

GENDER DIFFERENCES IN SCIENCE INTEREST, SELF-CONCEPT, AND CAREER ASPIRATIONS

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Gender issues in science education have been widely reported in the literature and linked to the under-representation of women in science careers, particularly in physics. Drawing on survey data from the European Commission funded project “MultiCO – Promoting youth scientific career awareness and its attractiveness through multi-stakeholder cooperation”, we analyse the English baseline findings of science interest, self-concept regarding science and career aspirations, prior to introducing scenario-based interventions aimed at raising interest in science and future science-related aspirations. The scenarios illustrate careers that use science skills. By examining the responses of 210 English students, it was found that girls are more interested in biology and less interested in physics than boys; and that their self-concept regarding science subjects is significantly lower. The findings also suggest that self-concept is an influencing factor for girls’ interest in science, but not for boys. Regarding career aspirations, helping other people is more important for girls, and making money, inventing new things, and becoming a leader is more important for boys. This paper also presents the preliminary findings of a questionnaire that collected the responses of 31 students after a scenario-based intervention in physics presenting a female scientist, suggesting that girls were more likely to consider pursuing the career covered in the scenario.

Keywords: self-concept in science, career-based interventions, career aspirations

INTRODUCTION

Attracting young students to study science and follow careers in science, particularly female students, continues to be extremely challenging. Many studies have showed that girls tend to prefer biology to physics topics (e.g. Francis, Archer, de Witt, & Yeomans, 2016), and that they generally have a lower academic self-concept in science (Jansen, Schroeders, & Lüdtke, 2014), undermining their career aspirations in science (Nagengast et al. 2011). Context-based pedagogic approaches have a positive impact on students’ attitudes towards science and interest in science related careers (Bennett, Lubben, & Hogarth, 2007), and making links between science skills and employability by illustrating careers that use those skills and the provision of information specifically about careers in science, encourages the transfer of career aspirations into career choices in science (Dewitt & Archer, 2015). Hence, school activities that challenge assumptions about gender stereotyped careers and images of scientists, and that promote discussion around the advantages of working in science fields for both girls and boys have the potential to be effective in raising interest in science. That is the premise of the EU funded MultiCO project, in which interventions using career-based scenarios are being introduced over a two-year period prior to students’ critical subject choice. This paper reports the gender differences in science interest, self-concept regarding science subjects, and career aspirations prior to scenario-based interventions; and the preliminary findings of a scenario-based intervention designed to address girls’ engagement with physics.

METHOD

Data were collected from 210 students from 3 secondary schools in Greater London. Of the participants, 57.1% were girls and 42.9% were boys, 13-14 years old ($M = 13.7$, $SD = 0.473$). From the initial group of students, 31 completed a questionnaire after a scenario-based intervention, of which 38.7% were girls and 61.3% boys, when 14-15 years old ($M = 14.27$, $SD = 0.450$).

Two self-administered questionnaires developed and validated across the project's partners were used, and a scenario-based intervention presenting a female scientist working in Nuclear Medicine was designed to raise the interest of girls in physics. The pre-questionnaire was designed to explore students' interest in science and in studying and working in science related careers, and test influences on interest. Students were asked to rate the importance of the statements, or their level of agreement, using a 4-point Likert scale (1 = not at all important/strongly disagree, 4 = very important/strongly agree). For this paper, three scales of the questionnaire were analysed: *science interest in general* (6 items), *self-concept regarding science subjects* (6 items), and *career awareness* (14 items). The questionnaire for evaluating scenarios assessed students' engagement with the scenario-based lesson (e.g. knowledge value, practical value, career awareness), and comprised 22 statements with a 4-point Likert scale (1 = totally disagree, 4 = totally agree).

Consent forms were sent to parents, students and schools. Students were asked to complete the pre-questionnaire, 4 months before the first scenario-based intervention. The "Nuclear Medicine" scenario was used in the second scenario-based intervention in two classes of one of the three participating schools 9 months later. At the end of the intervention, students completed the questionnaire for evaluating scenarios. Data were anonymised and analysed with the statistical software SPSS v.24.

RESULTS

Girls were significantly more interested in biology and less interested in physics than boys. No differences were found for chemistry. Gender differences are presented in Table 1.

Table 1. Gender differences

	Girls	Boys	t-test
Interest in Physics	M = 2.58, SD = 0.952	M = 2.88, SD = 0.981	t (207) = -2.211, p < .05
Interest in Biology	M = 3.13, SD = 0.922	M = 2.83, SD = 1.041	t (208) = 2.146, p < .05
Interest in Chemistry	M = 2.84, SD = 0.944	M = 2.90, SD = 1.050	t (208) = -0.422, p > .05
General interest in science	M = 2.59, SD = 0.773	M = 2.65, SD = 0.822	n.s.
Self-concept regarding science subjects	M = 2.67, SD = 0.719	M = 3.05, SD = 0.585	t (208) = -4.278, p \cong .00
Career aspirations			
Making money	M = 3.36, SD = 0.704	M = 3.58, SD = 0.683	t (206) = -2.573, p < .05
Becoming a supervisor/leader	M = 2.10, SD = 0.890	M = 2.46, SD = 0.901	t (203) = -2.918, p < .01
Inventing new things	M = 2.20, SD = 1.050	M = 2.59, SD = 1.025	t (205) = -2.971, p < .01
Helping other people	M = 3.41, SD = 0.713	M = 2.94, SD = 0.942	t (204) = 3.580, p \cong .00

Overall, students have a relative high general interest in science (M = 2.61, SD = 0.793), and a relatively high positive self-concept regarding science subjects (M = 2.83, SD = 0.690). However, girls have a significantly lower self-concept than boys. When analysis the influencing factor of self-concept on science interest, it was found that it was a moderate positive influencing factor for girls (r = .605, p < .001), but just a low positive factor for boys (r = .388, p < .001), suggesting that girls interest in science is more likely to be strongly associated with their self-concept in science subjects.

The top three career aspirations were: using own talents and abilities, making money, and having lots of job opportunities. The least important were: becoming famous, having an easy job, and being a supervisor/leader. When all career aspirations were analysed by gender, boys were significantly more interested in making money than girls, becoming a supervisor/leader, and inventing new things. On the other hand, girls were significantly more interested in helping other people than boys.

The preliminary results of the career-based intervention showed that, when asked if the scenario topic was important to them personally, no differences were found between girls and boys. When analysing future career and study intentions, girls were more likely to consider pursuing the career covered in the scenario.

DISCUSSION

In this study, girls tended to have a lower self-concept in science compared to boys, as has been found by recent studies (e.g. Jansen, Schroeders, & Lüdtke, 2014). The literature also points out that a higher self-concept leads to more engagement in science-related activities and career aspirations (Nagengast et al. 2011). In line with this, our findings suggest that self-concept can be an influencing factor for girls' interest in science, which may help to explain the gender differences found in our students' career aspirations and interest in science topics. These results align with other studies' findings reporting that people-related motivations are negatively associated to physics identity (Hazari, Sonnert, Sadler, & Shanahan, 2010), and that men tend to be more interested in 'things', and women in 'people' (Su, Rounds, & Armstrong, 2009). The scenario, although covering topics in physics, was related to careers in medicine, helping others and improving human life (Archer et al., 2012; Holmegaard, Madsen, & Ulriksen, 2014), which are generally more appealing to girls. Quotes from girls who were interested in pursuing a career in medicine, but had different levels of interest in physics, also support the findings (low interest "Because it gives good examples of real-life situations"; high interest "I wasn't already aware of this (...) It somewhat relates to the career I hope to do"). Considering the career-based intervention preliminary results, implications for future interventions in the project should be considered. Future developments will focus on the design and assessment of scenarios that explore the conceptual understanding and real-world relevance of physics for girls (Hazari et al., 2010), to raise their interest in learning and pursuing careers in physics.

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