

A didactic pathway on the concept of energy in primary school: cognitive well-being and self-efficacy based on gender

Giusy Giarratano (2), Onofrio Rosario Battaglia (1), Giulia Termini (1), Claudio Fazio (1)

(1) Department of Physics and Chemistry - Emilio Segrè, University of Palermo, Italy

(2) Department of Psychological, Pedagogical, Physical Exercise and Training Sciences, University of Palermo, Italy

Abstract. The main focus of this research is to investigate the gender gap in learning processes in physics in five classrooms of Sicilian primary school. After analysing the data reported in the literature related to the gender gap in learning processing, we discuss the results of a didactic pathway on the concept of energy, based on the IBSE methodology, conducted with 10-year-old pupils. We discuss the answers to a questionnaire on self-efficacy and approach to scientific disciplines, administered before and after the didactic pathway, that we realized for primary school, focusing on the differences emerging from male and female pupils.

Introduction

Despite the many strides women have made in recent decades, they remain underrepresented in some STEM fields [1]. The reasons for the lack of girls in science are certainly not due to a lack of academic skills, but to socio-cultural factors [2]. Women's relatively minor interest in male-dominated STEM careers is likely limited by gender stereotypes [3]. Some children begin to learn these gender stereotypes as early as preschool [4] and continue throughout adolescence. Gender differences remain through high school and are even more apparent in tertiary education. This implies the continual decline of women's representation in STEM fields across consecutive stages of human development [5].

The research

Students usually make decisions according to their self-efficacy beliefs and choose educational pathways and careers in areas they deem themselves capable of succeeding. Students with low self-efficacy beliefs for science would therefore be less likely to choose careers within science. Indeed, girls are less likely to aspire to science careers than boys [6] and PISA 2018 results show gender gaps in drive, motivation and self-belief, with girls reporting lower self-belief in their abilities [7]. This highlights the importance of developing a good sense of self-efficacy. Science Self-Efficacy (SSE) can be described as an individual's self confidence in completing tasks successfully in science [8]. Although self-efficacy develops as early as primary school, most research focuses on the later stages of education [9]. There are different physics self-efficacy's surveys for high school or University but there is an absence of a suitable instrument to measure the science self-efficacy of children. For this reason, our research group has realized a survey for students of primary school on the basis of other studies conducted at different schooling levels [7, 8, 10]. The aim of this research is to study pupils' promotion of a sense of well-being and self-efficacy on scientific disciplines, with particular attention to gender differences, through an Inquiry-Based-Education didactic pathway focusing on the energy concept. The research questions we will answer in our whole research are the following:

1. How do pupils approach the study of science and physical content, and in particular what is their levels of self-efficacy and well-being in learning?

2. To what extent can an educational intervention based on Inquiry Based Education promote an improvement in well-being, self-efficacy and interest of students in the study of scientific disciplines and particularly of physics?
3. How does the gender influence the previous aspects?

Methods and findings

The didactic pathway involved five classes of Sicilian primary school with 10-year-old students for 14 hours for each class. The pathway contains activities to explain some relevant phenomena related to energy conservation. Most of the didactic tools consisted of toys, and many of the materials were inexpensive and easy to find, as well as being familiar and engaging to students. The energy concept is developed from the idea of a state property of bodies that transforms during interactions [11]. We measured students' self-efficacy at both the beginning and the end of the didactic pathway of physics with a survey of closed questions. For each item, participants are asked to choose their response using a five-point response scale and a ten-point response scale for the last item. At the end, we also conducted semistructured interviews for a subset of 10 students with the goal of understating students' thinking when they completed the self-efficacy survey. The data has been analysed by both qualitative and quantitative methods with particular reference to thematic and content analysis.

Conclusion

At this stage, the full analysis of the data we collected is ongoing. We will present some preliminary results related to self-efficacy of both male and female pupils.

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