

*Selected papers presented at  
the first Network Gender &  
STEM Conference, 5-6  
September 2012, Haarlem,  
The Netherlands:  
[www.genderandSTEM.com](http://www.genderandSTEM.com)*

*In association with*



**NETWORK  
GENDER  
& STEM**  
educational and  
occupational pathways  
and participation

## **Editorial: Gendered Pathways Towards (and away from) STEM Fields**

***Helen M.G. Watt<sup>1</sup>, Noortje Jansen<sup>2</sup>, and Gertje Joukes<sup>2</sup>***

***<sup>1</sup> Monash University, Australia, <sup>2</sup> VHTO, The Netherlands***

### **INTRODUCTION**

This special issue is an initiative of the "Network Gender & STEM: Educational and occupational pathways and participation" ([www.genderandSTEM.com](http://www.genderandSTEM.com)). Members of the network, founded in 2010, share the objectives to:

- (i) gain more insight into the various connected aspects of career choices and professional careers of girls/women (and boys/men) in STEM; and
- (ii) identify new approaches that will improve the representation of girls/women in STEM.

The collection of papers in this special issue of the International Journal of Gender Science and Technology is drawn from presentations made at our first Network conference, in Haarlem, the Netherlands, 5-6 September 2012, which focused on gendered pathways towards (and away from) STEM fields.



## **BACKGROUND AND REVIEW**

From the late 1970's the underrepresentation of girls and women in STEM fields in many countries has been considered to be problematic; this has been the subject of much research, various policies and intervention programmes (see OECD, 2006). Fewer girls and women are retained in STEM pathways through high school, university, and into STEM fields of career. Gender differences in STEM participation and associated factors have continued to occupy researchers who are concerned about gender equity. Several researchers, including those represented in this special issue, have argued that many girls restrict their possible education and career options by opting out of STEM pathways in high school or soon after, impacting on their future wellbeing from economic and psychological perspectives.

One of the most influential researchers in the field of gender and STEM, who has conducted seminal and continued research on this issue, is Professor Jacquelynne S. Eccles. For that reason she was invited to be Patron member of Network Gender and STEM. She and her colleagues have been developing the Expectancy-Value model of achievement-related choices for more than 30 years (Eccles, 2005, 2009; Eccles et al., 1983), which provides an integrated framework to approach the question of why girls/women (and boys/men) make their career and educational choices. In her keynote address at the first Network gender and STEM conference in 2012, Professor Eccles called for research to closely examine what choices girls and women make and why, rather than a focus on *why not*, in relation to choices they do not make. We are most pleased to include her overview of this event as the opening perspective to this special issue, [Gender and STEM: Opting in versus dropping out](#). She stresses that we need to focus on why girls and women opt into certain STEM fields but not others. For example, why are girls and women motivated to choose STEM teaching but not mechanical engineering?

This issue contains four perspective papers (papers 1, 6, 7 and 8) and five empirical studies (papers 2, 3, 4, 5 and 9), whose authors come from five countries: Australia, Germany, the Netherlands, Norway, and the United States. We briefly review the nine contributions in sequence below, for those who wish to focus on selected aspects.

## **REVIEW OF SPECIAL ISSUE CONTENTS**

In [\(How\) does gender matter in the choice of a STEM teaching career and later teaching behaviours?](#), Helen Watt, Paul Richardson and Christelle Devos point out that in order to attract and retain STEM teachers in the profession and ensure positive development for their students' STEM skills and engagement (especially girls) we need to understand why women and men choose to teach STEM subjects, and, whether STEM teachers are differently motivated than other future teachers.. For girls and boys to be capable and enthusiastic about STEM participation, they need well-educated and positive STEM teacher role-models. Using longitudinal data following Australian pre-service teachers into their early career experiences, Watt et al. were able to identify that women had more positive motivational profiles than men, and non-STEM teachers had more positive motivational profiles than STEM teachers. In particular, men and STEM teachers were more motivated than women and non-STEM teachers, to choose teaching as a fallback career, which

consequently led to greater negative interactions with their students once they commenced in the teaching profession. These findings suggest gendered implications for enhancing the effectiveness of efforts to recruit and support future STEM teachers, who will be central to future students' STEM learning and engagement.

Rebecca Lazarides and Angela Ittel examined the role of parent and teacher support in their longitudinal study, [\*Mathematics interest and achievement: What role do perceived parent and teacher support play?\*](#) They found that German girls in secondary school reported lower mathematics interest at each of the two measurement timepoints. Perceived social support was particularly important for girls' motivational, but not cognitive, learning outcomes. The significant relationship for girls (but not boys) between perceived parents' valuing of mathematics and their own mathematics interest, indicated that parent beliefs were important to girls' interest development. The findings imply that intervention programs which aim to facilitate girls' and boys' interest and achievement should be tailored to include the involvement of relevant social agents such as parents.

The role of peers in girls' and women's intent to pursue careers in STEM was further explored in Rachael Robnett's study conducted in the U.S., [\*The role of peer support for girls and women in STEM: Implications for identity and anticipated retention.\*](#) Prior research showed that peers can influence students' interest and retention in STEM, but less is known about *why* peers are influential. In her study among high school and college students, STEM peers' influence on motivation predicted participants' STEM identification, which in turn predicted their intent to pursue a STEM career. As anticipated, participants' phase of education influenced several of the paths in the model. Peer influences on motivation were most relevant for high school and college students, whereas peer influences on confidence were most relevant for graduate students. Earlier studies had shown that many women in STEM graduate programs are already highly motivated, but face challenges such as social isolation that could undermine their confidence. These women may therefore be especially likely to benefit from a STEM peer climate that makes them feel more confident in their abilities.

Amy Roberson Hayes and Rebecca Bigler from the U.S. investigated [\*Gender-related values, perceptions of discrimination, and mentoring in STEM graduate training.\*](#) They studied occupational values of women STEM graduates, the degree to which STEM careers enabled the fulfilment of their values, gender discrimination in their department, mentor support, and satisfaction with their graduate training experiences. Statistics suggest that women's experiences during doctoral training may be critical to their persistence in the STEM fields. Hayes and Bigler's data indicate a continuing double standard in which men who value family flexibility perceive research careers as enabling the fulfilment of their values, whereas women who hold similar values do not. To increase the number of women who successfully pursue STEM research careers, it will be necessary for women to believe that having a family is compatible with such careers. Women who valued family and viewed university teaching (rather than a research career) as enabling them to fulfill their values, did not perceive any increased gender discrimination. However,

those women who valued power and altruism perceived more gender discrimination within their department. Women who had more satisfying experiences during graduate training believed that a university research career would enable the fulfilment of their values while the opposite was true for their perceptions of university teaching careers.

In the popular media there are heated discussions about the question of whether or not women and men have innate brain differences that allow or prevent them from succeeding in (for instance) STEM tasks. In their perspective paper, [\*Is the brain the key to a better understanding of gender differences in the classroom?\*](#), Jeffrey Derks and Lydia Krabbendam from the Netherlands, point out that the issue is highly complicated. They stress that misinterpretation and misapplication of science is a problem for all areas of science, but this may be even more pressing for neuroscience because of the authority with which the field is regarded. Along with high authority comes a responsibility to clearly communicate to non-academic audiences the limitations of neuroscience findings. Brain research can help us to understand more about the fundamentals of learning and conditions under which students can best learn. However, this can best be achieved in interdisciplinary collaborations that aim to integrate knowledge from neuroscience, developmental psychology and educational sciences.

In many countries, interventions have been designed and executed to raise the participation of girls and women in STEM. In Germany, there have been a number of national programmes during the last ten years. In their perspective paper, [\*Gender and STEM in Germany: Policies enhancing women's participation in academia\*](#), Kathinka Best, Ulrike Sanwald, Susanne Ihsen and Angela Ittel describe these programmes and present an analysis of their success. They conclude that gender equality improved throughout the last decade, but that female students still report a non-inclusive STEM culture, and women continue to opt out of STEM-related academic fields in larger numbers than men. Considering the number and the scope of the various and largely independent initiatives, the overall success seems rather limited. Given these findings the authors recommend fostering action targeted at a better *qualitative integration* of women into STEM culture, to attract and retain them more effectively.

In the Netherlands, [\*VHTO\*](#), the Dutch national expert organisation on girls/women and STEM, has designed and executed interventions to raise the participation of girls and women in STEM since VHTO started in 1983. In their perspective paper, [\*Long term, interrelated interventions to increase women's participation in STEM\*](#), VHTO consultants Noortje Jansen and Gertje Joukes stress that interventions should be carried out for a longer period of time and with all different kinds of actors involved, in order to increase their effectiveness. They describe VHTO's 'Girls Approach' which was part of the Dutch national *Universe Programme* (2004-2011), designed to encourage more female (and male) students to opt into STEM fields during pre-university education. This 'Girls Approach' consisted of (1) speed-dates for female students with female STEM professionals before choosing a subject cluster or a university programme, (2) teacher training, and (3) policy consultations with school managers. A quantitative evaluation showed that the *Universe*

*Programme* resulted in more students (both female and male) opting into STEM subjects in secondary education and their university studies, and, that significantly more girls who attended schools that participated in VHTO's 'Girls Approach' participated in the highest level of pre-university STEM education.

Based on the U.S. "Take our daughters and sons to work" initiative launched in 1993, *Girlsday* has been organised in several European countries for more than 10 years, to promote girls' interest in STEM careers. Germany started *Girlsday* in Europe, followed by (among others) the Netherlands, Hungary, Denmark and Norway. Fredrik Jensen and Maria Vetleseter Bøe investigated how STEM motivations of high-achieving female upper secondary students were influenced by their participation in *Girlsday* at the Norwegian University of Science and Technology. In their study, [\*The influence of a two-day recruitment event on female upper secondary students' motivation for science and technology higher education\*](#), they report that two-thirds of the respondents had become more certain of what to study as a direct result of participation in the *Girlsday* event. Meeting university students (role models) appeared as the main factor contributing to making the female students more certain. *Girlsday* experiences also positively affected participants' STEM motivations, including their expectation of success and the value they placed on STEM tertiary education.

## **OUTLOOK AND FUTURE DIRECTIONS**

The Network Gender & STEM will hold its 2nd Conference, entitled, [\*Gender and STEM: What schools, families, and workplaces can do?\*](#), from 3–5 July 2014, at the Technische Universität Berlin, Germany. This conference will highlight the roles of schools, families and workplaces for supporting or constraining girls/women and boys/men to choose and persist in STEM, in comparison to other pathways. Complementary perspectives will address how such pathways can be facilitated at various points along students' and young adults' educational and occupational development. Building on this special issue, we look forward to ongoing collaborations in our shared endeavour to increase the participation of women and girls in STEM

## **REFERENCES**

- Eccles (Parsons), J., Adler, T. F., Futterman, R., Goff, S. B., Kaczala, C. M., Meece, J. L., & Midgley, C. (1983). Expectancies, values, and academic behaviors. In J. T. Spence (Ed.), *Achievement and achievement motivation* (pp. 75-146). San Francisco, CA, WH Freeman.
- Eccles, J. S. (2005). Subjective task value and the Eccles et al. model of achievement-related choices. In A. J. Elliot & C. S. Dweck (Eds.), *Handbook of competence and motivation* (pp. 105–121). New York: Guilford Press.
- Eccles, J. (2009). Who am I and what am I going to do with my life? Personal and collective identities as motivators of action. *Educational Psychologist*, 44, 78-89.

Organisation for Economic Co-operation and Development (2006). *Evolution of student interest in science and technology studies: Policy report*. Paris: OECD Global Science Forum.