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## GIRLS INTO PHYSICS - ACTION RESEARCH

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### Introduction

The Girls into Physics programme of work focuses on the persistent problem that girls are under-represented in physics after the age of 16. A substantial number of girls do well at Key Stage 4 but do not choose to study physics 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). Whilst there has been a small year-on-year increase in the number of A level physics candidates between 2006 and 2008 (Institute of Physics, 2008), there has been little change in the proportion of girls that have taken the subject post-16. In 2008, 28,096 students sat physics A level and of these 21,941 (78%) were male (Institute of Physics, 2008).

The 'Girls into Physics' action research programme arose from a desire to share information on successful teaching and learning strategies to engage girls with physics. There were three elements to the programme including:

- a literature review, to understand the problem (Murphy, P. and Whitelegg, E., June 2006)
- a 'teachers' guide to action' to identify good practice (Hollins et al., December 2006)
- action research to effect change.

Initially piloted in 2006-2007, the action research programme was extended in 2008 with funding from the Department of Children, Schools and Families to enable 100 schools to participate. Teachers from 59 schools completed the project in this second phase. The overall aim of the evaluation was to gauge the success of the interventions that schools undertook as part of the 2008 Girls into Physics action research project. The three objectives of the evaluation were to:

- develop a framework to identify key questions for the evaluation
- to work with schools to enable them to measure the impact of the interventions in their schools and
- to collate the results from the schools to produce a synthesis of impact.

### Methodology

The action research approach was adopted for this project in order to share information with teachers and to support them in trying out strategies that have been identified as successful in earlier research studies. Science Learning Centres (SLCs) recruited schools and worked with teachers to review participation of girls in physics in their own schools. The teachers then developed individual action research projects to address the issues identified within their own schools.

The action research projects were organised into the following clusters

- learning and teaching strategies: shaping the curricula and pedagogies to be more relevant and inclusive
- classroom management: to promote girls' engagement in group work
- school culture: promoting a positive physics culture
- careers education and guidance: highlighting the value of physics careers
- progression: increasing girls exposure to pathways for studying physics; and
- workforce: increasing access to good physics teaching.

The teachers' involvement consisted of attendance at two workshops with a period of approximately six months in between in order to perform the action research. The first workshop was to provide teachers with the skills and resources to plan their own action research projects. The second focussed on providing teachers with an opportunity to share their experiences and learn from each other's action research interventions. Schools were also asked to complete an e-survey to gather information on the broad characteristics of schools involved in the project.

The following section provides an overview of the evaluation findings in relation to the areas of impact which were identified from the research. Quotations from teachers who participated in the research are also provided in the introduction to each section. The full research report, which is available from the DCSF, provides a full description of each of the six clusters (including a summary of the action research projects in each cluster and an outline of teachers' practice at the start of the project and their experiences during their interventions).

## Findings

A number of successes and challenges in engaging girls with physics were identified by teachers as an outcome of the research projects undertaken by schools. This evidence is drawn from teachers' action research reports and workshops, which were designed to advise other teachers about how to further engage girls with physics.

## Making it relevant

*"Make it relevant - to do with people."*

Approaches to teaching physics with an emphasis on physics as a socially relevant and applied subject has led to higher attainment for both males and females (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:

- Integrating physic-related careers in class (e.g. through direct references, set assignments, posters and displays in the classroom).
- Creating opportunities in lessons for students to explore the social relevance of physics (including the roles of physicists).
- Real life experiences with work experience and role models were also effective in 'bringing physics to life'.

There were also challenges associated with this, which included the inability of some students to articulate their careers aspirations, and a lack of knowledge about career options among teachers and students, as well as a lack of in-school resources allocated to science related careers.

## Good teaching practice

*"Be aware of the barrier of language. Use games and communication strategies to get an input into the activities."*

Interventions were most effective when they were built on general good practice in science teaching (including good teaching which supported both boys and girls). However in a few cases the gender-specific aspect was given too much priority to the detriment of the overall classroom experience. The study also found that:

- Students were empowered by being able to demonstrate their understanding of a concept using everyday language.
- Structuring groups and assigning roles to pupils for group work resulted in fewer interventions to keep students on task and promoted greater participation in all aspects of tasks by both boys and girls.

- Practical, hands-on sessions built understanding and confidence in physics.
- The challenges included balancing the importance of specialist teaching with other factors that contribute to good teaching and ensuring gender-specific interventions support general good teaching practice.

### **Personalised learning**

*“Independent learning using approaches to enable students to have choices in responses, contexts and approaches.”*

The research also highlighted the advantages of personalised learning in physics. This involved including an element of choice for students in activities to help them feel in control of their learning and tailoring activities to pupils’ interests and needs. However the challenge associated with this approach was ensuring that teachers were aware that all activities will not suit all students at all times, and therefore they needed to change teaching styles and activities regularly.

### **Sharing practice**

*“Talk to your colleagues early on about what you are trying to do.”*

Sharing practice within and outside school was a strong success factor for teachers; this included collaboration with specialist teachers to build the confidence of non specialist teachers in teaching physics. Involving colleagues at an early stage also worked well and some teachers worked with other departments to share learning. The project also identified however, a need for more CPD in gender-aware teaching.

### **Action research and changing practice**

*“Identify a ‘small’ change in practice as the focus. The key is to make that small change significant.”*

Teachers were asked to reflect on the impact of the action research approach. They agreed that small changes in practice that don’t take much time or resource can have a big impact on engagement. Involving students and highlighting student voice greatly enriched the process. The challenges included timing; the timescale for the project was short and so teachers were frustrated at not being able to measure longer-term outcomes. Timing an intervention so that it does not cause disruption to a class was also critical to success.

## **Synthesis of impact: themes from researchers**

*“The year 10 girls’ focus group was an eye opener to how girls view physics”*

The researchers identified three themes as crucial first steps in the process of changing girls’ participation in physics in schools:

### **1. Understanding gender equality**

The action research projects provided evidence that teachers have varying levels of understanding of gender equality in relation to physics teaching. Some teachers appeared confident about exploring their teaching and learning approaches and reflecting on impacts on girls’ (and boys’) achievement. Others appeared unsure about what constitutes gender aware or gender neutral examples and resources.

Teachers were exposed to a range of seemingly contradictory policy/practice messages, through the media and in school regarding the benefits and challenges associated with single-sex groups for girls’ and boys’ achievement and behaviour. Detailed discussion of the various policy perspectives was outside the project remit; however future projects may benefit from discussion of the wider issues of single-sex teaching year groups compared with single-sex lessons or work groups within lessons. This may support teachers to make an informed choice about different approaches.

Consideration of gender equality in relation to theory, policy and practice will inform teachers in their current practice and have an impact on girls’ participation in physics in the long term.

### **2. Action research**

Action research has been an effective way for teachers to access the Institute of Physics ‘Girls into Physics’ materials. Active learning approaches (in the workshops) enabled teachers to identify the key themes affecting girls’ participation in physics. The most successful aspect of this phase has been providing the space for teachers to reflect on their own practice individually and with peers. This was made possible through the two-day CPD programme which meant teachers could implement an action research project between a planning workshop and a reporting workshop. This type of learning needed to be experiential; where teachers could try out methods for themselves.

### 3. Pupil voice

Many teachers reported that they found pupil voice to be one of the most informative aspects of the project. The informal and qualitative discussions with girls in particular had an impact on teachers' appreciation of the extent of girls' exclusion.

Students and teachers have little control over the curriculum; however teachers used this project to include students' contributions to the planning, implementation and evaluation of interventions to deliver the curriculum.

Another important aspect of pupil voice has been in the area of 'student peer learning'. Some teachers worked with young researchers explicitly as peer educators (mainly with other year groups) and others opened up their learning and teaching methods to allow students to peer review and support learning in class. The legacy of this project is that teachers have experienced methodologies that help them access pupil voice and value that contribution.

#### Concluding comments

*"The pre-questionnaire we did on students' attitudes was a big wake up call to the Department... ..this generated a lot of discussion about how we would tackle this"*

Teachers required time, space and support to place the Girls into Physics literature and pedagogies in the contexts of their own schools and classrooms. Capturing and listening to students' opinions and voices was a powerful way to inform practice. The wealth of information in 'A Teachers' Guide for Action' (Hollins et al., 2006) was overwhelming for some teachers, so support to identify a starting point for change was crucial to success.

#### Recommendations

The project has highlighted a number of recommendations arising from the research:

##### **Recommendations for teachers** (from participating teachers)

#### Learning & Teaching

- Talk to students to understand the context in your classroom
- Get students onside to work with you to change this

- Make sure students understand what physics is
- Discuss the nature, purpose and relevance of physics

#### Classroom Management

- Ensure interventions are appropriately timed
- Sharing good practice in school and beyond

#### Careers

- Careers advice should be integrated throughout secondary school
- Become aware of students' career aspirations
- Improve access to existing physics-related careers materials
- Links to careers should be highlighted throughout normal teaching

#### Progression

- Use appropriate role models at all stages of progression
- Link the physics covered to wider social relevance and interest

#### Workforce

- Specialist teachers can work with non-specialists to build their confidence and suggest strategies
- Consider the balance of factors that create a good physics teacher and don't prioritise specialist knowledge above all else

#### Culture and ethos

- Use interventions that the whole school can see or get involved in

## **Recommendations for stakeholders**

*(based on the findings from the research project)*

- The two-day programme model should be continued as it was well received by teachers and ensured their deeper involvement.
- Appropriate application of the ideas, theory and practice in the literature review (Murphy, P. and Whittlegg, E. 2006) and the teachers' guide to action (Hollins et al., 2006) can inform teachers of previous research and best practice, but it is crucial that the data and methodologies contained within are not followed blindly.
- Gender aware teaching should be incorporated into standard CPD.

## **References**

Institute of Physics (2008) *Year on year increase of physics A-level entrants.*

Available from:

[http://www.iop.org/News/Community\\_News\\_Archive/2008/news\\_31001.html](http://www.iop.org/News/Community_News_Archive/2008/news_31001.html)

Hollins, M., Murphy, P., Ponchaud, B. and Whitelegg, E. (2006) *Girls in the Physics Classroom: A Teachers' Guide for Action.* London, Institute of Physics

Hollins, M., Murphy, P., Ponchaud, B. and Whitelegg, E. (2006) *Girls in the Physics Classroom: A Teachers' Guide for Action.* London, Institute of Physics

## **Additional Information**

The full report (DCSF-RR103) can be accessed at [www.dcsf.gov.uk/research/](http://www.dcsf.gov.uk/research/)

Further information about this research can be obtained from Rosalyn Xavier, 4FL-SARD, DCSF, Sanctuary Buildings, Great Smith Street, London SW1P 3BT

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