commissioned by the Institue of physics and undertaken by Daly. A., et al (2009) aims to address five key assumptions that girls have about physics identfied in prior research by

Murphy, P and Whitelegg, E (2006). This essential practice (figure 2) is deemed to support female participation within physics and it is hoped that it will be adopted as part of the classroom management.

Figure 2: Essential practice that supports girls participation in physics

Source: Daly. A., et al 2009, GIRLS INTO PHYSICS – ACTION RESEARCH, Figure 2, page 6.

[Available online]

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The research, also carried out on behalf of the Department for Education (DfES), recommends numerous ‘ top tips’ for successful teaching and learning with these suggestions available to view in the appendix. These tips have been identified by teachers who have shown some success in enagaing female students.

Alternatively, B. Ponchaud (2008) conducted a review within schools where the female uptake of physcis was already particularly high. Ponchaud identified several top tips for teachers to use to engage female students.

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Table 2: B. Ponchard’s top tips to engage female students in physics

Source: Ponchaud, B, The Girls into Physics project. School Science Review, March 2008, 89(328)

Antonia Rowlinson from St Anthony’s RC girls’ school implemented the ‘ top tips’ without the need to alter the curriculum. Physics was contextualised or illustrated in the areas of interest revealed by Ponchaud’s investigation. For example, within the forces module, questions on friction were set in the context of the then current Strictly Come Dancing television programme. The follow-up survey showed that ‘ whilst this new teaching technique had not substantially shifted the students’ perceptions about physics there were improvements. More girls saw physics as relevant to their career aspirations' (Ponchaud 2008).

In conclusion, evidence clearly shows that an under-representation of females is a cause for concern. Girls perceive themselves to be less capable and less interested, than boys, in science and these attitudes can be attributed to historical views of women that are proving hard to dismiss. Many believe that science educationalists have an obligation to alter those factors under their control. One would hope that within time, individual actions by teachers will help girls to break down the challenges experienced within the STEM pipeline and result in equal participation, benefiting society. Teachers should pay attention to the way they address and present physics, watching out for language and terminology, which has a vast psychological effect for females who may suffer from stereotype threat, where females believe they are not as capable as there male counterparts. I have also explored the idea that girls respond to physics when it is taught in an accessible and socially relevant way but countered this with the argument of teaching time constraints and available school resources.

Research that examines the overall successful impact of initiatives and policies aimed at promoting the cause of women in science has provided a mixture of opinions and outcomes that can be open to critique. It seems apparent that although these initiatives specifically target the thoroughly researched reasons why females may disengage from physics and science as whole, they cannot systematically prove that the apparent incremental growth in participation figures are down to the programmes and measures they have put in place. Only recently, has initiatives such as UKRC began to collect evaluative data on the amount of women that have been effected by their work. Some copies have presumed a positive impact for various policies, stating an increase in the proportions of women choosing certain courses as confirmation for different policies' success (e. g. WISE, 2010). I have explored such critique on this view including Phipps (2008) who recognises ' the limited successes and impact of initiatives in general, but tempers this with statements acknowledging the wide range of challenges facing these initiatives'. I believethat when more organisations begin to record and monitor engagement rates as a direct result of exposure to a particular initiative, successful programmes will become more apparent. However, I also realize that many of these organisations have limited funding and capabilities disabling them from doing this as they focus budgets on areas addressing there inherit strategy. Until this is addressed with additional funding, I fear the exact effects of many of these initiatives will never be known and it will remain a subject for academic discussion.

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