

# Improving gender balance in the teaching and learning of Physics at second level

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**Abstract.** The numbers of students studying physics in upper second level and the low numbers of teachers completing a qualification to teach physics at second level is a matter of concern for STEM Education. This study will present findings of a pilot programme being carried out in partnership with teachers from seven second level schools in Ireland. The focus of this collaboration is to investigate teacher's approaches to the teaching and learning of physics at lower secondary level and to examine teachers' and students' unconscious biases. The impact of this approach adopted to support teachers and students, particularly girls, in redressing this challenge will be presented.

## 1 Introduction

There is a strong concern internationally of the impact of the under representation of women in Science, Technology, Engineering and Mathematics (STEM) and particularly in the discipline of physics [1,2]. Several reports have been commissioned from bodies such as the Institute of Physics in Ireland and these have shown that the participation rate of women in physics at all levels, remains stubbornly low with a ceiling of around 25% [3]. According to the IWISH survey carried out in 2017 in which 2,397 girls across 15 cities responded, 82% of them wanted a career where they can help other people yet could not see how STEM can facilitate that [4]. This gender gap which permeates the education system, is itself a barrier to participation for young women.

In Ireland, typically only 13-14% of students choose to study physics at upper second level and complete the Leaving Certificate Physics Examination and of this cohort only 25-26% are girls. Worryingly, 22% of Irish second level schools do not offer Physics as a separate subject at upper second level. As highlighted in the 2016 report on STEM Education in the Irish Education System [5], an imbalance in the numbers of teachers qualified to teach physics leads to the situation that the majority (greater than 80%) of second level students do not encounter a specialist physics teacher at lower second Science level which contributes to the lack of popularity of the subject at Leaving Certificate level. In 2017, the registrations of the Teaching Council of Ireland indicated that 3878 teachers were registered to teach Biology, 2376 registered to teach Chemistry and 1259 were registered to teach Physics. The situation in Ireland is not unique with many countries seeking to address declining number of physics teachers. In England, physics teacher recruitment had hovered at about 400 each year from 1970 reaching an all-time low of 200 in 2001, while entries for physics A-level had declined by 40 % in the 20 years to 2006. However, following significant Government intervention, in partnership with the Institute of Physics both trends have reversed in England with physics teacher recruitment figures reaching an all-time high of 920 in 2012 and an average annual recruitment over the last five years of 750.

## 2 Methods

This study has been carried out in collaboration with teachers and students from seven second level schools in Ireland. The schools were selected to represent the wider cohort of schools around the country; and include two all-girls schools, and four co-education schools. The specific aims of this study were to: enhance science teachers' approaches to the teaching and learning of physics in Junior Cycle science; employ a whole school approach to addressing unconscious bias and gender stereotyping and build confidence and resilience for students, particularly girls, to continue with Physics.

School based workshops have been facilitated with science teachers to address teachers' pedagogical content knowledge of core physics concepts, e.g. light, energy, electricity, that they teach at lower second level. Teachers have documented the teaching and learning approaches used in their classroom and have completed post-lesson reflections on their practice. In addition, a whole school approach has been adopted to raise awareness around the unconscious biases of teachers and students and to minimize the gender stereotypes that persist in subject selection and STEM career choices. Teachers and principals have participated in unconscious bias workshops and completed pre- and post-workshop surveys. Selected groups of female students in each school have participated in resilience building and unconscious bias workshops.

## 3 Findings

Data collated from over 250 second level teachers in Ireland has outlined the key challenges to students, particularly girls, participation in STEM are: student's self-efficacy in STEM; students, parents and teachers lack of awareness of STEM careers; impact of negative stereotypes and preconceptions; lack of resources for STEM subjects in school; and lack of awareness of STEM in society. This study has collated a baseline analysis of the profile of STEM teachers and the student participation in all STEM subjects in each school. An initial analysis of the school's website and policies was also carried out. The main focus of the workshops with science teachers was to enhance teachers' pedagogical content knowledge as well as their awareness of careers in Physics/STEM. An overview of these workshops will be presented along with feedback from the participating teachers. Findings from the data collected from the unconscious bias workshops will be presented to highlight the preconceptions and negative stereotyping that impacts on student subject choices and career aspirations. The findings from this study highlights that the best way to rectify gender imbalance in physics (and other subjects) is to address the problem through a combined approach of working across the school as well as in the subject areas.

## References

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