



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



**Newcastle
University**

Business School



NATIONAL
EXPERT ORGANISATION
ON GIRLS/WOMEN AND
SCIENCE/TECHNOLOGY

3rd Gender & STEM Biennial Conference

**Newcastle University Business School,
Science Central, Newcastle upon Tyne, England**



**Conference Program
21 – 23 July 2016**

3rd Network Gender and STEM Conference 2016

Promoting girls' and women's participation in STEM advancement and innovation: Connecting research with global policy and practice

Welcome from Gender & STEM conference organisation team

Welcome to our 3rd biennial Network Gender & STEM conference! The aim of our international conference is to gain deeper insight into the various, closely connected aspects of career choices and professional careers of girls/women and boys/men in the broad field of STEM (Science, Technology, Engineering, and Mathematics) and connected specialisms. There is an urgent need to integrate complementary perspectives addressing the question of how pathways into STEM can be facilitated at various points along students' and young adults' educational and occupational development. Additionally it is important to move beyond results, which highlight only single aspects. By drawing together international researchers from diverse disciplinary perspectives, alongside policymakers and practitioners, an important aim of this conference is to stimulate new research and findings to reshape future inquiry, by formulating advances in future research, policy and actions concerning the promotion of girls and women (and boys and men) in STEM fields through connecting theoretical, methodological, and empirical issues.

There is large surplus value to interrelate relevant research results to gain a coherent interdisciplinary account concerning gender and STEM from childhood to labor market. The inclusion of cutting-edge research from diverse disciplines where there is relevant scientific and scholarly expertise, their integration with each other, and also with inputs from STEM professionals, policy-makers and educators, will collectively break new ground and stimulate new lines of study on issues that have been largely unexplored concerning the persistent issue of gender and STEM participation, to understand the state of the knowledge and chart directions for future research.

In this conference, we highlight the following dimensions, which contribute to participation and retention of girls and women in the STEM pipeline:

- 1) key factors and good practices within school, university and workplaces;
- 2) role of higher education institutes (HEIs) technology transfer officers and commercialisation policies in enhancing women's participation in commercialisation of STEM research and creation of university spinoffs;
- 3) the role of government, industry, public policy and career development policies;
- 4) positive action measures: STEM initiatives, schemes, networks and organisations; individual, family, teacher and peer processes.

Conference Host:

Professor Pooran Wynarczyk, Newcastle University, Business School, UK

Co-Organisers:

Professor Helen Watt, Monash University, Australia

Mrs E.J.M. (Noortje) Jansen,

VHTO, National expert organisation on girls/women and Science/Technology,

The Netherlands

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Structural Agenda

Thursday 21 July	Friday 22 July		Saturday 23 July	
	<i>Room 2.04</i> 9-10:25am <i>Papers I:</i> EXPECTANCIES AND VALUES FOR STEM PURSUITS	<i>Room 2.03</i> 9-10:25am Workshops (2) 1. Learning initiatives improving girls' engagement in STEM studies... 2. GenPORT connecting research policy and action	<i>Room 8.10</i> 9-9:10am - Housekeeping / Notices <i>Room 8.10</i> 9:10-10am KEYNOTE 3: Fara	
	<i>Room 8.10</i> 10:30-11:20am KEYNOTE 1: Rosser		<i>Rooms 1.11 (RT 1—3); 1.13 (RT 4—5); 1.14 (RT 6—7)</i> 10-10:50am Roundtables (7)	
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<i>Room 8.10</i> 2:00-3:00: Registration 3:00-3:30pm: Welcome & Notices Professor John Wilson, Director of Newcastle University Business School; Watt / Wyncarczyk / Jansen 3:30-5:30pm: Distinguished Symposium: WHAT MOTIVATES GIRLS & BOYS TO PARTICIPATE IN STEM DISCIPLINES?	<i>Room 2.04</i> 2:30-4pm <i>Papers II:</i> SOCIAL PERSPECTIVES ON STEM CHOICE	<i>Room 2.03</i> 2:30-4pm <i>Papers III:</i> THE LEAKY STEM PIPELINE	<i>Room 2.04</i> 2:10-3:40pm <i>Papers VII:</i> BEST PRACTICE TO SUPPORT GIRLS AND WOMEN IN STEM	<i>Room 2.03</i> 2:10-3:40pm <i>Papers VIII:</i> DEVELOPMENT AND SOCIAL BARRIERS TO STEM PARTICIPATION
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Keynote Speaker Schedule

Keynote 1



Professor Sue V. Rosser
San Francisco State University, USA

Sue Rosser has served as the provost and vice president for Academic Affairs at San Francisco State University since August, 2009. Previously, she served for 10 years as the dean of Ivan Allen College, the liberal arts college at Georgia Institute of Technology, where she held the endowed Ivan Allen dean's chair of Liberal Arts and Technology. She is the author of 13 books and over 130 journal articles on theoretical and applied aspects of women, science, health and technology. Rosser received her Ph.D. in Zoology from the University of Wisconsin-Madison. srosser@sfsu.edu

Breaking into the Lab: Engineering Progress for Women in Science & Technology

Although the overall percentage of women receiving degrees in STEM fields has increased in the U.S., the data mask wide variance among fields. Responses and interviews of over 450 current women scientists, both junior and senior, document that despite increases, many of the same issues for women in science and engineering persist today, although the obstacles or expression of experiences may differ slightly. Balancing career and family, time management, isolation, lack of camaraderie, poor mentoring, issues for dual career couples, as well as gaining credibility and respectability from colleagues and superiors in science remain as problems. Sexual harassment and gender discrimination still occur all too frequently.

Data from interviews of current scientists reveal what happens to successful women as they become senior and consider going into administration, and whether women are excluded from leading edge work in commercialization of science and technology transfer. Since the focus of scientific research globally has shifted from basic to applied research and innovation, the dearth of women receiving patents suggests a possible new 21st C. face on the old story of women's exclusion from the leading edge of science.

Keynote 2



Professor Dr Birgit Spinath
Heidelberg University, Germany

Birgit Spinath is professor of Educational Psychology at Heidelberg University, Germany. Her research interests include learning and teaching in schools and in higher education, motivation as a prerequisite for and an outcome of education, teacher education and self-regulation in the context of learning and achievement. She has been publishing her research in internationally leading journals (e.g., *Child Development*, *Journal of Educational Psychology*, *Intelligence*) and is on the editorial boards of several journals (e.g., *Learning and Individual Differences*, *European Journal of Personality*). Moreover, she is Associate Editor for the *Journal of Educational Psychology*, the *European Journal of Psychology of Education* and the *Psychologische Rundschau*, as well as Editor-in-Chief of *Psychology Learning and Teaching*. Dr. Spinath is currently Dean of the Faculty of Behavioral and Cultural Sciences at Heidelberg University. Birgit.Spinath@psychologie.uni-heidelberg.de

Motivation as a Key for Successful School-Trajectories and Careers

Although the gender gap has become smaller or even has closed in many disciplines, it is still wide in certain sciences, such as strongly math-based fields, and across all disciplines with regard to the highest-ranking job positions. Recent research shows that the reasons for gender disparities have to be searched much earlier in life than when career choices actually take place. Specifically, motivational preferences and beliefs formed at the beginning of school trajectories are very important for women's opting in or dropping out of certain fields. This presentation starts with pinpointing the current gender gap in different disciplines. It then carves out why early motivation is more important to understand the reasons for gender disparities than many other factors. One key to get more women into math-based fields and high-ranking positions is to help female students to assess their ability realistically and to prevent their preferences from being corrupted by gender stereotypes. To substantiate this conclusion, I will draw on my own research with students in different developmental stages and connect it with recent research on women's career tracks.

Keynote 3



Dr Patricia Fara
Clare College, Cambridge, UK

Patricia Fara is the Senior Tutor of Clare College, Cambridge. Her major research area is science in eighteenth-century England, but she also writes and lectures on women in science and scientific imagery. A regular contributor to popular and academic journals as well as radio and TV, she has published a range of books on scientific history. These include her prize-winning *Science: A Four Thousand Year History* (translated into nine languages), *Pandora's Breeches: Women, Science and Power in the Enlightenment* and a book designed for teenagers – *Scientists Anonymous: Great Stories of Women in Science*. She is currently writing about women, science and suffrage during World War One. pf10006@cam.ac.uk

A Lab of One's Own: Science & Suffrage in the First World War

Inspired by utopian dreams, H G Wells imagined a future characterized by science, equality and justice; and in 1919, the suffragist leader Millicent Fawcett declared triumphantly, 'The war revolutionised the industrial position of women. It found them serfs, and left them free.' Their optimism was premature. World War I did benefit British women by enabling them to take on traditionally male roles in science, engineering and medicine. But even though some women over 30 gained the right to vote, conventional hierarchies were rapidly re-established after the Armistice. Concentrating mainly on a small group of well-qualified scientific and medical women, marginalized at the time and also in the secondary literature, I review the attitudes they experienced and the work they undertook during and immediately after the War.

Keynote 4



Professor Jay Mitra
University of Essex, UK

Jay Mitra is Professor of Business Enterprise and Innovation at Essex Business School. He has acted as Scientific Adviser to the OECD, is a Fellow of the Royal Society of Arts, and leads the International Entrepreneurship Forum, a unique network and forum for researchers, policy makers and business practitioners working on entrepreneurship, innovation and regional development. He has written widely on entrepreneurship and innovation with a focus on opportunity development, female entrepreneurs, innovation and development and policy. His most recent book is '*Entrepreneurship and Knowledge Exchange*' (2015) which follows '*Entrepreneurship, Innovation and Economic Development*' (2012), by Routledge. He is editor of the '*Journal of Entrepreneurship and Innovation in Emerging Economies*'. jmitra@essex.ac.uk

STEMS of new venture creation: Women, Innovation and Opportunity Development

The stories of two STEM women, Ellen Pollack and Angie Chang, are those of women breaking through against expectations. Their narratives of isolation and biased cultural hegemonies on the one hand, and successful female scientific community networking on the other, make it possible to consider a different ontology for opportunity development by and for women. We know that the achievement of excellence in higher scientific or technological learning by women generates an unequal yield in terms of both pay, promotion and diversity in the world of work. We know less about the advances by STEM women in the high octane universe of high tech start-ups. We know that firms with the most women board directors (WBD) outperform those with the least on ROIC by 26 percent in the US. But we do not why only 30% of entrepreneurs in Europe are female. A European Commission report showed that at the European level 8.3% of patents awarded by the European Patent Office were awarded to women, that only 20.3% of businesses started with venture capital belonged to women and that women scored less than men when accessing the level of innovation of their own business. Even the arrival of the Internet appears to have flattened the world according to men only! On average across the developing world, nearly 25 percent fewer women than men have access to the Internet, and the gender gap soars to nearly 45 percent in regions like sub-Saharan Africa. If only entrepreneurship could advance equality of opportunity, for as an APEX Women report suggests, if men and women participated equally as entrepreneurs global GDP could increase by 2% or \$1.5 trillion. Perhaps the STEM stories of Victoria Ransom, Michelle Zatlyn, Kiran Mazumdar and Ylva Ryngbo, can spawn many more not just to increase the GDP but change the dynamics of growth and development. I draw together some propositions and make policy recommendations for creating a people focused, non-gendered and diversity-based framework for opportunity development for technology entrepreneurs.

Invited Distinguished Symposium

What motivates girls and boys to participate in STEM disciplines? The role of individual and contextual factors

Organiser and Chair

Dr Rebecca Lazarides, University of Potsdam, rebecca.lazarides@uni-potsdam.de

Session abstract

This session brings together international perspectives on individual and contextual factors that contribute to gendered motivation and participation in STEM disciplines. The presented research discusses the role that contextual factors, such as educational and occupations transitions, classroom settings and socially shaped work and family roles play in gendered motivation, performance and choice behaviours. Individual factors that contribute to gendered motivation and choices are also highlighted by demonstrating how vocational interest profiles and domain-specific gender stereotypes contribute to gendered motivation and choice. The presented research uses a great variety of quantitative research approaches, including longitudinal variable-centered studies, profile analyses and experimental settings. By focusing on different life stages, from middle childhood to early adulthood, the discussed findings provide detailed insights into salient institutional, social and individual factors that enhance or inhibit girls' and boys' and women's and men's performance and persistence in STEM.

1) The role of vocational interest profiles in reconstructing gender differences in educational transitions

Author

Gabriel Nagy, Leibniz Institute for Science and Mathematics Education, Germany,
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Abstract

Vocational interests are powerful determinants of occupational choices and are strongly related to gender. Starting in adolescence, vocational interests exhibit high rank-order stability. Gender differences in interest profiles have been discussed as a major reason for gendered occupational choices. However, studies that investigate whether vocational interest profiles account for gendered patterns of career choices are still rare. Ideally, studies should focus on the first phases of occupational careers, because educational attainments and/or specializations completed in tertiary education limit the range of occupational options accessible in later life.

The present research examines the role that gender and vocational interests play in predicting educational transitions related to individuals' career paths. It considers transitions from lower to upper secondary school, involving choices either of vocational tracks or of thematic profiles in upper secondary school (10th graders), and transitions from secondary to tertiary education reflected in the choice of fields of vocational education and training (10th graders) or university majors (13th graders).

The data sets stem from various large-scale studies in Germany and encompass approximately $N = 6000$ students. In all of the studies, vocational interests were assessed by the same well-established instrument based on Holland's RIASEC taxonomy, thereby ensuring the comparability of results. The predictive power of gender and interests was evaluated by using multinomial regression models.

Gender differences in interest profiles were large, and their magnitude was roughly constant across samples. Vocational interests were related to all choices considered. However, compared to post-school transitions, within-school transitions were less strongly related to students' interest profiles. However, within-school choices were related to gender even after controlling for interests, but gender was of minor importance in predicting post-school transitions.

Our results indicate that vocational interests already play a role in the early within-school transitions that forego occupational careers. However, as within-school transitions provide a limited range of options, a significant proportion of students need to compromise their interest profiles. As a consequence, students' background characteristics exert incremental effects in predicting choices

over and above interest. Post-school transitions to tertiary education offer a variety of options, allowing individuals to choose environments that best fit their interests. Hence, the effects of background characteristics vanish once interests are controlled for. The findings suggest that, in order to be effective, interventions whose aim is to increase the number of females in school courses that prepare students for tertiary education in STEM fields also need to address females' interest profiles.

Bio

Gabriel Nagy is a Professor for Quantitative Methods in Educational Research at the Leibniz Institute for Science and Mathematics Education (IPN). He completed his PhD thesis at the Max Planck Institute for Human Development. His research interests include educational and work-related transitions, cognitive and motivational development, achievement measurement, and statistical methods for longitudinal and multilevel data.

2) Effects of student-perceived mathematics classroom characteristics on mathematics motivation: School-related socialization of gender-differences in math?

Author

Rebecca Lazarides, University of Potsdam, rebecca.lazarides@uni-potsdam.de

Abstract

Teachers' beliefs and classroom behaviours are important influences on adolescent girls' and boys' domain-specific success expectancies and task values, which in turn affect their educational and occupational choice behaviours (Eccles et al, 1983). Only recently, classroom research thereby began to examine how teachers' emphasis on certain goals in the classroom and their beliefs regarding the ability of their students contribute to adolescent girls' and boys' gendered success expectancies and values. Given that girls often display lower valuing of mathematics, lower competence beliefs in mathematics and less often aim to attain a job in mathematics-related fields, it is important to analyse systematically how student-perceived classroom context and students' perceptions of their teachers' beliefs contribute to gendered motivational processes in mathematics. Research for example has suggested that girls and boys may benefit differently from their teachers' emphasis on classroom goals in mathematics classrooms (Meece, Gleenke & Burg, 2006).

The present research gives an overview on findings regarding gendered socialization processes in mathematics classrooms and discusses the role that classroom characteristics, such as goal structures, play for adolescent girls' and boys' personal goal orientations, success expectancies, task values, effort and persistence. Findings are presented from two questionnaire studies, which were conducted in Berlin, Germany. Data was assessed in both studies from approximately N = 1000 students and their mathematics teachers (N = 50; Study 2) in upper secondary schools (9th to 12th grade). Both studies included measures on students' perceptions of their mathematics classroom characteristics, their teacher beliefs, their task values and success expectancies.

Across samples, boys reported valuing of mathematics and higher success expectancies in mathematics than girls. Findings showed that student-reported mastery goal structure in mathematics classrooms significantly predicted students' task values across samples. Findings of Study 1 revealed that for girls perceived mastery goal structure affected mathematics self-concept more strongly than for boys, indicating that particularly girls benefit from a focus on understanding and mastery instead of competition in mathematics classrooms. Extending these findings, Study 2 examined through which gendered motivational processes mathematics classroom goal structure affects girls' and boys' task values, self-concept, effort and persistence.

Summarizing the findings, it was highlighted that student-perceived teachers' behaviours in mathematics classrooms are of high relevance for the socialization of gender differences in mathematics motivation and success beliefs in adolescents. In terms of educational implications, the findings suggest that reflecting own classroom behaviours and focusing on the gain of mastery may increase girls' and boys' motivation in mathematics.

Bio

Rebecca Lazarides is a Junior Professor for School Pedagogy at the University of Potsdam (Germany), Department of Education. Her research interests include the role of classroom characteristics, teachers and parents for the development of girls and boys motivation in secondary school. She is especially interested in the development of gendered motivation and career plans in mathematics.

3) A burden in girls' schoolbag: The consequences of math-gender stereotypes at the transition into primary school

Author

Carlo Tomasetto, University of Bologna, Italy, carlo.tomasetto@unibo.it

Abstract

Traditional gender stereotypes about males' and females' ability in math are among the last to be acquired by children in western societies, and the majority of early adolescents actually disavow these stereotypes at the explicit level¹. In this contribution I will present three subsequent studies in which the emergence and the consequences of gender stereotypes about math in middle childhood was studied by using both explicit and implicit measures, the latter aimed at detecting automatic associations stored in children's memory between math and the male gender.

In Study 1 (N = 202), gender stereotypes about math were studied in a sample of Italian first-graders by using both explicit (self-report) and implicit measures. A pictorial version of the Implicit Association Test (Child-IAT²) was purposely created. In Study 2 (N = 241) implicit and explicit stereotypes were studied in a sample of third-, fifth-, and eighth-graders. In Study 3 (N = 240) the salience of gender stereotypes was experimentally manipulated by having first-grade children coloring a stereotype-consistent vs. stereotype-inconsistent vs. neutral drawing. Implicit and explicit stereotypes and performance on a numerical fact-retrieving task were assessed.

Results from Study 1 demonstrate that at the explicit level stereotypes are neither known nor endorsed, as both boys and girls manifest a strong bias in favor of their in-group's ability. However, stereotypes emerge at the implicit level, as automatic associations between math and the male gender are present in girls, but not in boys. Study 2 further demonstrates that although explicit stereotypes are systematically disavowed, automatic associations increase in strength in both boys and girls from grades 3 through 8. Results from Study 3 demonstrate that stereotype salience does not impact on explicit stereotyping of math. However, automatic associations increase in strength in the stereotype-congruent vs –incongruent condition, and this variation reverberates in a corresponding decrease in girls' but not in boys' performance on the numerical fact-retrieving task. Taken together, these findings shed light on the relevance of implicit cognitive processes in the acquisition and vulnerability to gender stereotypes about math in middle childhood. Importantly, they prompt for more systematic interventions in the school contexts and in the society at large aimed at sustaining girls' identification with math from the very beginning of formal schooling.

Bio

Dr. Carlo Tomasetto is Associate Professor in Developmental and Educational Psychology at the University of Bologna (Italy), Department of Psychology. His research interests are mainly focused on the emergence of a variety of societal stereotypes (e.g., concerning gender, obesity, physical appearance, etc.) and their relations with cognitive functioning in children. With regards to gender and STEM studies, his work is aimed at better understanding how implicit cognitive processes, on the one hand, and parental influences, on the other, affect children's stereotyping of math as a male domain.

Symposium

Gender-stereotypical beliefs, expectations, and motivation, and STEM career choice: Challenging trajectories for teachers and students?

Organiser and Chair

Penelope Watson, University of Auckland, New Zealand, p.watson@auckland.ac.nz

Session abstract

The proposed symposium presents complementary national and theoretical perspectives interrogating the role of gender-stereotypical beliefs in influencing motivation to engage in trajectories leading towards STEM-related fields, for girls (and boys). In four papers, the effects of an intervention to raise male teachers' lower expectations of their male and female students' mathematics achievement; teacher and student gender beliefs about career choice, subject aptitude, and gendered learning styles; barriers against girls' involvement in the technology-related trades; and preferences motivating postgraduate students' future career choices will be respectively revealed. After brief introduction by the chair, each presenter will be allotted 15 minutes with 2 minutes each for specific queries. A 10 minute discussant summation will conclude the symposium, followed by 5 minutes for robust audience dialogue. Importantly, the symposium foregrounds key findings and approaches which offer the potential to address shortcomings in the pathway towards choosing STEM careers for girls and young women.

1) Teacher gender and expectations of mathematics achievement: STEMming the flow with an intervention?

Authors *Presenting author

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Abstract

Gender stereotypes have been found to shape student participation and sense of self-efficacy in mathematics (stereotyped as a masculine domain), and in turn to influence teacher expectations. Further, although teacher expectations influence student academic outcomes there is only an emerging understanding of the role that teacher (as opposed to student) gender plays in shaping teacher expectations. The current paper reports on the results of an intervention to raise and sustain teacher expectations of student achievement, during a longitudinal study conducted with New Zealand elementary school teachers and their students. Hierarchical linear modelling of base line data for the study, revealed that male (as compared to female) teachers had substantially lower expectations of both their male and female students' mathematics achievement. The results from the study's pre-intervention data also indicated that girls in the classes of male mathematics teachers achieved lower results in mathematics than their male peers, suggesting that other forces (such as stereotype threat) may have been at play. Thus, it was hypothesised that the intervention would positively influence male teachers' lower expectation of their students' mathematics achievement, and diminish the gender gap disadvantaging girls' mathematics achievement in classes of male teachers. Specifically, the results of hierarchical linear models conducted with intervention data from the second and third years of the study (Phase 4, $n = 1,861$; Phase 5, $n = 1,727$; Phase 6, $n = 1,373$; and Phase 7, $n = 1,216$), revealed that teacher gender was no longer associated with differentiated teacher expectations of mathematics achievement ($d_{\text{phase1}} = .5, p < .001$; $d_{\text{phases4 to 7}} = -.03 \text{ to } .1, p > .05$). As well, no statistically significant difference in achievement was found between girls' and boys' mathematics achievement for students in male teachers' classes after the intervention had been introduced ($d < .1, p > .05$ for phases 4 to 7). Taken together, the findings of the current study suggest that the intervention to raise and sustain teacher expectations mitigated the lower male teacher expectations demonstrated prior to the intervention, and may have been positively associated with removing a gender achievement gap in mathematics evidenced to disadvantage girls in male teachers' classes in the base line data. The findings of the study hold implications for addressing the continued underrepresentation of females in mathematics-related fields, and for the raising of gender awareness in teacher education programs.

Bio's

Penelope Watson is a Lecturer at the University of Auckland's Faculty of Education and Social Work. Her research interests are gender, gender stereotypes and identity, gendered beliefs and expectations, and gender stereotype threat. She contributes as a researcher to several projects exploring, for example, the influence of gendered teacher expectations of academic achievement on male and female students, and the influence of adolescent gender self-concept on school belonging, and on ethnic identity. Penelope's work has been published in *The International Journal of Gender, Science, and Technology*, and in the *Routledge International Handbook of Social Psychology of the Classroom* (2015).

Christine Rubie-Davies is a Professor at the University of Auckland's Faculty of Education and Social Work. Her research interests are whole class level teacher expectations, how teacher beliefs and personality characteristics influence instructional and socioemotional classroom climates, ethnic issues, and gifted students. Christine is a Fellow of the Association for Psychological Science (US), has received a National Tertiary Teaching Excellence Award, and has been recognized for excellence in reviewing by the American Educational Research Association. Her work has been published in journals such as *Journal of Educational Psychology* and *Contemporary Educational Psychology*. Kane Meissel is a Lecturer in Educational Psychology within the Faculty of Education and Social Work at the University of Auckland, specialising in quantitative research methodology. Kane is also interested in research that improves equitable outcomes for under-served students, as well as professional development, schooling improvement and evaluation, literacy and second language acquisition.

Elizabeth Peterson is Senior Lecturer in the School of Psychology at the University of Auckland and currently teaches in the Developmental Programme. Most of her research is focused on trying to understand the factors, processes and pathways that optimise human learning and development and that promote happy, healthy, well rounded and resilient young people. She is particularly interested in the how people's self-beliefs and expectations affect their wellbeing, learning and educational outcomes. Elizabeth is a researcher on Growing Up In New Zealand, a longitudinal study following approximately 7000 New Zealand children.

Annaline Flint is a lecturer and researcher in the School of Learning Development and Professional Practice at the University of Auckland's Faculty of Education and Social Work. Her current research is mainly focused on the relationships between various teacher beliefs and how these influence student achievement and link to teacher practices. Annaline also has interests in teacher expectations, the induction and mentoring of novice teachers, and teachers' perceptions of values education. Annaline has published articles in journals such as the *British Journal of Educational Psychology* and *Professional Development in Education* and has authored two book chapters.

Lynda Garrett is a Senior Lecturer in the School of Learning Development and Professional Practice at the University of Auckland's Faculty of Education and Social Work. Her research has focused on motivation, social-emotional aspects of giftedness, the talent development process for young gifted and talented students in the verbal-linguistic domain, and the influence of teacher expectations on young gifted and talented readers. Lynda has presented at national and international conferences on gifted and talented education, and is currently building a publishing profile within journals such as *English Teaching: Practice and Critique*, and *The European Journal of Social and Behavioural Sciences*.

Lyn McDonald is a Senior Lecturer in the Faculty of Education and Social Work at the University of Auckland. Her research interest is focussed on her doctoral study which relates to teacher education and the specific role of the visiting lecturer in student teacher learning on practicum. Her second area of research interest is in the field of teacher expectations. Her teaching interests relate to assessment, the professional teacher and learning theories. Her work has been published in journals such as *British Journal of Educational Psychology* and *New Zealand Journal of Teachers' Work*.

2) Teachers' and students' beliefs about career choice, science, and learning styles. Are they gender related?

Authors **Presenting author*

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Abstract

Teachers' beliefs influence students' classroom behaviour and learning outcomes. Little is known, however, about how specific teacher-related characteristics (gender, teaching domain) may be associated with these beliefs. In the current study, situated in The Netherlands, three versions of the Implicit Association Test (IAT) were used to assess teachers' gender-related implicit beliefs regarding career choices, aptitude for science, and learning styles. The IATgenderLearningStyles was especially designed for the study. The beliefs of 107 participants (teachers in pre-vocational secondary education) were investigated. Student views on course- and career-choices, and classroom behaviour and achievements were also investigated using focus group data. Participants ($N = 176$) comprised students from 10 secondary education schools (female, $n = 88$; and male, $n = 88$; $Mage = 13.77$, $SD = 0.66$). Neither gender nor teaching domain was associated with teachers' gender-related beliefs regarding career choices. For male teachers, having a STEM background was associated with stronger gender-related beliefs regarding aptitude for science. The results of the IATgenderLearningStyles indicated small gender-related scores (i.e., stronger male student-independent learning association: seeking no teacher confirmation; employing trial and error) in male teachers and STEM teachers. There was a significant main effect of gender with a small effect size ($\eta_p^2 = .12$) and a significant main effect of teaching domain ($\eta_p^2 = .052$), indicative of stronger results for STEM-teachers. Students' stereotypical course- and career -choices were reflected in the participants' focus group data, with boys opting for technical subjects and girls preferring 'health and care'. Such results confirmed the findings of the majority of prior research, but contradicted some evidence that girls (rather than boys) were more interested in STEM subjects. Further, in the current study girls and boys shared the same gender-stereotypical views towards aspects of learning and classroom behaviour such as achievement ("*girls want to achieve better*") and learning style ("*they ([girls] are more precise and serious*"). Boys also commented that they were treated differently to girls in terms of marks (lower in general) and rules (stricter for boys). Furthermore, boys reported that they were held to higher standards by their teachers compared to girls. Moreover, in line with previous findings, girls expressed less self-confidence compared to boys and doubted their abilities. The findings of the current study indicate persistent influence of stereotypical bias. A continuous mutual reinforcement of teacher and student beliefs might sustain these stereotypical notions and suggest implications for maintaining gender gaps and limiting career choice.

Bio's

Emmy de Kraker Pauw is an educational specialist, managing director of education, teacher, and PhD student in the Department of Educational Neuroscience and Research Institute, Learn!, Faculty of Psychology and Education, Vrije Universiteit, Amsterdam. She has pursued a career in the educational field for 37 years in primary, secondary, higher education, and schools for special education (e.g. psychiatry). Emmy will defend her doctoral dissertation in the next few months.

Dr. Floryt van Wesel is an Assistant Professor at The Department of Methodology and Statistics, Faculty of Social Sciences, Utrecht University. In 2011 she defended her PhD thesis 'Priors & Prejudice: Using existing knowledge in social science research', and then until 2015, taught methods and statistics at The Department Educational Neuroscience, Faculty of Psychology and Pedagogy, Vrije Universiteit, Amsterdam. In recent investigations upon return to Utrecht University, she has focussed on the methodology of systematic reviews, using mixed methods, meta-analysis, and qualitative evidence synthesis. Her research is published in *Open Journal of Statistics*, *Quality and Quantity*, and *Transcultural Psychiatry*.

Dr. Nienke van Atteveldt, is an associate professor in the Department of Educational Neuroscience and LEARN! Research Institute for Learning and Education, at the Faculty of Behavioural and Movement Sciences, Vrije Universiteit, Amsterdam. She is intrigued by the flexibility of the brain, and wants to narrow the gap between brain research and the (educational) practice. The selective processes contributing to the evolution of the brain, and the plasticity and experience-dependence

during a lifetime particularly interest her. Publications include those for *The Journal of Cognitive Neuroscience*, *Neuron*, and *Neuropsychologia*.

Dr. Lydia Krabbendam is a Professor in the Department of Educational Neuroscience and LEARN! Research Institute for Learning and Education, at the Faculty of Behavioural and Movement Sciences, Vrije Universiteit, Amsterdam. Her professional interests include the development of higher cognitive functions and social cognition during adolescence and early adulthood, and how these relate to school performance and development of psychopathology. Key research topics include the development of self-regulation, cognitive control, decision making, emotion-regulation, mentalising, trust, and fairness, and the neural correlates of these functions. She publishes in journals such as *The Psychological Bulletin*, *Psychological Medicine*, and *Schizophrenia Research*.

3) Girls in trades: Why young women are not choosing the trades from secondary school

Author

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Abstract

Gender stereotypes and societal beliefs of gender-role conformity can impact the choices made by young adults as they transition from school to the world of work. Specifically, stereotypes indicating gender-inappropriateness of male-dominated industries (such as plumbing, building, and electrical engineering) have affected young women's self-efficacy and self-identification with careers in the manual trades. As women seek support to transition out of school, they often find the societal beliefs around appropriate roles for women in the workforce (e.g., roles involving care and support) can create barriers to careers such as those in the manual trades. In addition, emotional barriers can prevent women from thriving in male-dominated workplaces as these environments can be devoid of the relational quality that many women value. Ultimately, the trades offer a career pathway that provides a good income based on technical training but without the need for a university qualification. However, women are underrepresented in this and other technology-based career pathways gendered masculine, with wider impact on female earning equity, and with implications for reduced global gross domestic product (GDP). Further, there is an acknowledged shortage of personnel prepared to enter the trades. There are, nevertheless, ways in which young women can be effectively supported to transition into the trades. Internationally, these have been based on effective mentoring, clustering women into training programmes, and specialized career advice. In one New Zealand school, there is a push for an all-female Trades Academy, where the young women are clustered together to develop the skills required for the manual trades. There is also a focus on mentoring the young women to support them into a career into the manual trades, including an explicit understanding of the barriers. The current research aims to identify possible ways to remove real and perceived *barriers* that prevent young women from entering male-dominated trades. Such objectives shape the rationale for and design of the proposed study reported in this paper. Thus, the current research will interrogate qualitative data from young women participating in an all-female trades training programme, to gauge the effectiveness of the initiatives implemented to reduce barriers that persist in contributing to the underrepresentation of women in the trades. The aforementioned initiative supports the enhanced entry of young women into the manual trades, providing the potential for improved life-opportunities, the possibility of utilizing a hitherto neglected human resource pool, and a potentially increased GDP in countries prepared to encourage such initiatives.

Bio

Kylie Taffard is an Assistant Principal at Kelston Girls' College, Auckland, New Zealand, and the Director of the school's Trades Academy. She is also an EdD student researching the transition from school to employment, with a particular focus on young women transitioning into non-traditional career pathways. She is a member of the local council's steering group and provider working party to improve youth employment in the local area. Kylie has developed a passion for developing opportunities for young people to make informed choices about their careers pathways. This includes working with employers and ITO's to provide meaningful work placements.

4) Gender and disciplinary differences in the future plans of postgraduate students

Author

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Abstract

There has been a surge in university enrolments worldwide as well as in Pakistan during last two decades, which makes us think about what motivates these students to enter university and accomplish a postgraduate degree. It is widely observed that human activities are driven by the motivational force of present as well as future goals. This paper presents the results of a study conducted to explore the reasons for engaging in a postgraduate degree and future career plans of postgraduate students in Pakistan. Participants in the study were 365 Postgraduate students (235 female) with a mean age of 22.45 years and who were enrolled in five different departments of study, namely, Department of Gender Studies (DGS), Mathematics (DM), Business Education (DBE), the Centre of English Language Teaching and Linguistics (CELTL) and the Institute of Business and Information Technology (IBIT). A questionnaire was personally administered by the author in order to collect data. A thematic analysis of the students' responses to three open ended questions about the reasons for pursuing their current degree and preference and choice of a future career, and a regression analysis of one structured response question about the importance of various activities after getting a postgraduate degree, revealed that gaining employment was not only the most important reason for completing a postgraduate degree, but was also the most important activity that these students wanted to pursue after getting their degree. The current study did not show any significant effect of gender on the importance of various future activities such as employment, studying further, and getting married. However some differences were noted across departments of study. Overall, employment was considered important by most of the students in all departments but this proportion was the highest in the CELTL, DGS and IBIT. Getting married and having family were considered to be comparatively less important by students in all departments but the percentage of such students was highest in the department of Mathematics, which had a majority of female students. Teaching was the career/employment preferred by most of the respondents from CELTL and DM, departments that had more females than male students. Teaching and government jobs were considered to be very suitable and respectable for females. The future plans of the students highlighted their strong instrumentality and extrinsic goal orientation, characterised by their preference for better employment, financial status and respect.

Bio

Dr Munaza Nausheen is an Assistant Professor at the Institute of Education and Research, University of the Punjab, Lahore Pakistan. She completed her MA in Secondary Education from Punjab university, Lahore, MA in Educational Technology from the University of Bath, UK, and her PhD in higher education from Monash University, Melbourne, Australia. She has been teaching courses in quantitative research, student assessment, monitoring and evaluation, and instructional methodologies, at postgraduate level for the last twenty years. Her research interests focus on higher education, learning experiences, motivation, assessment and reporting of student learning, and gender differences in learning and achievement.

Themed Paper Sessions

PAPER SESSION 1: Expectancies and values for STEM pursuits

1) STEM vs. Non-STEM careers: Exploring the roles of expectations, experiences, and support in the lives of women

Authors

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Abstract

The pipeline that exists for women going into STEM-related careers has been an area of research that is widely studied (Fuoad et al., 2010; Fuoad et al., 2011; National Science Foundation, 2008; 2009). Factors such as social support or academic curriculum are important for girls and women in their decisions to pursue STEM careers (Messersmith et al., 2008). However, few studies have focused on how STEM-related career decisions are shaped from high school aspirations and experiences. Moreover, the narratives behind the different factors that play a role for women in STEM and non-STEM careers are understudied. This study had two aims. First, we explored the role of social support (from parents and teachers) and experiences in the lives of women who were in STEM versus non-STEM careers. Second, we explored how ideals such as value, cost and attainment that are specific to math and science informed their choices to go into STEM or non-STEM careers and to stay or leave their intended career pathway.

The original sample consisted of 49 individuals who participated in two 20-year longitudinal studies. Individuals participated in semi-structured qualitative interviews that asked about the experiences in their lives ranging from high school to the present career. Thirty-three (67%) of these participants were female and in their mid-30's. During high school, 67% had STEM career aspirations whereas 33% had non-STEM career aspirations. However, 79% were in non-STEM careers, while 21% were in STEM careers at the time of the interviews.

Coding of the interviews was done by thematic analysis. Themes that emerged included: 1) social support from teachers and families, 2) experiences within the classroom, and 3) experiences at the workplace. Additionally, we explored whether notions of cost, utility, attainment, and value (Eccles et al., 1983) around participants' STEM beliefs were associated with their careers. In particular, we found that women in non-STEM careers discussed having negative or neutral support from their teachers or families, whereas those in STEM careers talked of positive support from both teachers and families. Women who were in STEM fields discussed the positive utility and interest in science and math, whereas women in non-STEM fields discussed difficulties and challenges they had in math and sciences in their high school and secondary education classes. Implications for the importance of considering how these different factors can shape females' STEM and non-STEM aspirations and later careers decisions will be discussed.

Bio's

Meeta Banerjee is currently an assistant professor in Psychology at California State University, Northridge. Dr. Banerjee was a postdoctoral student under Dr. Jacque Eccles at the University of Michigan. She received her Ph.D. in Ecological-Community Psychology from Michigan State University in 2012. Her research employs both integrative and ecological frameworks to understand the influence of contextual factors on early and late adolescent developmental trajectories in ethnic minority families. She is especially interested in exploring the interaction between ecological contexts (e.g., schools, families, neighborhoods, racial discrimination, and communities) and racial socialization processes. Additionally, she has begun to examine how gender and race may intersect with regards to academic trajectories and outcomes.

Katerina Schenke is a postdoctoral scholar at the University of California, Los Angeles. Her research focuses on understanding what makes classrooms effective environments for increasing students' learning and motivation. She is also affiliated with the National Center for Research on Evaluation, Standards, and Student Testing where she works on issues related to large scale educational assessment. She received her PhD in Education from the University of California, Irvine.

Arena Lam is a research associate at WestEd since 2015. Her research focuses on the different contexts, such as the classroom climate, that impact students' motivational beliefs for mathematics and science. She received her PhD in Education from the University of California, Irvine.

Jacquelynne S. Eccles is Distinguished Professor of Education at the University of California, Irvine and formerly McKeachie/Pintrich Distinguished University Professor of Psychology and Education at the University of Michigan, and Senior Research Scientist and Director of the Gender and Achievement Research Program at the Institute for Social Research. Over the past 30 years, she has conducted research on a wide set of topics including gender-role socialization, teacher expectancies, classroom influences on student motivation, social development in the family and school context. A leading developmental scientist of her generation, she made seminal contributions to the study of achievement-related decisions and development. Her expectancy-value theory of motivation and concept of stage-environment are perhaps the most dominant models of achievement during school years. Service to her profession has included Chair of the Advisory Committee for the Social, Behavioral and Economic Directorate at the National Science Foundation; Chair of the MacArthur Foundation Research Network on Successful Pathways through Middle Childhood; Editor of *Developmental Psychology* & *Journal for Research on Adolescence*; Associate Editor for *Psychological Bulletin* & *Child Development*. She is president of Division 7 of APA, past president of the Society for Research on Adolescence (SRA) and Division 35 of APA, and served on faculty at Smith College, University of Colorado, and University of Michigan.

2) School students' aspirations for STEM careers: how are they thinking about their futures?

Authors

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- Leanne Fray, University of Newcastle, Australia, Leanne.Fray@newcastle.edu.au

Abstract

The growing imperative for a strong future STEM workforce is high on the political agenda in Australia as in other Western nations (Office of the Chief Scientist, 2013). Within STEM education and careers low participation rates persist particularly for females and for those from disadvantaged backgrounds. While traditionally the focus of careers research has been on the career choices of adolescents, increasingly researchers are interested in the formation and circumscription of career aspirations in younger children. If progress is to be made in increasing STEM participation then understanding the complex intersection of factors impacting on children's aspirations is essential.

Our analysis is shaped by the comprehensive synthesis of van Tuijl & van der Molen (2015), who hypothesise that STEM career development for children aged 8-16 is impacted by three factors: knowledge of STEM careers; the affective value attributed to STEM careers; and ability beliefs and self-efficacy building. Using these three broad categories we examine school students' thinking in relation to STEM careers to identify significant enablers and barriers from their perspective.

This paper examines the aspirations for STEM careers of more than 10,000 survey responses from over 6,000 students in Years 3-12 over the period 2012-2015 in government elementary and secondary schools in New South Wales, Australia. We categorise STEM careers as core (those involving advanced mathematics and/or pure science eg. engineer, scientist) or related (those involving applied mathematics or science eg. veterinarian, nursing) and investigate the characteristics of the students aspiring to these careers in terms of socioeconomic status, gender, prior achievement, year level, location language background and proxies for cultural and social capital. We also examine the reasons that students give for their aspirations to gain insight into their reasoning about the possibilities for their futures. Further, we analyse focus group data from more than 600 students to gain a deeper understanding of the discourses on which school students draw when discussing their interest or disinterest in STEM fields.

We found significant gendered differences in the aspirations for core and related STEM careers and in the reasons that male and female students give for those aspirations. This study contributes to the knowledge base associated with the career development of children and adolescents, and in doing so provides insights for policy makers charged with addressing the predicted STEM skills shortage. Understanding these issues from the perspective of children and young people is critical if intervention strategies are to be effective.

Bio's

Kathryn Holmes is Professor at the University of Western Sydney. A founding member of the Teachers and Teaching Research Program and Co-Editor of the prestigious international journal, *Teaching and Teacher Education*, Kath has won more than \$2.4 million in research funding. With a PhD in Financial Mathematics and a background in mathematics education, Kath has extensive experience in conducting large-scale longitudinal, mixed methods studies that involve complex statistical analysis. She currently holds an ARC Linkage grant and an OLT grant, among others.

Adam Lloyd is a post-doctoral research fellow in the School of Education at the University of Newcastle, Australia. He was awarded his PhD from the University of Newcastle in 2015. He also completed a bachelor of Engineering (Hons 1) and Diploma in Education through the University of Newcastle before obtaining a Master of Education through the University of Melbourne. He has published in international journals and presented at national and international conferences. A member of the Teachers and Teaching Research Program, Adam's research interests include; RCTs, student aspiration, and improving equity and excellence in education, particularly in relation to STEM disciplines.

Jenny Gore is a Professor in the School of Education at the University of Newcastle, Australia, where she was Dean of Education and Head of School for six years. Currently Director of the Teachers and Teaching Research Program and Co-Editor of the prestigious international journal, *Teaching and Teacher Education*, Jenny has won more than \$4.9 million in research funding. Widely published and cited, her current major research projects include a randomised controlled trial investigating the impact of Quality Teaching Rounds, and a longitudinal study exploring the formation of educational and career aspirations in the middle years of schooling.

Originally a secondary social sciences and computing studies teacher mostly serving in rural schools, Max Smith held a series of senior departmental positions during his 36-year career with the NSW Department of Education. Joining the School of Education at the University of Newcastle, Australia, as a Professor of Education in 2012, Max has continued to maintain strong professional interest and ongoing research commitments across a variety of public policy contexts. Currently Co-Editor of the prestigious international journal, *Teaching and Teacher Education*, Max is also a founding member of the Teachers and Teaching Research Program at the University.

After working as a teacher in public schools following her undergraduate training in teaching and social science, Dr Leanne Fray completed her PhD in 2012. Currently a project manager in the School of Education at the University of Newcastle, Australia, Leanne previously worked on various other research projects at the University across such disciplines as health and social sciences, including the Australian Longitudinal Study on Women's Health. With extensive experience in qualitative data analysis, Leanne provides research support to the Aspirations Longitudinal Study and is currently managing a HEPP-funded project which investigates the aspirations of students for higher education.

3) Maximizing gender equality in STEM by minimizing personal choice? Differential effects of obligatory math coursework on gender differences in STEM-related outcomes

Authors

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Abstract

Theoretical framework. Math achievement, self-concept, and interest are critical predictors of STEM careers and closely linked to high school coursework in math (Schoon & Eccles, 2014). Girls are less likely to choose advanced math courses and there is evidence that encouraging females to enrol in such courses may bring more women into STEM careers (Watt & Eccles, 2008).

Aims and objectives. We examined the effects of a state wide educational reform in one of the German states that required all students to take advanced math courses in high school. We studied whether gender differences in central math outcomes may change when math coursework is held constant for girls and boys.

Sample. Data were drawn from the TOSCA study (Trautwein et al., 2010). Data from 4,730 students before the reform (age: $M = 19.56$; 55.0 % female) and 4,715 students after the reform (age: $M = 19.42$; 54.3% female) was compared.

Methodology. We specified multiple regression models and tested gender as a moderator of the effect of the reform on math achievement (based on items from TIMSS; Mullis et al., 1998), math self-concept (SDQIII; Schwanzer et al., 2005), and realistic and investigative interests (AIST-R; Bergmann & Eder, 2005), as those interests are most closely associated with STEM (Su et al., 2009). We examined gender, cohort, and the interaction effect of gender and cohort, after controlling for socioeconomic background, predicting each outcome variable separately. The sample was weighted to obtain representative results. Robust standard errors were estimated to consider the hierarchical structure of the data (Snijders & Bosker, 2012). All missing values were treated using FIML in Mplus 7.3 (Muthén & Muthén, 2012).

Results. We found clear gender differences before the reform with higher scores for boys in all studied outcomes. Differential effects on the outcomes were found after the reform: Whereas gender differences in math achievement decreased, differences between boys and girls in math self-concept and both interest facets increased.

Significance. Results indicate that reforming course choice options in math moderates gender differences in various STEM-related outcomes. Because self-concept and interests are critical for career choices above and beyond the impact of achievement (e.g., Wang et al., 2013), changes in math coursework requirements might stream females away from STEM. This study is making an important contribution towards a better understanding on how gender differences in STEM could be manipulated through educational reforms.

Bio

Eike Wille is working as a research associate at the Hector Research Institute of Education Sciences and Psychology at the University of Tübingen, Germany. After studying Educational Science and Natural Science Education, Eike Wille completed her Master in communication science (M.A.), with focus on multimedia learning. Her research examines the role of math and science motivation for gender differences in the STEM area. In her dissertation project under supervision of Professor Kerstin Oschatz, Professor Ulrich Trautwein, and Professor Benjamin Nagengast, she studies individual and structural factors that affect women's math and science motivation and their choices of STEM university majors.

PAPER SESSION 2: Social perspectives on STEM choice

1) Understanding high school girls' interest in pursuing STEM: A social identity perspective on belonging and achievement concerns.

Authors

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Abstract

In order to understand women's and girls' underrepresentation in STEM, many steps have been taken to increase insight in their study and career interests and choices (e.g., social-cognitive career theory, expectancy-value theory). This literature often focuses on goals and self-efficacy regarding achievement. In the current research, we extend this to goals and self-efficacy regarding belonging, arguing that both achievement and belonging have unique and interactive effects on STEM interest and choices. Additionally, we combine this with a contextual social identity perspective, emphasizing that the social environment can trigger or reduce concerns about belonging and achievement goals, and consequently affect girls' interest in pursuing STEM.

We conducted a longitudinal study in collaboration with the non-profit organization greenlight for girls (www.greenlightforgirls.org). Greenlight for girls is an international organization dedicated to inspiring girls of all ages and backgrounds to pursue STEM. The current sample consisted of girls between 11 and 15 years old from secondary schools in the Brussels area who completed online questionnaires. Results showed that supportive contextual factors (e.g., encouraging teachers, presence of role models) reduced concerns about belonging and achievement in STEM-fields, while identity-threatening contextual factors (e.g., perceptions of social stereotypes, perceiving incompatibility between their gender and STEM) increased these concerns in this sample of high school

girls. Moreover, results showed that supportive and identity-threatening contexts can differentially impact belonging and achievement concerns. We subsequently investigated how this impacted their perceived belonging and achievement self-efficacy in STEM-fields, and their interest in pursuing advanced STEM-subjects, STEM-studies, and STEM-related careers more generally. The discussion focuses on the differing and interactive roles that concerns about belonging and achievement play in interest and motivation to pursue STEM.

These insights in processes that are key for high school girls' interest in pursuing STEM can be used in applied settings by greenlight for girls to continually optimize their social impact, as well as by schools and other organizations aiming to reduce negative influences that limit high school girls' interest in STEM.

Bio's

Jenny Veldman's PhD project focuses on understanding women's underrepresentation in work and study fields such as STEM from a social identity perspective. She investigates how contexts can elicit (e.g., negative stereotypes) or reduce (e.g., role models) concerns about belonging and achievement, and how regulating behavior and affect in the service of these goals affects well-being and motivation – and ultimately the choices women make regarding their work or studies. She studies these issues among women in crucial decision-making phases (e.g., high school girls making decisions about advanced STEM courses) as well as women starting new STEM-related disciplines (e.g., first-year STEM students).

Colette van Laar is the newly appointed research Professor of Gender Studies at the Center for Social & Cultural Psychology, University of Leuven. Her research examines social psychological factors and processes that transfer negative group stereotypes and prejudice into lower outcomes in education and work. She examines well-being, motivation and performance in women in a number of fields, including girls with regard to math, young Muslim women in education and the labor market, and women pursuing upward mobility and leadership positions in the police force, telecom, banking and other organizations in which they have traditionally been underrepresented.

2) Exploration of parental influence(s) on who seeks a career in STEM

Authors

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Abstract

Internationally there is growing concern of a potential 'crisis' in industries that require a STEM (Science, Technology, Engineering and Mathematics) trained workforce. As the 21st century progresses and society becomes ever more dependent on the products produced from STEM industries, it is imperative that educational institutions are attracting and training students to meet the evolving needs of industry. In many areas of STEM there is still a disparity in the representation of females and disadvantaged students, particularly at the tertiary level. When exploring strategies to encourage students to consider STEM and inform and educate all students about pathways into STEM education/careers, educational institutions should consider involving parents. Parents play a significant part in children's home environment, lifestyle behaviours and potentially career aspirations, however there appears to be a paucity of research exploring the influence of both parents on children's aspirations into STEM pathways.

Drawing on data from a four-year (2012–2015) mixed method longitudinal study led by Gore, Holmes, Smith, Southgate, and Albright (ARC LP120100013) of over 6,000 students (and additional focus groups involving more than 500 students) in Years 3 to 12 in New South Wales public schools, which explores the career aspirations of young people, we examine the views of those students who signal interest in pursuing STEM studies/careers. The sample also includes parent surveys (n=1360) and parent interviews (n=63). Utilizing aspects of expectancy-value theory, we look at the alignment of parent STEM occupations to those of children's aspirations and the potential differential influence of parent gender is also explored. Regression analysis in SPSS was used and it appears students who express an interest in STEM are typically high achieving and depending on the specific area/specialisation of STEM, there is clustering based on gender. Students' motivations for interest in STEM are varied, however, altruism, money, academic performance, interest in making things and family influences all play a part in informing their aspirations. The analysis highlights

the importance of considering parental influences on students' aspirations which may help inform the activities and strategies that schools and universities undertake to attract and retain students (male and female) from diverse backgrounds into STEM pathways.

Bio's

Adam Lloyd is a post-doctoral research fellow in the School of Education at the University of Newcastle, Australia. He was awarded his PhD from the University of Newcastle in 2015. He also completed a bachelor of Engineering (Hons 1) and Diploma in Education through the University of Newcastle before obtaining a Master of Education through the University of Melbourne. He has published in international journals and presented at national and international conferences. A member of the Teachers and Teaching Research Program, Adam's research interests include; RCTs, student aspiration, and improving equity and excellence in education, particularly in relation to STEM disciplines.

Jenny Gore is a Professor in the School of Education at the University of Newcastle, Australia, where she was Dean of Education and Head of School for six years. Currently Director of the Teachers and Teaching Research Program and Co-Editor of the prestigious international journal, *Teaching and Teacher Education*, Jenny has won more than \$4.9 million in research funding. Widely published and cited, her current major research projects include a randomised controlled trial investigating the impact of Quality Teaching Rounds, and a longitudinal study exploring the formation of educational and career aspirations in the middle years of schooling.

Kathryn Holmes is Professor at the University of Western Sydney, Australia. A founding member of the Teachers and Teaching Research Program and Co-Editor of the prestigious international journal, *Teaching and Teacher Education*, Kath has won more than \$2.4 million in research funding. With a PhD in Financial Mathematics and a background in mathematics education, Kath has extensive experience in conducting large-scale longitudinal, mixed methods studies that involve complex statistical analysis. She currently holds an ARC Linkage grant and an OLT grant, among others.

Originally a secondary social sciences and computing studies teacher mostly serving in rural schools, *Max Smith* held a series of senior departmental positions during his 36-year career with the NSW Department of Education. Joining the School of Education at the University of Newcastle, Australia, as a Professor of Education in 2012, Max has continued to maintain strong professional interest and ongoing research commitments across a variety of public policy contexts. Currently Co-Editor of the prestigious international journal, *Teaching and Teacher Education*, Max is also a founding member of the Teachers and Teaching Research Program at the University.

After working as a teacher in public schools following her undergraduate training in teaching and social science, Dr *Leanne Fray* completed her PhD in 2012. Currently a project manager in the School of Education at the University of Newcastle, Australia, Leanne previously worked on various other research projects at the University across such disciplines as health and social sciences, including the Australian Longitudinal Study on Women's Health. With extensive experience in qualitative data analysis, Leanne provides research support to the Aspirations Longitudinal Study and is currently managing a HEPP-funded project which investigates the aspirations of students for higher education.

3) How do gender role orientations and teaching styles affect vocational aspirations towards STEM fields? Empirical evidence from Swiss school studies

Authors

- Andreas Hadjar, University of Luxembourg, Esch-Belval/LU, Andreas.Hadjar@uni.lu
- Belinda Aeschlimann, Swiss Federal Institute for Vocational Education and Training, Zollikofen/CH

Abstract

Horizontal gender inequalities appear to be rather stable, with girls more often choosing 'female' service professions, and boys choosing career paths related to STEM fields. Gender stereotypes, namely non-egalitarian patriarchal gender-role orientations and gender associations of the school subjects German and mathematics, will be theorised and empirically analysed as a major predictor of gender-typical vocational perspectives considering interest in these school subjects as a mediating factor. Furthermore, we focus on structural patriarchy as a root of gender-role orientations, and teacher gender regarding its impact on gendered images of subjects. Furthermore, we consider instructional design and orientation toward a STEM career in a classroom as relevant factors.

Empirical analyses are based on survey data of eighth-graders in secondary schools in the Swiss canton of Bern (Study I) and of upper secondary school students in their final year at school from the German-speaking part of Switzerland (Study II). Results from the first one, reveal different patterns for boys and girls; for boys, gender-typical (male) vocational perspective could be explained via gender role orientations, interest in mathematics and gender associations of the school subjects, for girls, the factors under consideration could be empirically linked to 'atypical vocational perspective'. The second study shows that improvement of the motivational conditions in mathematics, physics, and chemistry classes through targeted teaching practice not only can raise the learning motivation of male and female high school students, but can also have a positive effect on their willingness to start studies in a STEM field.

Bio's

Dr Andreas Hadjar is Professor in Sociology of Education at the University of Luxembourg, Institute of Education and Society. His research interests center on inequalities, education, political sociology, methods of empirical research and international comparisons. He has carried out research and published a wide range of articles on educational inequalities, educational expansion, gender, migration, subjective well-being, xenophobia, social values and political participation. He frequently reviews manuscripts and proposals for journals (e.g. European Sociological Review, Educational Research), research foundations (e.g. in Germany, Switzerland, The Netherlands, the US, European Research Council) and manifold conferences and awards.

Belinda Aeschlimann is a Senior Researcher at the Swiss Federal Institute for Vocational Education and Training (SFIVET), Zollikofen, Switzerland. She studied educational sciences at the University of Bern, Switzerland, where she also received her PhD in Philosophical and Human Sciences in 2014. Her research interests cover career orientation, higher education, gender studies, as well as methods of social science research.

PAPER SESSION 3: The leaky STEM pipeline

1) Higher education dropout in Germany and the gender gap in STEM fields: Is dropout dependent on institutional setting?

Author

Annika Grieb, German Centre for Higher Education Research and Science Studies (DZHW),
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Abstract

Although it has been a major educational policy goal to increase the proportion of women in STEM fields, women are still underrepresented and at a higher risk of dropout from STEM fields. In Germany, currently about one half of all male students take up studies in STEM fields, as opposed to only one in four women. Another gender difference exists with regard to institutional choices. Women are more likely to take up STEM majors at public universities than men (72% compared to 58%), than at universities of applied sciences (*Fachhochschulen*), where only 28% of women but 42% of men take up STEM majors. Dropout rates at public universities are traditionally higher than in universities of applied sciences, which is generally attributed to smaller classrooms and the better-structured study program. This potentially confounding factor has so far been often overlooked in gender gap research.

In this paper I examine which institutional framework is better suited to reduce the gender gap in STEM fields, i.e. whether equally competent women are more likely to persist in universities of applied sciences than in public universities. I follow the theoretical approach to dropout from higher education provided by Tinto (Tinto 1987; Tinto 1997). Dependent on a set of background characteristics and personal attributes, social and academic integration in college are the main driving forces for higher education persistence. Two competing hypotheses are formulated: Dropout might be more likely in universities of applied sciences than in public universities for women compared to men, because universities of applied sciences are more male-dominated, which might make them feel less integrated. In contrast, especially women should profit from a more well-structured study program, smaller classes, and close relations to instructors and make dropout therefore less likely in universities of applied sciences compared to public universities.

Testing these hypotheses, I use data from the Student Cohort of the National Education Panel Study (NEPS), which offers the most extensive panel data suitable for almost any research question related to higher education in Germany. The sample is representative for Germany including

all fields of study (N=17,910). The longitudinal data structure enables the use of advanced analytical methods, such as panel discrete choice models.

Preliminary findings suggest that female students feel more socially integrated in universities of applied sciences compared to public universities. Yet, this is also true for male students. Both are more likely to drop out from public universities compared to universities of applied sciences. Contrary to expectations, social integration is more important for male students than female students. This suggests that universities of applied sciences are equally prone to reproduce the gender gap in STEM fields.

Bio

Annika Grieb works as a research fellow at the German Centre for Research on Higher Education and Science Studies (DZHW). Here she works in the project National Educational Panel Study (NEPS) and is responsible for the conceptualization and development of questionnaires and research instruments for the Starting Cohort 5: Higher Education and the Transition to work. At the same time, she is a PhD candidate at the LEAD Graduate School / Eberhard Karls University of Tübingen. Her dissertation project with the title "Women in STEM – Pathways into Higher Education and Course Completion" is located within LEAD's intersection 5: Education, Life Course Development, and Social Disparities.

2) Preventing the pipeline from leaking during administrative transitions at the university level

Author

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Abstract

In 2013, the state oversight body – the Board of Regents – consolidated two institutions into the new Kennesaw State University. Southern Polytechnic State University (SPSU) was founded in 1948 as a technical college, and grew to a state university by 1996. In Fall 2014, SPSU graduated students in primarily polytechnic majors. With over 6,700 students by Fall 2014, the men were outnumbering women almost 4 to 1. Kennesaw State University (KSU) began as a two-year junior college, in 1963, and grew to a state university by 1996. With a student population of over 25,700 in areas such as nursing, business, arts, and humanities, by Fall 2014, KSU was the third-largest public university in the state of Georgia. The student body was 58 percent women and 42 percent men. The new institution has over 33,000 students, of which more than 50 percent are women, however STEM majors are primarily located at the smaller campus (8 miles from the larger campus). As of Fall 2015, the smaller STEM-focused campus has a student women:men ratio of 1:6, a decrease from prior levels, and faculty ratios have decreased, although less.

The aim of this study is to identify the resources needed to balance participation in the growing STEM programs offered at the new, larger institution. This work will utilize data from the previous institutions, the new institutions, including quantitative and qualitative data from a variety of internal sources, including student life needs assessment and academic success scores. Current findings, as of the end of Fall 2015, imply that women students that are admitted to the STEM programs are flourishing academically in spite of a sense of lack of gender privilege stemming from overall underrepresentation on campus and in the STEM areas in general. The author's current hypothesis is that recruiting efforts are insufficient and more women need to be encouraged and enabled to apply and participate, and that increasing campus resources is a secondary (and not negligible) consideration. This study will form a foundational structure for other institutions managing transitions of this magnitude.

Bio

Dr. Sarah Holliday is an Associate Professor of Mathematics and is affiliated with the Women's Leadership Center at Kennesaw State University in Georgia, USA. She also serves on the Presidential Commission for Gender and Work-Life Balance at Kennesaw, collecting and analyzing data to study the campus climate. Dr. Holliday participates actively in mentoring women university students and engaging in outreach and recruiting projects. She earned the PhD in Mathematics from Auburn University and continues research in graph theory, design theory, and number theory.

3) Understanding female students' pursuance in STEM subjects - A perception study from Pakistan

Authors

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- Nishat Riaz, Director Education, British Council Pakistan, Nishat.Riaz@britishcouncil.org.pk

Abstract

In many countries in South Asia, and in the UK, women's participation in higher education (HE) has equalled or surpassed men in recent years, and yet this representation is still not seen in STEM subjects. Women's influence is therefore lessened in STEM careers meaning there are fewer role models for young girls when they are making their subject choices. Pakistan has seen an increase of students enrolling in and completing higher education, this trend is matched in both the female and male populations. However, STEM disciplines are still dominated by men. The paper will be an outcome of a study which is initiated in Pakistan to look at the current situation of women in STEM subject, who have opted and completed O levels and equivalent local qualifications in schools. It will also identify factors which determine female students' choice for STEM subjects and understand the reasons why they discontinue if they do. Interventions to improve the on ground situation will also be proposed including ways to enhance female participation in STEM in Higher Education.

Bio's

Dr Maryam Rab. I was a founding member of the British Alumni Association Islamabad Chapter, and have been involved in multiple projects from Higher Education Links to Knowledge Exchange to Transnational Education. Currently I am heading the Research Evaluation and Monitoring Unit which will promote thought leadership keeping in view contemporary global challenges. I have over 17 years' experience in the private and public sector. My field of expertise is policy formulation, strategy development and execution, research, and programme management. I played an active role in establishing the first Women University in Pakistan.

Nishat Riaz. I am leading on British Council's education work in Pakistan. This includes management and implementation of programmes covering schools, skills, higher education and Education UK. I have over 12 years' experience in managing development programmes on health, gender, skills, culture and education. I am one of the founding members of Karakorum International University- the first university in the Karakorum and Himalayan ranges. I was selected as a Chevening Scholar from Pakistan in 2003, through which I did my MA in International Development from University of Manchester. I was twice the recipient of President's award of excellence for best academic performance.

PAPER SESSION 4: The role of gender stereotypes

1) Changing gender stereotypes for promoting female teenagers' choice of science and engineering

Author

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Abstract

The European Coordination Project MOTIVATION "Promoting positive images of SET to attract young people under gender perspective" (lasting 2008 to 2010) studied how gender stereotypes influencing choices of degree courses could be changed so that girls would choose more often engineering and science. Participant members have been universities and non-profit associations from seven countries (Austria, France, Germany, Netherlands, Slovakia, Spain, Sweden).

From European Projects INDECS and Womeng we knew that a traditional masculine image of engineering has been proved still alive (Sagebiel / Dahmen, 2006; 2005), and all students, even engineering students complained about less information about engineering profession. And even though many recruitment measures try to transmit an image of an optimal job direction with future chances, homepages for engineering degree courses were not reflecting this new image. So, often young people have obsolete and unattractive job images about SET in their minds, whereas their ideas and wishes of professions are not far away from SET reality. As socialisation agents, peer

groups, teachers and media are influencing the attitudes of young people towards SET jobs differently by gender (through information and presentation of role models).

MOTIVATION project developed the idea of understanding more about the interconnectedness of reasons why young people and especially girls do not choose SET very often. Based on state of the art and a comparative overview of different school systems several methodological measures were constructed, practised and evaluated in field work. Relevant mass media for teenagers at the age of 15 to 16, like printed youth magazines and TV soaps were systematically analysed to know how gender and stereotypes in science and technology are represented. Different secondary school types with different clientele by class and ethnicity were chosen for interviews and focus group discussions with young people to get their perspectives on SET individually and in relationship to their peers besides expert interviews with teachers about their perspectives and exemplary documentary analysis of school books in use. In qualitative case studies, chances for changing attitudes and examples of good practice were analysed. Measures of good practice were collected and evaluated, to create new effective methods for changing images of SET under gender aspects. Last not least a website as recommended main action has been developed and designed. This paper will give an overview of results (Sagebiel 2013; Sagebiel et al. 2009).

Bio

PhD in Sociology 1978 (Technical University of Berlin), associate professor in the Faculty of Human and Social Sciences (University of Wuppertal) <http://www.erziehungswissenschaft.uni-wuppertal.de/personen/weitere-personen/felizitas-sagebiel.html>, since 2001 scientific leader for the University in several European Commission funded Research Projects on gender in engineering education, profession, research and career: In 5th Framework Programme coordinator of "Potentials on Interdisciplinary Degree Courses in Engineering, Information Technology, Natural and Socio-Economic Sciences in a Changing Society" (INDECS 2001-2002) www.indecs.uni-wuppertal.de, and work package leader in "Creating Cultures of Success for Women Engineers" (WomEng 2002--2005), www.womeng.net; in 6th Framework Programme work package leader in "Empowering Women Engineers Careers in Industrial and Academic Research" (PROMETEA 2005-2007), www.prometea.info; in 7th Framework Programme coordinator of "Promoting positive images of SET in young people under gender perspective" (MOTIVATION 2008-2010 and partner of consortium of „Meta-analysis of Gender and Science Research" (Tender 2008-2010) www.gender-andscience.org/.

2) Stereotypes as impact on the career choices of female STEM students

Authors

- Bernhard Ertl, Department for Interactive Media and Educational Technology, Austria, duk@ertl.org
- Silke Luttenberger, University of Graz, Department of Psychology, Educational Psychology Research Unit, Austria, silke.luttenberger@uni-graz.at
- Manuela Paechter, University of Graz, Department of Psychology, Educational Psychology Research Unit, Austria, manuela.paechter@uni-graz.at

Abstract

Despite continuing efforts to motivate females to study STEM subjects, their numbers remain still low. This contribution deals with key factors for the females' career choices in STEM. Therefore, it will have a look into factors that contribute to females' self-concepts and motivation. A particular focus of this contribution will be on stereotypes about females and STEM because according to stereotype threat research stereotypes endanger the development of skills, competencies, motivations, and a self-concept, which is necessary for pursuing a career in STEM. Outcomes of the PISA study at school level in Germany and Austria support this assumption. They point at significant differences between female and male students with regard to their self-concept, although there are no differences in the science achievements – a result that may explain the low numbers of females in such subjects. Nevertheless, one might assume that notably women in STEM studies with a low proportion of females have successfully overcome such barriers in school and the family so that they are less prone to stereotypical views and influences.

The present contribution focuses on the analysis of facilitators and barriers that were experienced by female students who choose a career path in a STEM subject with a low proportion of females (e.g. mechanical engineering, physics or computer sciences). It analyses different factors of influence — in particular to which degree social support and barriers, stereotypes, and school-related factors may influence these females' self-concept and motivation.

The analysis is based on a survey with 296 females from different German universities, all from STEM studies with less than 30% females. By regression analyses factors that may influence self-concept and motivation were identified.

The results show that even in the very specific sample gender stereotypes had a large impact on students' STEM-specific self-concept, while support regarding their career choice had positive impacts. Furthermore, they point at negative influence factors in the family that lower self-concept and motivation.

The results of the study are important for educational research and practice. Regarding research, the main significance relates to the sample of students in male-associated STEM subjects at the university level. The study shows that stereotypes even affect the very specific sample of females in highly male-dominated STEM subjects and supports concept of stereotype threat. The significance for educational practice relates to the identification of supporting factors, in particular self-concept strengthening support in career decisions.

Bio's

Bernhard Ertl is professor for educational technology at Donau-Universität Krems. He works in several research projects to design and evaluate methods of instructional design. He developed a particular research focus on gender equality issues in the field STEM. In this context he worked on concepts for gender mainstreaming in STEM didactics and gender specific facilitation methods. A further field of research focuses on gender specific career choices in STEM. Bernhard Ertl, Silke Luttenberger and Manuela Paechter were editors for a special issue of "Gruppendynamik und Organisationsberatung" with the topic of gender-stereotypical views of and attitudes towards academic subjects and occupations.

Silke Luttenberger is a teaching and research assistant at the Department of Psychology, Educational Psychology Research Group at the University of Graz, Austria. She studied teacher education at University College of Teacher Education Styria and Psychology at the University of Graz. Her research interests are: career choice and development, the impact of intrapersonal and environmental influence factors on gender-untypical career aspirations and choices. Her recent work focusses on the impact of congruence between actual career aspirations and vocational interests, peers' career aspirations, and parents' vocations.

Manuela Paechter is a professor for Educational Psychology at the Department of Psychology, Educational Psychology Research Group at the University of Graz, Austria. In her research she is concerned with cognitive and emotional processes that may impair (or facilitate) learning and achievement, e.g., anxiety in a subject, students' self-concept or their goal orientations.

3) STEM for tween & teen girls in Croatia and beyond: Pyxie Dust project

Authors

- Predrag Pale, Faculty of Engineering, University of Zagreb, predrag.pale@fer.hr
- Tina Lee Odinsky-Zec, Zagreb School of Economics and Management, tlozec@gmail.com

Abstract

Theoretical/conceptual framework. The research indicates that girls show better achievement in mathematics and STEM related areas in their early schooling, partially developing interest for STEM areas, even careers. However, in puberty and adolescence, they lose interest or get distracted away from STEM. Causes still remain in the speculative domain and much more research is required.

Aims and objectives. In particular, this project's aim was to provide girls 12+ with hands-on experience in male dominated STEM area: electronics. It was hoped that if preconceptions of girls towards "boring" and masculine career like electronics could be changed, it might completely change their perception of their own competencies and talents as well as influence their choice of career.

Sample/Data sources. Female participants in STEM events held in Zagreb, Croatia in November 2015 which has been collected and analyzed by the time of this abstract submission. Additionally the workshops will be repeated in 2 other locations March in Osijek, Croatia and May in Zadar, Croatia. The data from these additional events will be incorporated into the final paper. *Methodology.* An open call was promoted for girls aged 13-18 to participate in a 2 day STEM event. Participant

motivation and effects of the workshop were measured by surveys and interviews completed before and after the interactive workshop. A complimentary literature review will also be used to frame and further analyze the findings.

Results. The preliminary results from the first sample group have shown that key factors that led to girls' enrollment in the workshop were a person in their environment: family member, teacher or colleague. It has also show that all participants grew very positive attitudes towards electronics and saw it as one possible career choice. They explicitly stopped perceiving that the field of electronics as an exclusively masculine career path.

Scientific and Applied significance. The workshops are organized as 120 minutes sessions. No pre-requisite knowledge is required, although proficiency in using computers is beneficial. It was a true workshop in sense that girls were involved in hands-on building of electronic circuits and programming microcontrollers thus leveraging "Learning by doing" principle. While this only highlights one of the workshops at the STEM event, the whole event was consistently structured to put the female participants in collaborative learning with their mentors. The events are set up for scalability and therefore the ongoing research and training can be extended to other locales.

Bio's

Predrag Pale has a background in electrical engineering and computing. He has designed complex electronic systems and information systems. In early 1990's he initiated and led the deployment of the Internet in Croatia. Since then he has been dedicated to researching methods to improve education with ICT. He strongly believes that the future depends on the quality of education and erasing gender barriers in careers. He devotedly researched dance pedagogy and gender bias in the arts. He profoundly believes that changing teacher's attitude and increasing their competence is the key to better education where gender biases play a major role.

Tina Lee Odinsky-Zec is the Director of Innovation and Entrepreneurship Center at Zagreb School of Economics and Management where she has lectured, managed international projects and mentored hundreds of students on business plan development since 2006. As of January 1, 2016, she was selected as the National Point of Contact for the European Centre for Women and Technology. From 2011-2015, she led the US Department of State funded project *Invest for the Future* which aims to unite women through entrepreneurship by creating collaborations to learn, network and earn both online and offline. She has ABD status in her doctoral studies.

PAPER SESSION 5: STEM teacher characteristics

1) Do teachers interact differently with boys and girls in the classroom? Results from a video-based study in elementary mathematics instruction

Authors

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- Friederike Heinzl, University of Kassel, heinzl@uni-kassel.de
- Frank Lipowsky, University of Kassel, lipowsky@uni-kassel.de

Abstract

Theoretical/conceptual framework. Gender differences in STEM-subjects have long been of interest in educational research. Even if the percentages of women in these areas are increasing, they are still less represented in academic domains as well as in vocational careers (Quaiser-Pohl, 2012). The differences in boys' and girls' domain-specific self-concepts in STEM-subjects have been documented in numerous studies. Especially in elementary school mathematics, girls have a significantly lower self-concept than boys which also cannot be explained through differences in their achievement (Dickhäuser & Stiensmeier-Pelster, 2003; Gabriel, Mösko & Lipowsky, 2011). Apart from socio-psychological phenomena, researchers also see an explanation for these discrepancies in classroom communication (Dickhäuser & Meyer, 2006; Muijs & Reynolds, 2011).

Aims/Objectives. Aims of the study are (1) to analyze whether teachers interact differently with boys and girls in mathematics instruction in second grade and (2) to evaluate if there are sex differences in the development of mathematical self-concept when incorporating aspects of communication in the classroom.

Sample/Data Sources. Data derives from the IMaGe-project which focuses on the interaction between students and teachers in **mathematics** with special attention to **gender** specific issues (Denn, Lotz, Heinzl & Lipowsky, in press). The project is a follow-up study to the PERLE-study

(Lipowsky, Faust & Kastens, 2013) and uses the videotaped lessons which had been generated during second grade mathematics instruction with the standardized topic “introduction to multiplication”. Further instruments were questionnaires evaluating mathematical self-concept of students which had been administered at the end of first and second grade. In total, the sample comprises 36 classes with a total of 571 students (46.6% male and 53.4% female).

Methodology. The interaction between teachers and students is evaluated with video analysis. Low inference coding schemes are developed to measure aspects of communication in the classroom such as teacher questions, student signals, teacher call-up behavior, student responses and teacher feedback. Rater reliability exceeded cut-off criteria of 85% respectively Cohens Kappa $\geq .70$ in all categories. Analyses are conducted by path analytical regression models using the software *Mplus 5* (Muthén & Muthén, 2007).

Results. Results show that there are no differences in boys and girls volunteering rates or teacher responsiveness in calling up or questioning types. However, boys generally receive more teacher reaction than girls which is mostly due to increased disciplinary feedback towards boys (Denn et al., 2015). Aspects of teacher responsiveness during instruction seems to affect the self-concepts of boys and girls differently.

Scientific and Applied Significance. The research underlines the importance of detailed analysis of classroom processes in STEM subjects.

Bio's

Ann-Katrin Denn is a research assistant at the University of Kassel, Department of Educational Research with an emphasis on Instructional Quality, School Effectiveness and Evaluation in Education, since 2013. In her doctoral thesis she focuses on the classroom communication between teachers and students with special attention to sex differences and analyses in how far the mathematical self-concept of girls and boys is affected by aspects of teacher-student-interaction.

Friederike Heinzl is Head of the Department of Primary School Pedagogy at the University of Kassel since 2003 and has been a member of the commission for equal opportunities at the university since 2004. She also worked as a freelance collaborator at University of Mainz's Office for Women and has published a multitude of articles concerning gender-sensitive issues in educational research. In addition to her research interest in gender studies, she also focuses on the analysis of the everyday life at school including interactions in primary school classrooms and children as acting agents in the school environment.

Frank Lipowsky is Head of the Department of Educational Research with an emphasis on Instructional Quality, School Effectiveness and Evaluation in Education at the University of Kassel since 2006. He is leading a multitude of projects which focus on various aspects of instructional quality in primary and secondary schools as well as teacher education and professionalization. He has been the director of the Centre for Empirical Research on Teaching and Learning at the University of Kassel since 2013 in which a multitude of projects link technical didactics to educational science.

2) Divided by discipline? Contrasting motivations, perceptions, and background characteristics of beginning English and Mathematics teachers

Authors

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Abstract

To identify differences among beginning teachers in mathematics (a male-typed domain) versus a domain gender-stereotyped in the opposite direction, the motivational profiles, perceptions about teaching, and background demographic characteristics of beginning English and Mathematics teachers were compared within an Australian sample, from the start of their teacher education studies ($N_{T1} = 325$; 213 English) until early career teaching ($N_{T2} = 132$; 89 English). Beginning Mathematics teachers tended to be older, to study through graduate-entry mode, were less likely to have chosen teaching as their first career, and more likely to have parents who worked in STEM (Science, Technology, Engineering and Mathematics) fields. Relative to beginning English teachers, there was a higher proportion from non-English speaking and less advantaged socioeconomic backgrounds. Preservice English teachers tended to have parents who worked in education, were more

highly motivated to enhance social equity, less motivated to teach as a “fallback” career, and regarded teaching as more demanding. From initial teacher education until early career teaching, the only significant change was that perceptions of teaching demand increased for beginning English and Mathematics teachers; overall, there were more similarities than differences between the motivations and perceptions of beginning English and Mathematics teachers.

Bio's

Paul W. Richardson is Associate Professor in the Faculty of Education, Monash University, and Associate Dean (Research). He previously served as Associate Dean (Education), and on the Faculties of the University of Michigan and University of Sydney. Paul's interests concern professional development and socialisation experiences of beginning teachers (including in STEM and gender issues); teaching and learning in higher education; academic literacy; youth identity development; qualitative and mixed-methods research. He has attracted substantial funding from Australian Research Council Discovery Grants to conduct large-scale longitudinal studies with beginning teachers and published in leading journals.

Helen M. G. Watt is Professor in the Faculty of Education, Monash University, and previously served at the University of Michigan, University of Western Sydney, University of Sydney, Macquarie University. Her interests include motivation, gendered educational and occupational choices, motivations for teaching, teacher self-efficacy, longitudinal research, quantitative methods. Her work has implications for redressing gender imbalances in mathematics-/science-related careers, and supporting career and professional development of beginning teachers. Helen is Associate Editor for *AERA-Open*, previously for *Education Research Review*, and served on several Editorial Boards. She received inter/national awards and funding for her STEPS Study (www.stepsstudy.org), & FIT-Choice project with Richardson (www.fitchoice.org).

Zoe A. Morris is an educational and developmental psychologist and lecturer in Education at Monash University. She has previously worked as a Research Assistant on Watt's Study of Transitions and Educational Pathways (STEPS) which longitudinally examines the career intentions of Australian youth. As an early career researcher, her research interest is ethical and professional issues in the helping professions; her PhD focused on ethical and professional aspects of teacher-student boundaries.

3) A window into “my classroom” – an approach for developing resources to encourage pre-service teachers to engage with mathematics and science

Authors

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Abstract

Pre-service teachers (PSTs) in early childhood and primary Bachelor of Education courses are not always confident in teaching mathematics and science. Opportunities to observe or participate in exciting, engaging mathematics and science learning experiences may not have occurred for them as students and may not eventuate during practical placements. Generating these experiences becomes a crucial element of initial teacher education, however, this also needs to incorporate the pedagogical elements that contributed to them.

Opportunities for PSTs to develop pedagogical understandings of classroom experiences can be enriched through the use of environments incorporating resources that highlight teacher decisions that impact on learning experiences. These environments and decision processes can be quite complex and detailed, so ways to assist PSTs to unpack them would need to be carefully considered to ensure PSTs can develop their understandings. Although the practical placement should be the venue for PSTs to immerse in an atmosphere that provides access to these processes, the chance to fully develop understandings may be limited due to the immediacy of the experience, lack of re-iteration or reflective time.

Engineering offered a virtual reality environment (VR) that had been developed by a team from five Australian universities and companies. The platform enabled engineering students to use interactive and immersive VR environments that captured the construction and operation periods of an industrial facility, allowing students to explore the changes in the environment over a set time period. The PST VR environment provides the platform to immerse and interrogate exemplary mathematics and science experiences. PSTs will be able to select student work and then view interviews with the teacher that discuss the lesson that created that artefact and the teacher's reflections on

it, the lesson plan the teacher used, video of the lessons, and assessment tools used to mark work samples. PSTs will benefit from the platform on several levels – viewing successful science and mathematics lessons, unpacking the elements behind the lesson, and witnessing female teachers working in what is often considered masculine areas. These will contribute to PSTs developing new ideas and identities around the enactment of mathematics and science learning experiences. This paper outlines the processes involved in the collaboration between education and engineering, through the use of technology, to share exciting and engaging mathematics and science learning experiences. This will enable other practitioners to modify the process to suit the needs of their environment and learners.

Bio's

Dr Audrey Cooke's passions for technology and mathematics have combined in her work with pre-service teachers. Her beliefs that everyone should have the opportunity to engage with technology and to enjoy mathematics and their mathematical experiences, has driven her scholarship and research at university. Her work with pre-service teachers focuses on creating experiences that enable pre-service teachers to fully embrace the opportunities that teaching will provide. She uses technology to help pre-service teachers re-vision how they see and engage with mathematics. These experiences often include pre-service teachers experiencing technology-driven ways of engaging with mathematics.

Associate Professor *Nicoleta Maynard* is an engineers' educator, an international and national teaching award winner with research in the engineering education area; she was part of the team developing the Engineering Virtual Reality Environment and recently worked on the Australian Research Council's project 'Improving Primary-School Students' understanding and interest in engineering and technology'.

PAPER SESSION 6: Gender dynamics and bias

1) Integrating gender dynamics into innovation ecosystems

Authors

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Abstract

Introduction. Most analyses of STEM-led innovation systems tend to assume gender-neutral position with regard to identity and roles of participating actors and their activities. However, real-life innovations can often (A) result in different quality of outcomes for women and men; (B) the innovation potential of highly trained women remains unrealised; and (C) the recent socioeconomic empowerment of women as driver of market needs continues to be ignored.

Theoretical/conceptual framework. Drawing on latest research evidence from studies of gender issues in science we developed a conceptual framework consisting of four scenarios for constructing gender sensitive innovation ecosystems based on different gender dynamics that combine scientific understanding of sex and gender differences with improved engagement of women in innovation process, enabled through participatory methods and open and inclusive innovation practices.

Aims and objectives. The driving motivation comes from the growing policy interest in promoting responsible research and innovation. For example, in the EU Horizon 2020 Programme, Responsible Research and Innovation (RRI)¹ is defined as composed of five thematic elements: gender, ethics, public engagement, science education, and open access.

Sample/Data Sources. The analysis included (A) investigation of the CVs of 1200 women scientists and engineers to identify and compare career paths; (B) survey of the career preference profiles of 400 members of the alumni association called UNITECH; (C) review of innovation processes deploying participatory approaches in idea/solution creation, and the benefits of increasing the role of women.

Methodology. The research included three approaches (A) exploratory research to assess current

¹ <http://ec.europa.eu/programmes/horizon2020/en/h2020-section/responsible-research-innovation>

perceptions of the roles gender can play in innovation; (B) analysis of open and inclusive innovation practices and their scope to promote gender sensitive knowledge exchange activities; and (C) analysis of the characteristics of career pathways in science and engineering-related areas that relevant to effective development of innovation human capital.

Scientific and applied significance. Increasingly, countries compete on the basis of their innovation capacity and effectiveness, which is seen by policy makers as a fundamental source of wealth generation within an economy, and a way to stimulate job creation. Ignoring the different roles that gender can play in innovation systems (e.g. diversity and creativity through greater participation of women) is a strategic flaw that can hamper the capacity of innovation systems to achieve socioeconomic progress for all through STEM.

Bio's

Dr Elizabeth Pollitzer co-founded Portia in 1999 and continues to serve as Director. Portia Ltd UK is an organization devoted to improve gender equality in STEM and inclusion of the gender dimension in STEM. Prior to Portia, taught and researched in the Departments of Computing and Management at Imperial College, University of London.

Prof Martina Schraudner is Head of Department, Gender and Diversity in Organizations, Technical University Berlin, and Director of Responsible Research and Innovation Unit, Fraunhofer Gesellschaft, Germany. She received her PhD in Biology from the Technical University of Munich, and worked as a researcher at the Swiss Federal Institute of Technology in Zurich (ETH Zurich) and the Forschungszentrum Jülich. She obtained her "Inauguration as a Lecturer" (Habilitation) at the Faculty of Agriculture and Horticulture at the Humboldt University of Berlin. She then accepted a position with Fraunhofer-Gesellschaft where her main responsibility was in strategic research planning with an emphasis on life sciences.

2) Gender bias effects in physics grading across three countries

Author

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Abstract

The existence of gender-STEM stereotypes is well-documented. Research on the effect of stereotypes on judgment processes indicates that stereotypes may influence the judgment process particularly in situations that are cognitively demanding and provide ambiguous information. The information that is available to make a decision about a student's performance level usually is complex, ambiguous, and open to various interpretations, particularly for teachers with little experience of teaching. With increasing experience, teachers can be expected to develop the cognitive resources that are necessary to avoid biases that are based on stereotypes.

The present study applied an experimental design to examine gender bias in physics teachers' grading in Switzerland, Austria, and Germany. Using an online-survey tool, secondary school physics teachers (N=780) received a physics test question and the same written student answer, accompanied by the prompt to assign a grade. Two factors were randomly manipulated in a short introductory text: student gender and specialization in languages vs. science. The second factor, specialization, was only included to gauge the relative strength of potential gender bias effects. Based on existing research, the present study expected physics teachers to show a gender bias in grading, to the detriment of girls. The study further aimed at investigating the potential moderating effect of teaching experience, which may reduce gender bias with increasing years of practice. Because the three countries are culturally closely related and comparable in terms of the national representation of women in STEM fields and in terms of an existing advantage of boys on science performance measures, a generally valid pattern of bias effects, independent of the country, was expected.

The specialization of the fictive student turned out to have no influence on grading. It was hence excluded from all analyses. Multiple group regression analyses, with the grade that was awarded as the dependent variable and the three predictor variables gender, teaching experience, and the interaction between the two variables, indicated the existence of a clear gender bias against girls in the first part of physics teachers' careers that disappeared with increasing teaching experience. This pattern applied to all Swiss, all Austrian, and female German teachers, while male German teachers showed no gender bias effects. The present findings stress the importance of techniques

that allow anonymous evaluation and of straightforward criteria when student performance is assessed.

Bio

Sarah Hofer received her diploma degree in psychology 2010 at Ludwig-Maximilians-University Munich focusing on educational, social, and (neuro-)cognitive psychology. From 2011 to 2015, she was a PhD student at the Center for Research on Learning and Instruction at ETH Zurich (thesis: the interplay between gender, underachievement, and conceptual instruction in physics). Since end of 2015, she is postdoctoral researcher. Her work addresses individual differences in science learning and performance (gender, intelligence, motivation), performance assessment (validity of grades, formative assessment, test development and evaluation), learning with cognitively activating instructional methods, and the interplay between conceptual and procedural instruction and knowledge development.

3) Boys', girls' and teachers' attitudes towards Science & Technology and the effect of an educational program that addresses (gender) stereotypes

Authors

- E.J.M. (Noortje) Jansen, VHTO (Dutch) National expert organisation girls/women & science/technology, The Netherlands, jansen@vhto.nl
- Annemarie van Langen, KBA Nijmegen, Expert centre education & labour market, The Netherlands, a.vanlangen@its.ru.nl

Abstract

Talent Viewer (TV) is to break down (gender) stereotypes about Science and Technology (S&T) among primary school pupils (age 10-12), parents, and teachers. During the program pupils explore their (S&T) talents and learn about S&T professions that combine these talents. Each class is visited by a female S&T professional for a guest lecture highlighting the technical, but also the social and economic relevance of her job.

Relevance. Strong (gender) stereotypes on S&T are among the main reasons why the Netherlands lag behind in the percentage of students opting for S&T study programs (OECD, 2013) Such associations are already present in early childhood (e.g., Schoon & Eccles, 2014) To provide equal chances for boys and girls on a career that fits their talent it's important to start breaking down stereotypes and creating gender awareness early in the school career.

Aims & Objectives. TV aims at breaking down (gender) stereotypes about S&T among pupils and teachers by offering counter stereotypes, exploring talents and showing the variety and diversity in S&T professions. The present empirical study examines to what extent the program succeeds and what lessons can be learned.

Methods. Teachers participating in TV received a folder with program instructions, assignments, worksheets and a gender training (optional). VHTO arranged a guest lecture by a female S&T professional for each class. Before and after the program, teachers and pupils filled out an online questionnaire. Multilevel analyses were conducted on pre- & posttest to assess teachers' and pupils' attitudes towards S&T, how they are related, and how Talent Viewer affects these attitudes.

Results. >3000 pupils, >400 teachers participated in the study. Overall, Talent Viewer was considered successful in raising gender awareness by teachers. Differences were found between boys' and girls' attitudes, also dependent on the fathers' profession. Pupil attitudes changed slightly after participating in Talent Viewer, specifically on stereotype ideas among boys.

OECD (2013). *Education at a Glance 2013*. Paris: OECD.

Schoon, I., & Eccles, J. S. (Eds.). (2014). *Gender differences in aspirations and attainment: A life course perspective*. Cambridge University Press.

Langen, van, A. (2005). *Unequal participation in mathematics and science education* (diss.).

Apeldoorn/Antwerpen: Garant-Uitgevers.

Bio's

Noortje Jansen is a policy advisor at VHTO. She ran projects involving implementation of gender inclusive policy and outreach in vocational and higher STEM education. She evaluated choice behaviour in (educational) career paths of STEM alumni and developed a website/digiboard application to enable children, young adults, teachers and parents to work with gender inclusive pictures and videos of STEM professionals. She keeps track of the research in the Gender & STEM and

feeds VHTO projects with the most recent scientific findings and implementation methods. She evaluates VHTO projects and is responsible for the Gender & STEM Network Secretariat.

Dr. Annemarie van Langen is a senior researcher at KBA. Previously, she was affiliated with the University of Nijmegen, where she conducted the present study. She specializes in the participation of students in STEM programs in secondary and tertiary education. Her thesis (2005, 'Unequal participation in mathematics and science education') was the starting point of several research projects in secondary and tertiary education on this topic. Annemarie has also investigated national and international differences in boys' and girls' school attainment and education careers. Other work involves school effectiveness and educational opportunities of ethnic minorities and other disadvantaged groups. She has also been involved in the large Dutch cohort studies on primary education.

PAPER SESSION 7: Best practice to support girls and women in STEM

1) Classroom practices and primary school girls' knowledge in physics

Authors

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- Franziska Vogt, University of Teacher Education, franziska.vogt@phsg.ch

Abstract

Theoretical framework. Over the last years, the gender gap in STEM has been narrowing but it still persists especially for interest and academic self-concept in physics (Jansen, Schroeders & Stanat, 2013; Liben, 2015; Schilling, Sparfeldt & Rost, 2006). Explanations for this gap have been found in individual and social variables (Brotman & Moore, 2008; Scantlebury & Baker, 2007). Teachers' attitudes and classroom practices affect students' self-perception (Dickhäuser & Meyer, 2006) and contribute to stereotyped socialization (Petersen & Hyde, 2014). Gender-related differences in self-concept and interest probably develop during primary school (Kessels, 2012; Petersen & Hyde, 2014).

Aim. The focus of this study was on the relation between teachers' gender, physics knowledge, conceptions of teaching and learning and students' gender, prior knowledge, domain-specific interest and academic self-concept in a physics related domain.

Sample and Methodology. The sample consisted of 46 teachers (34 female) and their classes with 839 students (443 girls) from grade 3 and 4. In this cross-sectional study, teachers filled in a questionnaire which assessed their prior knowledge, pedagogical orientation and attitude towards science education. Students' questionnaire included an assessment of prior physics knowledge, domain-specific interest, and academic self-concept. Since data is clustered, a multilevel approach was used to analyze the relationships between teachers' attitudes and outcome variables on the student level. First, gender differences on a student level were investigated and second, teachers' gender, prior knowledge, conceptions of teaching and learning, attitudes or self-concept were related to girls' outcome variables.

Results. Girls' prior knowledge, domain specific interest and academic self-concept were all significantly lower than boys' ($p < .001$, $< .001$ and $< .05$, respectively). Teachers' own prior knowledge and their gender were not related to any of the girls' outcomes. Teachers' pedagogical orientation towards cognitive activation ($\beta = 0.20$, $p < .01$) and students' own ideas ($\beta = 0.20$, $p < .05$) predicted higher prior knowledge of girls. Girls' domain specific interest was lower if teachers rated science education ($\beta = -0.61$, $p < .01$) and physics education ($\beta = -0.31$, $p < .01$) as very important. There was no significant effect for girls' academic self-concept.

Significance. The findings of this study suggest that teachers' classroom practices and attitudes have an effect on girls' learning and motivation. It seems that for girls it is more important whether teachers use activating teaching methods than whether they hold strong views about the importance of science education which can even be detrimental for girls' interest in science topics.

Bio's

Angelika Meier is a research assistant and associate professor at the institute of research in teaching and learning at the University of Teacher Education in St.Gallen, Switzerland. She holds a PhD in psychology. In her dissertation she investigated motivational and cognitive outcomes of primary school students' visits to an out-of-school setting in the natural sciences. Her research interests include motivational aspects of learning, diversity in schools, as well as the integration of qualitative

and quantitative research methods. Her work has appeared in the International Journal of Educational Research, Tertium Comparationis and Perspectives in Science.

Franziska Vogt is professor at the University of Teacher Education in St.Gallen, Switzerland and is the director of the institute of research in teaching and learning. Her research interests include teaching and learning, teacher professionalization and cooperation, early childhood education and care, gender and mixed-method research. She is currently co-leading a project investigating the social construction of gender in day-to-day practices in nurseries. Her work has appeared in Gender and Education, Teaching and Teacher Education, and Perspectives in Science.

2) Should I dare or not? Career aspirations of women in computer science and best practice examples to support female careers

Authors

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Abstract

Theoretical framework. The proportion of women in leading positions in the IT sector is small. We assume that self-efficacy beliefs, personnel development measures and family-friendly policies of companies influence female career aspirations.

Aims and objectives. By interviewing graduates at different points of time, we wanted to gain insights into gender-specific motivation for career aspirations, changes in individual career goals, and differences in career advancement. Interviews with representatives of Human Resource Departments were conducted to identify best practice examples which support female computer scientists in their careers and allow for a good balance of work and private life.

Sample. During the first wave, 280 (28%) out of 1000 graduates completed the questionnaire. 251 graduates were eligible for the second wave. 136 (54%) of that group completed the questionnaire of the second wave. 30 interviews with small, medium and large sized companies were conducted.

Methodology. Questionnaires for graduates were designed to collect longitudinal data on self-assessment, self-efficacy beliefs, job transition, career advancement, occupational conditions, and work-life balance. Hypotheses were tested using Wilcoxon rank-sum test and discriminant analysis. Semi-structured interviews with companies were conducted focusing on conditions of employment, human resource development, and work-life balance.

Results. Female computer scientists have significantly lower self-efficacy beliefs than men. They attach less importance to occupying a leading position and pursue more often a specialist career than a management career. Role models of women in leading positions that would encourage women's interest for management careers are missing. The results of the discriminant analysis show across all personnel development measures that individual career development plans push female career intentions. However, women are less often supported by career development measures than men. Best practice examples of the company survey reveal that empowerment measures that actively ask women to apply for leading positions and coach women during the application process can strengthen self-efficacy beliefs of women. Family-friendly measures such as job-sharing in top management positions or part-time managers can further increase the number of women in leading positions.

Scientific and applied significance. Women who work in a male dominated environment need positive feedback by superiors and personnel development measures that strengthen their capability beliefs. Family friendly measures that allow women to combine professional and personal goals are needed to raise the proportion of women in leading positions. So more female role models in the field of computer science can be created and encourage female employees to opt for a management career.

Bio's

Silvia Förtsch studied educational sciences (B. Sc.) at the University of Hagen and empirical educational research (M. Sc.) at the University of Bamberg. She worked as assistant of the Women in Computer Science Equal Opportunities Officer and organized a mentoring program for female students of computer science. From 2012-2015, she was a research associate at the project "Alumnae Tracking". Since 2015 she works as PhD candidate in the project "Career Coaching in STEM". Her research interests include longitudinal research on educational and professional pathways, career aspirations, life course research, and gender studies.

Anja Gärtig-Daugs studied health economy with focus on public health and information systems at the University of Bayreuth and received her doctoral degree (Dr. rer. pol) in economics. After graduation, she focused on accompanying empirical research and worked as research associate at several institutions in the field of health care and population studies. Since 2012 she is senior researcher at the Women in Computer Science Equal Opportunities Office. Her research focus is on gender studies, job satisfaction, life course research, and elementary computing skills of kids.

Ute Schmid is professor of applied computer science and head of the cognitive systems group at the University of Bamberg. She holds a diploma in psychology and a diploma in computer science. Her research interests are mainly in the domain of high-level learning on structural data. Due to her function as women's equal opportunity officer, she is organizing workshops for female high-school students since about ten years with the intent to raise the number of female students in computer science. From 2012 to 2015, she conducted the research project "Alumnae Tracking" that compares career choices and paths of female computer scientists with criteria-matched males. Since 2015, she is head of the research project "Coaching in STEM". The objective of this project is to develop a coaching program that will support especially women after their reintegration into the workforce or in time of professional reorientation. Women's motivational resources and self-efficacy beliefs shall be strengthened so that women will make better use of their career opportunities.

3) Educational innovations to support women's return to STEM careers

Authors

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- Clem Herman, The Open University, UK, clem.herman@open.ac.uk

Abstract

Women who take career breaks from STEM find it particularly difficult to return to their substantive professions (Herman 2015). The persistence of normative gendered career pathways and gendered organisational cultures in STEM sectors present barriers to those who have non-linear or unconventional career trajectories (Sabelis and Schilling 2013). While interventions to support women re-launch their careers have been in existence for many years, recent concern by the UK government has been prompted by the fact that over two thirds of women STEM graduates do not return to these sectors after taking a break (People Science Policy 2002). The Open University in the UK has a long track record of supporting women to enter and re-enter careers in STEM and particularly using innovative educational technologies to enable wide reach and flexibility via distance learning (Herman et al, 2011). In this presentation we will showcase two new schemes launched this year – Reboot Your STEM Career and Return to STEM - the latest in a succession of interventions by the OU to encourage and support women in their STEM careers. Building on the results of a longitudinal research project that tracked women's career progression over a five year period, these latest resources use new hybrid models of learning which integrate social media with traditional approaches in order to enhance the employability of women in STEM and support them in returning to work.

Bio's

Dr Clem Herman is a Senior Lecturer in the Department of Computing and Communications at the Open University and Director of eSTEeM, the Open University's Centre for STEM Pedagogy. She has worked in a range of roles and projects as an educator, practitioner and researcher to support women in ICT and other science, engineering and technology sectors. Clem's most recent research and publications focus on the employability and careers of women SET professionals especially on the impact of career breaks and experiences of women returners. Her latest project involves a comparative study of gender and skilled migration in IT in India and the UK. She is the Editor-in-Chief of the International Journal of Gender Science and Technology.

Dr Katie Chicot is a Staff Tutor/Senior Lecturer in the Department of Mathematics and Statistics. Katie has collaborated on a funded project on supporting women returning to careers in STEM and

works on the Open University's Athena Swan panels, developing and implementing institutional actions to support gender equality. Alongside mathematics research, Katie is active in many kinds of outreach events in mathematics and is a director of the UK Mathematics Trust.

PAPER SESSION 8: Development and social barriers to STEM participation

1) Girls on the road toward career in technology: Social barriers in Hungary

Authors

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Abstract

The ratio of women specialized in electronic, mechanical engineering and IT does not reach ten percentages in Hungary. It is important to understand the conditions under which female applicants opt for such programmes. We have conducted a comprehensive qualitative study to investigate what possible barriers stand in the way of getting more female students to apply to academic programmes in technology and what means could be utilized to potentially get more girls to apply. Focus groups with female students and semi-structured interviews with teachers have been conducted at three different secondary schools. Also focus groups with female students have been conducted at the faculties of electronic engineering, mechanical engineering and IT. Besides, semi-structured interviews have been conducted with five professors from each of the three faculties. Results show that incomprehension is given to the problem of the shortage of female students. Different professional interest of men and women is considered „natural”. Female students at the last year of their secondary studies knew extremely little about technology academic programmes and about what technicians actually did. Barriers standing in their way of choosing technology studies include existing stereotypes, bad experiences with certain science subjects at secondary schools, not getting support from family members to pursue technological academic programmes, and low self-esteem. Most female students at the university have friends or acquaintances who work in the field of technology. Our findings suggest the possible importance of getting personal impressions about an academic programme/profession in the decision-making process. Visual media is considered significant „to kill stereotypes”, that is to increase the self-confidence of potential female applicants. The findings of the research have been summarized in a book which is the first to present such issues in Hungary.

Bio

I work as an associate professor at the Óbuda University, Budapest. I have received my Ph.D. degree at the Tohoku University, Sendai, Japan. I have completed an intensive course about gender and macroeconomics at the University of Utah. I am a member of various women's organizations and representing the WiTEC (European Association for Women in Science, Engineering and Technology) in Hungary. At the Óbuda University I have conducted a project on what possible barriers stand in the way of getting more female students to apply to technology academic programmes and what means could be utilized to potentially get more girls to apply.

2) How does development influence sex segregation in majors? Urbanization, broadened access, and the STEM gender gap in Cambodia

Authors

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Abstract

Theoretical/conceptual framework. Several explanations have been posited for gender variation in STEM across different types of nations. Charles and Bradley (2009) concluded that, for advanced industrialized nations, gender segregation seemed to be driven by mathematics affinity. In contrast, transitional nations' GDP was the largest predictor for gender segregation in those countries, although, surprisingly, it was negatively related. This trend suggests that as GDP increases, economic outcomes become less important to major-field selection for women. Charles (2011) concluded that stereotypes about women's roles and abilities might be more present in advanced industrialized nations. Gender stereotypes might follow industrialization because increased overall economic security/flexibility and increased encouragement to select majors related to passion, rather than economic outcomes.

Aims and objectives. Given the previous research on the unexpected smaller gender gap between women and men in STEM for transitional countries (Charles & Bradley, 2009; Charles, 2011), and the variation in living standards across Cambodia, we seek to understand the relationships between gender, regional characteristics, and postsecondary enrollment in this industrializing nation. In the 1970s, systemic, mass executions of the highly educated by the Khmer Rouge regime destroyed Cambodia's higher education system. Today, the country has seen a boom in higher education development (Ministry of Education, 2013). Initial findings reveal cross-province variation in educational access (Figure 1), population density (see Figure 2), and gendered occupational perceptions (Perez-Felkner, 2014).

Data sources. Data for this study came from Cambodia's Ministry of Education, Youth, and Sport (MOEYS) and Census. MOEYS data is institutional-level and includes enrollment figures for female, total, scholarship, and non-scholarship (paid) students by major for the 2011-2012 academic year. These data were paired with national Census data from 2008 to estimate the relationships between gender, region, and STEM enrollment in Cambodia.

Methodology. First, we investigated the distributions of our variables at the branch and province levels, to examine the relationships among urbanization, gender, and major choice. Then, we used sample mean *t*-tests to examine if there were significant differences in campuses' (1) total enrollment and enrollment of males and females, (2) enrollment of scholarship/paid students, and (3) enrollment of female and male STEM majors for Phnom Penh versus the other provinces in Cambodia. Finally, we performed a series of step-wise logistic regressions using clustered standard errors to estimate the extent to which provincial-level characteristics predict the proportion of women in STEM and STEM-like majors on each campus.

Results. Gendered patterns vary by specific STEM field. Fewer women are enrolled in traditional STEM majors on Cambodian campuses (9.47%); the maximum on any campus reaches only 52.58%. In contrast, in accounting, an applied mathematics field – the share of women increases to an average of 40.55%, with one campus having over 90% of its student body as women majoring in this field. Therefore, Cambodian women may be less attracted to traditional STEM fields, but more attracted to those fields that use similar skill sets and methodologies (such as accounting). We found that the percentage of women in STEM fields on campuses is significantly related to province-level characteristics, even after controlling for institutional characteristics.

Scientific significance. Improving inequity in higher education has expanded beyond the borders of the United States and even other industrialized countries. Given the seeming persistence of gendered relationships with STEM in higher education in most industrialized nations, scholars would benefit from considering alternative models explaining gender inequality in STEM, in distinct contexts.

Bio's

Dr. Lara Perez-Felkner is an Assistant Professor of Higher Education and Sociology at Florida State University. She is also a member of the VHTO Network on Gender and STEM and an Alumni Fellow with Pathways to Adulthood. Her research uses developmental and sociological perspectives to examine how young people's social contexts influence their college and career outcomes. She investigates racial-ethnic, gender, and socioeconomic disparities in post-secondary educational attainment and entry to scientific career fields. Her work has been published in *Contemporary Sociology*, *Developmental Psychology*, *Frontiers in Psychology*, and *Teachers' College Record*, as well in edited volumes.

Samantha Nix is a third year doctoral student in Florida State University's Higher Education program. She earned her bachelor's degrees in English Literature and French from the University of Southern Mississippi in 2009 and her master's degree in Higher Education in 2013. Samantha served as the Program Coordinator for the Women in Math, Science, and Engineering Living Learning Community for three years. She is a research assistant with FSU's Center for Postsecondary Success. She studies women's responses to challenge in mathematics and scientific fields. The first paper from her dissertation was published earlier this year in *Frontiers in Psychology*.

3) Safety issues for women accessing shared toilets: A case study of women residing in informal settlements in cities of East Africa

Author

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Abstract

The global sanitation crisis is one of the most important developmental challenges in the twenty first century. One in three women still lacks access to safe toilets worldwide and risks shame, health issues, indignity, harassment and even attack because of inadequate sanitary infrastructure. Earlier research emphasizes the vulnerability of women to physical and sexual violence if they are forced to wait until early morning or late evenings to look for a secluded place to defecate. Additionally, previous studies reveal that violence became more pronounced towards women of lower socio-economic strata living in informal settlements while accessing sanitation infrastructure. This subset of literature exposes the oppressive relationship of women with sanitation and resonates with feminist analysis which is grounded on analysing systems of oppression of women like patriarchy, race, class etc. as well.

The lack of sanitation has been identified among the main causes of health problems among urban dwellers in African cities and the promotion of basic sanitation is largely focused on hygiene awareness, health and environmental benefits. Existing research also recognized that problems of poverty faced by female-headed households in rural areas of Africa were shown to be caused, in part, by unequal access to essential resources. Hence, women stand at an intersection of multiple categories like inadequate access to sanitation infrastructure, poverty and gender violence.

My research claims that there is a need to examine injustice against women through infrastructural inadequacy. My paper will present preliminary data obtained through qualitative semi-structured interviews conducted in March 2015 with women residents of informal settlements in Dar es Salaam, Tanzania and Nairobi, Kenya. In my interviews, I asked the women about their experiences of using a shared toilet, the challenges faced in accessing the service, their preference for a toilet type and finally their infrastructural priorities in daily life. Preliminary conclusions reveal that most women felt insecure and unsafe while accessing shared toilets at night in informal settlements. The findings of this investigation highlight that sanitation is often determined by engineering and public health policies that are far removed from local needs of women and their socio-cultural practices.

Bio

Anshika Suri has been working on her doctoral thesis at the Department of Architecture since January 2015. She holds a bachelor's degree in Architecture from the Sushant School of Art and Architecture, India, and a Joint European Double Degree Masters (MSc Mundus Urbano) in both *International Cooperation in Urban Development* from the Technische Universität, Darmstadt, Germany, and *International Cooperation in Sustainable Emergency Architecture* from the Universitat Internacional de Catalunya, Barcelona, Spain.

Roundtables

1) Be a Sumbody

Authors

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Abstract

During 2016 the project '**Be a Sumbody**' aims to develop coherence in the mathematics support provided for undergraduate students by targeting resources to this high risk area as follows.

- Presenting success in mathematics as an achievable human activity attainable through persistence, whatever previous experience may have been.
- Backing up the staff support available.
- Providing resources that are relevant, accessible, visible and available at a time and place to suit students.
- Developing a coherent and evidence-informed picture of the first year experience of mathematics across the university.

The project will align with academic support already provided, i.e. 1-1 tutoring help, peer mentoring, practice materials. In addition to existing provision of support in mathematics there will be four further activities:

1. A review of the provision of online materials undertaken in two stages:
 - a. A rapid update of online materials together with clear links for each disciplinary area and coordinated to link with the new overall curriculum website.
 - b. Development of a specific STEM/Mathematics teaching and learning support website, again to connect across the university, to be developed over the course of Semester 1 and in time for Semester 2 2016.
2. Interdisciplinary and cross university '**Be a Sumbody and meet other Sumbodies**' induction attitude workshop (repeated across campuses and at mid-year).
3. A stocktake of first-year student mathematics experience – participation, engagement, success – to identify and target hot and cold spots of mathematics provision. In the first instance this will be a desk audit of data. Next steps will be developed in the first part of 2016.
4. An action-inquiry approach to ongoing evaluation and opportunities to record and publish: success stories, reports, and academic articles; conference contributions and a visible on-line presence in mathematics support.

The Gender and STEM conference provides a timely opportunity to report on the work of 'Be a Sumbody' from the perspective of participation and gender, for whilst the university has an overall balance of male/female undergraduate population, enrolment by course is skewed. It is anticipated that the data analysis component of the project will enable evidence-informed conversation about particular groups of students at risk, e.g. early childhood teachers and nurses facing an unexpected science and mathematics curriculum at university.

Bio

Originally a mathematics teacher and a trained statistician, Pat Drake now also writes in the first person, having developed a perspective on authorial responsibility to make meaning of voices not otherwise represented, such as women in leadership. An active researcher, university teacher and occupant of university leadership positions (HoS, Dean), since coming to Australia she served on the Expert Numeracy Group of the Australian Council for Education Research and on the Victoria Institute of Teaching Accreditation Committee. Pat was a founder member of Gamma (Girls and Mathematics Association) in the UK in the 80s, and was part of the team offering 'Be a Sumbody' days to introduce logo programming to London schoolgirls.

2) Impacts of work-life balance and professional confidence on the career persistence for academic scientists in Japan: A gender comparison

Authors

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- Sayaka K. Shinohara, Division of General Education, Kyushu Women's University, Japan, sshinohara@kwuc.ac.jp
- Yuko Shinjo, Department of Contemporary Sociology, Chukyo University, Japan, uco.15.nov@gmail.com

Abstract

Aims. This study investigates gender differences in determinants of career persistence for Japanese academic scientists. We examine whether work-life balance and professional confidence exert differential impacts on the persistence for Japanese women and men in STEM fields.

Conceptual Framework. According to a survey conducted in 2008 among Japanese researchers in natural sciences, 66% of women considered "the difficulty in striking balance between family and career" as a main reason for women's underrepresentation in STEM fields. While family responsibilities continue to constrain career decisions for Japanese women in STEM, their persistence in academic career may also depend on the level of their confidence as scientists. Since professionals with high confidence in their occupational roles are more likely to set challenging goals and be persistent in achieving the goal, professional confidence and competence may exert significant influence on the career persistence for women in STEM. The question is whether the impact of experiencing balanced work and life differs for women and men. Because of substantial family responsibilities for Japanese women, it may exhibit a stronger positive impact on women than men.

Data and Methodology. Data for this study come from an online survey conducted by the first author in 2014. Our analytic sample was 129 female and 411 male Japanese academic researchers in STEM fields. We conducted a sequence of multiple regressions to explore the gender difference in the ways work-life balance and professional confidence affect career persistence.

Results. Women and men demonstrated similar levels of intention to persist in STEM career. Results from regression analysis revealed no gender difference in the positive effect of work-life balance on career persistence. However, work-life balance exhibited a stronger impact on women's professional confidence. Furthermore, the positive effect of professional confidence on career persistence was stronger for women than for men. These results suggest that although striking balance between work and life is important in its own right for both women and men to continue in their academic careers, being able to accommodate work and personal life is particularly important for women to feel confident as scientists, and this confidence in turn tends to enhance their propensity to persist in the academic science.

Scientific Significance. Our findings provide implications about the importance of women's belief in their ability to succeed in profession. Additionally, balance in work and life is an important condition with which Japanese women in science evaluate and envision their careers.

Bio's

Tetsushi Fujimoto is a professor of sociology at the Graduate School of Policy and Management, Doshisha University, Kyoto, Japan. His research interests include the intersection of gender, work, and family. He is currently investigating the gender difference in imposter phenomenon among young Japanese scientists in fixed-term appointment. His recent article, co-authored by Sayaka K. Shinohara and Tsuyoshi Oohira, titled "Work-Family Conflict and Depression for Employed Husbands and Wives in Japan: Moderating Roles of Self and Spousal Role Involvement" received the 2015 Outstanding Author Contribution award in Contemporary Perspectives in Family Research from the Emerald Group Publishing.

Sayaka K. Shinohara is an assistant professor at Kyushu Women's University, Fukuoka, Japan. She received her Ph.D. in Sociology from Bowling Green State University, Ohio, U.S.A. Her research interests include women's career development and family formation. She is currently working on the positive interactions between experiences in non-work domains and work performance particularly among women in STEM (science, technology, engineering, and mathematics) fields in Japan.

Yuko Shinjo is an adjunct lecturer in the Department of Contemporary Sociology, Chukyo University, Nagoya, Japan. Her research interests are centered around the issues of family, education,

and social stratification. In her current research project, she is investigating the factors associated with status attainment for Japanese women and men in STEM. She is also working on a project that explores the interaction between family and community social capital in Japan.

3) Serious game for girls about renewable energy technologies

Authors

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- Felix Kapp, Technische Universität Dresden, Psychology of Learning and Instruction (PsyLL), Felix.kapp@tu-dresden.de
- Martin Hartmann, Technische Universität Dresden, Vocational Education, Martin.hartmann@tu-dresden.de

Abstract

The project Serena aims at developing and evaluating a serious game providing individualized feedback to female adolescents (13-15 years) regarding their vocational competencies in the innovative field of renewable energy technologies. The serious game will use a point and click adventure to provide the girls with opportunities to explore the exciting working areas of technological vocations, and in doing so, to master typical challenges technicians are faced with when working in the renewable energy sector. The serious game is expected to contribute to (a) the acquisition of knowledge and competencies regarding technological vocations, in particular their typical tasks and challenges, (b) the development of interest in this vocational field, and (c) the increase of confidence in their abilities.

The design and evaluation of the serious game is done in close collaboration between the Science Shop Bonn, the Technische Universität Dresden (PsyLL; Vocational Education) and the Game Studio, The Good Evil:

- 1) Science Shop Bonn analyses current demands of the job market in the fields of renewable energies.
- 2) Two workshops have been organized with several schools in order to answer different research questions concerning graphic design.
- 3) The PsyLL-Team is planning and running a study to investigate students' preferences regarding the design features of the avatars that will be implemented as player and non-player characters into the game.
- 4) The Vocational Didactics team analyses the core competencies that are relevant for accomplishing technical tasks in the field of renewable energy professions.
- 5) The Good Evil designs the serious game.

The results of the doctoral thesis of Pia Spangenberg about the influence of sustainability on the motivation of women to choose a technical profession will be incorporated as well. A total of 40 people were interviewed, including 30 women and men working in the wind energy sector. The results of the qualitative analysis clearly show that sustainability has a stronger subjective significance for the career choice of women than for men.

The results of all research activities will be published in 2016/2017. The project has a scientific and applied significance because it combines a design-based research approach to develop a serious game that aims at addressing the underrepresentation of girls/women in STEM through improving their confidence in mastering technical tasks. At the same time it concentrates on environmental and green issues as well as "male specialisms" as Electro-Engineering technologies, which offer attractive general frameworks, state-of-the-art work places and future job perspectives.

Bio

Pia Spangenberg graduated in Economics at the University of Cologne in 2007. Upon completing her degree, she moved to New York where she worked for the German American Chamber of Commerce. 2010 she was hired by the Science Shop Bonn. Currently she leads a research project that aims at developing and evaluating a serious game providing feedback to female adolescents regarding their vocational competencies in renewable energy technologies. 2016 she will defend her doctoral thesis at the Technische Universität Berlin about the influence of sustainability on the motivation of women to choose a technical profession.

4) Fixing a leaky metaphor: Using intersectionality to rethink the “Pipeline” for females in STEM

Author

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Abstract

The use of the pipeline metaphor has been pervasive since its first introduction by Berryman (1983) as a metaphor for the pursuit of STEM careers. Although it has been useful in analyzing the path that female students follow on their journey to become a STEM student and potentially part of the STEM workforce, its limitations as a metaphor are numerous. The metaphor was established as a formulaic way of evaluating the career paths of engineers. It purports that placing female students into one end of the pipe and supplying sufficient force will propel them successfully forward. Some researchers (e.g. Seymour & Hewitt, 1997) believe white privilege structures within institutions have changed the view of the pipeline to only reflect the norms of white males pursuing STEM careers. Thus, the pipeline metaphor may not accurately portray the obstacles that female students encounter in their career development journey (Carlone & Johnson, 2007; Cannaday et al., 2014). One possible way to approach modifying the pipeline metaphor is through the lens and methodology of intersectionality. Intersectionality centers on the complex and multifaceted lived experiences of individuals, traditionally concerned with people of color and other marginalized groups.

The original iteration of the construct of intersectionality was introduced by Crenshaw (1991; 1993) to illuminate the oppressions of Black women, including how they had been left out of the conversations about feminism and gender equality. Intersectionality could be used to examine the multiple identities of female students and how these identities are expressed as they follow their unique STEM career trajectories. Although the principle of intersectionality has guided research in areas such as Latino feminism (Blea, 2008) and criminal justice (Trahan, 2011), it has been underutilized as a tool for education research. Only one article was found (Settles, 2006) that uses research looking at minorities and females in STEM with an intersectional lens. A new model needs to be developed that centers on the intersectionality of race, gender, and career identity and includes multiple pathways for entry and exit into STEM career paths. This revised model also needs to better reflect the obstacles females could encounter through all levels of their education and as they prepare to enter a career in STEM. Options for repairing or replacing this outdated metaphor with one that is more accurate and equitable will be discussed, including ways to assist female students through the critical transitions of their career identity development.

Bio

David Sparks joined UTeach Arlington and the Department of Curriculum and Instruction as Visiting Assistant Professor of Science Education in 2013. In 2015, he became a Tenure-Track Assistant Professor in the Department of Curriculum and Instruction at the University of Texas at Arlington. His research is focused on three areas: (1) collaborative learning structures that strengthen both learning and diversity in STEM education, (2) intersectionality of race, gender, and identity in STEM students, and (3) environmental sustainability as a context and catalyst for learning in STEM classrooms. He is currently Affiliate Faculty with the Center for African American Studies.

5) On the influence of career choice decisions of high school students: An exploratory study

Author

Teresa Martínez, EASSE Vicepresident (www.easse.org/en/), La Vall Principal (www.institutio.org/lavall) tmartinez@la-vall.org

Abstract

A multitude of factors affect career choices of high school students. Discerning these factors may facilitate parents, educators, and industry to know where students place most of their trust and what criteria influence the career selection process. The current study was concerned mainly on the impact of technical studies offered in the school on the selection of engineering studies. It would help students to examine the processes they use along with their programme choices at high school for career selection. An exploratory study was conducted using a data collected from seniors at La Vall high school, using survey form and school records for a period of 10 years. This study attempted to identify to what extent Math level and Robotics programme played a role in career choice and which were most important for choosing engineering studies. Specific objectives of the

study were the following: 1) The association between math level and robotics programme on engineering career choice. 2) Demonstration of how influential robotics programme is to choose engineering studies as career choice from pre and post robotics programme introduction in the school.

Our findings suggest the following significances of the study: 1) The percentage of engineering as career choice has incremented drastically post robotics programme offered at the school. 2) Students learning interest of robotics programme influence positively on engineering career choice in spite of math level. 3) The study analyse the collected information and identify existing trends in the career choice of engineering studies. 4) Finally, the current exploratory study provide suggestions and explore implications and recommendations for future researchers and practitioners of institutions.

Bio

Teresa Martínez studied at the University of Barcelona, where she received a BA Degree in Psychology. She also holds a MA degree in Social Sciences Research from the International University of Catalonia. She has been Headmistress of La Vall since 1996. She is also a consultant of management teams regarding the implementation of quality models in educational leadership. Her research interests are in the area of early school dropout from a family perspective and the influence of gender on education. Teresa is a Visiting Lecturer at the International University of Catalonia (UIC) in postgraduate studies related to Education and Gender issues. Teresa is the president of EASSE, European Association Single-Sex Education- in Catalonia; coordinator of the Equality Plan for Single-Sex Education schools in Catalonia and contributor to the Single-Sex Education Forum.

6) Analysis of gender gap in career progression in stem fields in two south western states of Nigeria

Authors

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Abstract

Over the past two decades, women in Nigeria have made great strides in education and entry into the work force. However, despite these advances, women have continued to be underrepresented in the fields of science, technology, engineering, and math, collectively known as STEM. Women's representation is low at every level of the STEM career pipeline. Nigeria needs to improve the quality and access to STEM education and create a larger and more diverse pool of potential employees trained in these fields, in order to stay competitive in the global economy and fuel the innovation needed to solve world security problems. A very important step towards achieving this, is working on increasing the number of women who are pursuing career in STEM fields in order to produce scientifically literate, technologically skilled, and diverse workforce. Very few efforts have been made to analyze the representation of women in STEM fields over some period of time in Nigeria, without any giving full and current estimates of this representation till date. This paper therefore, studies the disparities in female-male enrolment in STEM at the undergraduate, postgraduate level and among staff with the view of addressing the gender gaps in these fields in two South Western States (Ondo and Ekiti) of Nigeria. Data were extracted from enrolment records of five universities in these states. The data were analyzed to discover the disparity and career progression in female-male enrolment between a period of ten years. Recommendations were also made towards a further study of possible reasons for the gap and means of closing it.

Bio's

B.A. Ojokoh bagged BTech., Mtech. and PhD in Computer Science from Federal University of Technology, Akure (FUTA). Her area of specialization is e-library and machine learning.

F.O. Isinkanye had Btech and Mtech. in Mathematics from FUTA. Her area of specialization is Numerical Methods.

M.T. Owoseni had BTech. in Computer Science from Ladoke Akintola University of Technology, Ogbomosho (LAUTECH), got MTech. degree from FUTA and presently a PhD student at FUTA. Her area of specialization is Communications and Networks.

O.A. Akinsowon O. A. had her BSc. in Computer Science from Ekiti State University, Ado-Ekiti, bagged MTech. from FUTA and presently PhD. student at FUTA. Her specialization is Computer Network Security.

7) The role of gender-based innovations for the UN sustainable development goals

Authors

- Elizabeth Pollitzer, Portia Ltd., UK, ep@portiweb.org.uk
- Heisook Lee, Center for WISET (Women in Science, Engineering and Technology), Korea, wisewiset@gmail.com

Abstract

The 17 SDGs promise to be more gender - aware than the Millennium Development Goals, however, although one goal, SDG5, and its nine targets are dedicated to achieving greater gender equality and empowerment of women, among all the targets, less than 10% recognise the special needs of women and girls. This is in sharp contrasts to the scientific examination of the SDGs conducted by the International Council for Science, which identified 78 scientific topics involving "gender" and/or "women" as the main and a separate concern.

Theoretical/conceptual framework. Gender inequality issues cannot be separated from actions to tackle poverty, hunger, poor health and wellbeing, maternal death, climate change adaptation, energy and environmental burdens, economic hardships, and social insecurity. Better understanding of sexual reproduction of plants, wildlife and farmed animals can help identify important conditions for protecting biodiversity, ensuring wellbeing of terrestrial and marine ecosystems and habitats, and advance sustainable agricultural methods.

Aims and objectives. Our aim is to help improve efficacy of the measures used to implement the SDGs, including their cross cutting impacts, by identifying research that investigates all sources and conditions of inequality in the lives of girls, boys, women, and men .

Sample/Data sources. Information was sourced from published scientific research in the areas mapped by the 17 SDGs and their targets and from recommendations made by 27 experts in these areas.

Methodology. A panel of 27 experts with knowledge and experience of research covering gender, STEM and development was recruited and asked to review the targets of each SDG and recommend four key research papers that provide important insights into the underlying STEM understanding, and to recommend four or more research topics representing gaps in the understanding. Extensive web search published scientific evidence was carried to supplement the data provided by the experts.

Results. 170 references and 150 research topics were selected to provide the first mapping of the STEM relevance for the gender content of the SDGs. The resulting report was widely disseminated and will be regularly updated through collaboration between science, innovation, policy and development experts.

Scientific and Applied Significance. When planning interventions for each of the 17 SDGs we must continually ask: Will these interventions work equally for women? Will they work equally for men? We must use the best scientific evidence when formulating sex- and gender-conscious solutions to ensure this, and also to address wider societal and environmental challenges.

Bio's

Dr *Elizabeth Pollitzer* is co-founded Portia in 1999 and continues to serve as Director. Portia Ltd UK is an organization devoted to improving gender equality in STEM and promoting the inclusion of the gender dimension in STEM. Prior to Portia, taught and researched in the Departments of Computing and Management at Imperial College, University of London.

Prof *Heisook Lee*, is President of the Center for WISET (Women in Science, Engineering and Technology), Korea. Her mathematics research interests include algebraic coding theory and algebraic structures over commutative rings. Her current interests are HRD in STEM fields and gender perspectives in science research. Prof Lee received her B.S. M.Sc. and PhD degrees in Mathematics from Ewha Womans University, Korea, the University of British Columbia and Queen's University, Canada, in 1971, 1974 and 1978 respectively. She worked at the Universitat Regensburg, Germany, as a postdoctoral fellow and was later appointed Professor of Mathematics at Ewha Womans University.

Poster Sessions

1) “Research shows it and now we know it”– Presenting research findings as an intervention to enhance females’ intention to pursue math-intensive careers

Authors

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Abstract

Females are still under-represented in science, technology, engineering, and mathematics (STEM) fields. Competence in mathematics, in particular, is seen as a filter to distinguished, high-income occupations (Watt, 2010), yet female students are performing just as well as their male counterparts (Else-Quest, Hyde, & Linn, 2010). Conversely, gender differences in affective variables and attitudes towards mathematics may explain why the intention to pursue math-intensive fields is lower among females (Meece, Wigfield, & Eccles, 1990; Watt, 2006).

Previous research has shown that simply informing individuals about psychological mechanisms that can influence motivation helped to enhance their STEM motivation (Weisgram & Bigler, 2007) and reduce the effects of harmful gender-based stereotypes (Johns, Schmader, & Martens, 2005). The aim of the present study was to investigate whether we could enhance the intention to pursue math-intensive careers by informing female students about research findings on mechanisms that can lead to unjustified conclusions about math ability or lead to more negative attitudes towards mathematics.

To examine the influence of being informed of these mechanisms on female students’ intention to pursue math-intensive careers, 127 female high-school students (9th and 10th graders) completed an online survey and were randomly assigned to an intervention or control condition. In the information-based intervention (lasting approximately 8 minutes), graphics accompanied by audio explanations were presented through Prezi to inform participants about mechanisms that can lead to unjustified conclusions about math ability and math-related attitudes (e.g., the role of gender stereotypes, the internal/external frame-of-reference-model regarding self-concept, and higher trait math anxiety among females but no gender differences in actual state math anxiety). Participants were also asked about their intention to pursue math-intensive careers, their math-related attitudes, and their prior achievement in math. MANCOVAs, which included prior achievement and intrinsic value in the domain of mathematics as covariates, showed a significant effect of the intervention on female students’ intention to pursue math-intensive fields, $F(1,106) = 7.30$, $p < .01$, $\eta_p^2 = .06$.

Initial, short-term evaluations of the intervention are promising in showing that female students’ intention can be enhanced by informing them about psychological and affective mechanisms related to the often unjustified decision to avoid STEM fields. The results will be discussed in light of future intervention studies that will employ a pretest-posttest design. Furthermore, implications for practice will be discussed including increasing awareness in the classroom about maladaptive mechanisms that can hinder STEM-based career options among female high-school students.

Bio's

Madeleine Bieg is an assistant professor of empirical educational research at the University of Konstanz, Germany. After finishing her diploma in Psychology, she worked in the department of Empirical Educational Research at the University of Konstanz with Dr. Thomas Goetz. She received her PhD (psychology) in 2013. In her dissertational thesis, she investigated relations between trait and state academic emotions. Her research focuses on emotions and self-concept in the learning and achievement context. She is interested in the role of emotions in STEM domains and career choices, gender and math anxiety, and the structure, antecedents, and assessment of academic emotions.

After finishing her studies in speech therapy, *Kristin Weiß* did her bachelor’s degree in psychology at the University of Konstanz and worked together with Madeleine Bieg on a research project aimed at enhancing girls’ STEM career intentions. Currently she is studying in the master’s program at the University of Marburg. Kristin is interested in the broad domain of school psychology, involving students’ academic emotions as well as teachers’ communication in the classroom.

Kyle Hubbard is currently completing his Ph.D. in the Department of Educational and Counselling Psychology at McGill University in Canada. He is an active member of Dr. Nathan Hall's Achievement Motivation and Emotion Research Group. He is currently interested in researching the dynamic characteristics of students' emotions, including the theorised reciprocal relations between emotions, their antecedents, and their outcomes within educational contexts. His dissertation will focus specifically on academic boredom and boredom coping.

2) The ideal balance between private and specialized talk: (How) does the self-assessed amount of STEM-related communication predict mentoring success?

Authors

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Abstract

As meta-analyses show, successful mentoring programs must fulfill certain requirements (cf., for instance, DuBois, Holloway, Valentine, & Cooper, 2002; DuBois, Portillo, Rhodes, Silverthorn & Valentine, 2011). They must, for instance, last at least three months and include a system of monitoring and assistance for participating mentors and mentees. In particular, interactions between mentoring participants must be carefully monitored. As soon as participants start also communicating with other program participants beyond their individual mentor–mentee dyad, one must then also consider additional aspects such as each participant's position within the social network and the kind of relationship to his or her communication partners (cf., for instance, Monge & Contractor, 2003). In our study, we regard effective mentoring for girls in STEM as a successful contagion process that is caused by an ideal interplay between relationships of the mentoring participants, their communication patterns, and program content. Our main research question is thus: What constellation of relationships regarding the communication network may lead to appropriate self-assessed mentoring success? We examined this question in the context of the CyberMentor program. The e-mentoring program has the goal of effecting a lasting increase in the participation of girls in STEM. In this program, more than 600 11- to 18-year-old girls are assigned a personal female mentor each year. The mentors are all STEM experts, either graduate students doing advanced degree work in STEM or university-educated professionals with careers in a STEM field. Mentors communicate with their respective mentees on a weekly basis for at least one year. Together, mentors and mentees discuss interesting STEM topics and work on joint projects. Communication takes place on a secure web-based community platform with internal email, chat, and forum systems. In accordance with the aforementioned literature, we examined the following criteria of effective mentoring: (a) the quality and quantity of communication between the mentoring participants and (b) the closeness and similarity in STEM-related interests between members of mentor–mentee dyads. These criteria were measured during the mentoring year via online questionnaires and log-file analyses. Our results indicate large effect sizes for both factors on the proportion of STEM-related versus private communication contents, the arrangement of communication partners, and participants' overall embeddedness in the communication network of the e-mentoring online platform on the self-assessed mentoring success.

Bio's

Manuel Hopp is a research associate at the Chair for Educational Psychology and Research on Excellence of the University of Erlangen-Nuremberg. He works in the e-mentoring project CyberMentor, where he is responsible for content production. His research activities focus on the field of (social) network analysis in the context of e-mentoring.

Teresa Greindl is research assistant at the Chair for School Research, School Development, and Evaluation at the University of Regensburg, Germany. She works in the e-mentoring project CyberMentor, where she is responsible for program participant support and communication. Her research activities focus on successful (e-)mentoring and fostering girls' interest in STEM.

Albert Ziegler, PhD, is Chair Professor for Educational Psychology and Excellence Research at the University of Erlangen-Nuremberg, Germany. He is the founding director of the State-Wide Counseling and Research Centre for the Gifted. He is currently serving as the secretary general of the

International Research Association for Talent Development and Excellence (IRATDE) and as editor-in-chief of *Talent Development & Excellence*. Prof. Ziegler has published more than 300 books, chapters, and articles in the fields of talent development, excellence research, educational psychology, and cognitive psychology.

Heidrun Stoeger, PhD, is Chair Professor for Educational Sciences at the University of Regensburg, Germany. She holds the Chair for School Research, School Development, and Evaluation. She has served as editor-in-chief of the journal *High Ability Studies* and is a member of the editorial board of the German journal *Talent Development*. Prof. Stoeger is vice president of the International Research Association for Talent Development and Excellence (IRATDE). Her publications include numerous articles and chapters on giftedness, self-regulated learning, motivation, fine motor skills, and gender-related issues.

3) Girls and math career expectations: Influence of teacher support and motivational variables

Authors

- Doriane Jaegers, University of Liege, Belgium, djaegers@ulg.ac.be
- Dominique Lafontaine, University of Liege, Belgium, dlafontaine@ulg.ac.be

Abstract

Theoretical framework. Previous studies have shown some differences according to gender in:

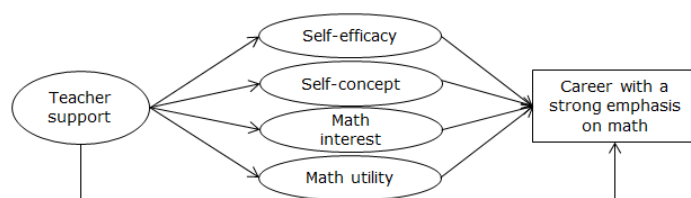
- *career expectations:* girls with a level of performance similar to boys less often choose math careers.
- *motivational variables:* girls are less confident, less interested by math and more anxious than boys (under control of their math abilities).
- *teaching practices:* teachers on average have lower math expectations for girls and underestimate high-achieving girls.

The link between motivational variables and career choices could be explained by the expectancy-value model^[7]: students' choices are influenced by their individual expectations for success and the value they attach to the task.

The link between student's perceptions of teaching practices and motivational variables could be explained by the three basic dimensions of instructional quality^[8]. These dimensions are "classroom management", "cognitive activation" and "supportive climate". This last dimension refers to the support of the three psychological basic needs (SDT^[9]): needs of autonomy, competence and relatedness.

Aims and objectives. This study aims at investigating to what extent professional expectations with a strong emphasis on mathematics knowledge and skills can be explained by, on the one hand, a perception of teaching support and, on the other hand, by motivational variables. A moderating effect of gender will be tested.

Sample. 30 schools in French speaking Community of Belgium, 2 classes per school, 1139 students, grade 11.



Methodology. Questionnaire: scales for measuring teaching support and motivational variables. The professional expectations are measured by asking the kind of job they expect to have when they will be 30. Reported occupations are converted into four-digit ISCO codes and also 2 possible values (1=work in a math field, 0=work in another field).

Analysis. Structural equation modeling with MPlus was used to test the relations.

Results. Data collection ended in December; analyses start in February and preliminary results will be presented in July. Recently, we have tested the hypothetical model using Belgian data from PISA 2003^[12]. Some interesting outcomes were observed, providing evidence to girls' perceptions of teacher support directly impact their self-efficacy and their perception of math utility and these two variables impact girls' choices of a math career. In other words, as hypothesized, the impact

of teacher support indirectly impact girls' career expectations; teacher support being mediated by motivational variables.

Scientific and applied significance. This study integrates many variables and especially students' perceptions of teaching support in one model to be tested. This model has been recently tested on US data^[13], but never in Belgium.

Bio's

Doriane Jaegers is a PhD Student (FRESH grant - 2015) in Educational Science at the University of Liege in Belgium (Department Education and Training). She works in the Center "Analysis of Systems and Practices in Education" (aSPe) and her PhD Supervisor is Pr. D. Lafontaine (head of the Department and of the Center). In her thesis project, she tries to understand why do girls less often choose math courses and math career in French speaking Community of Belgium by modelling the impact of perceived teaching practices and motivational variables.

Dominique Lafontaine is a Full Professor for Educational Sciences at the University of Liege and director of the Center "Analysis of Systems and Practices in Education"; she is currently President of the Department Education and Training. D. Lafontaine has a strong background in the field of reading literacy, comparative studies, teaching and learning processes, quantitative methods, development of cognitive and non-cognitive instruments. She graduated from the University of Liege with a master degree in Romance Philology (1978), an Habilitation to teach French and Spanish (1978) and a Ph. D. in Educational Sciences (1985).

4) Roberta, the robot: How a communal (vs. agentic) framing of STEM subjects influences girls' (and boys') academic interests and career choices

Authors

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- Andreas Borowski, Potsdam University, andreas.borowski@uni-potsdam.de

Abstract

Over the last two decades, considerable efforts have been made to increase the engagement of girls and women in STEM fields. However, although evaluation studies confirm positive effects for many STEM intervention programs, we still have a lack of understanding, what exactly is effective and why. There is evidence that STEM interventions are most successful in enhancing students' engagement in STEM domains, if the students perceive a fit of the subject's image and their self-view (e.g. Hannover & Kessels, 2004). How individuals see themselves is highly influenced by the knowledge they have acquired about masculinity and femininity (e.g. Markus et al., 1982). Agency, associated with masculinity, and communion, linked with femininity, are broad dimensions of personality that reflect a focus on the self and a focus on others, respectively (Bakan, 1966). Research revealed that particularly agency has a strong impact on career choices (e.g. Abele, 2003).

Following this line of research we have planned to test the "subject's image-self-view-fit" hypotheses across different STEM subjects (e.g. computer science, physics) by systematically varying the context (communion-focused vs. agency-focused) in which STEM subjects are embedded. We expect that the academic interest is particularly high for female students if STEM subjects are communion-focused (e.g. "Roberta, the robot, as a daily living aid for elderly"), whereas agency-focused STEM subjects (e.g. "Drone, Type XF 10F, as part of a science competition") primarily enhance the academic interest of male students. As an explanation, we assume that the link between contextual framing and academic interest is mediated by the fit of the subject's image and the student's self-view (study 1). In addition, we will investigate the differential impact of communion- vs. agency-focused STEM interventions on the academic interest and career choices over time (study 2).

Using data of about 350 German 9th graders, gained by a paper-and-pencil survey, first results of study 1 (mediation-analysis) with focus on programming "Roberta, the robot" vs. "Drone, Type XF 10f" (varied in a between-design) are presented. With respect to the question, if and why STEM interventions like "Roberta" work for girls, we discuss advantages of communion-focused interventions, but also potential risks in terms of women's ability to operate in a predominantly male world. The overall aim of this research is to determine the key triggers of attracting girls and young women to STEM professions, both in the short and long term, in order to increase the effectiveness of STEM interventions.

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Bio's

Dr Janine Neuhaus received a diploma degree in psychology in 2004 and a master's degree in science marketing in 2013, both from Technical University Berlin, Germany. She completed her doctoral thesis in the field of gendered aggression in 2010 at Freie Universität Berlin, which was awarded with the Marie-Schlei-prize in 2011. She was a member of the faculty in the Department of Education and Psychology, Freie Universität Berlin, from 2004 to 2015, mainly at the Chair of School and Teaching Research. Since October 2015, she is working as an advisor for educational research at Potsdam University.

Prof Dr Andreas Borowski graduated in physics in 2001 at Technical University Dortmund (Germany), where he completed as well his first state examination in physics and mathematics in 2003 and received his PhD in physics in 2004. He finished his legal clerkship with the second state examination for the upper secondary education level in 2005. After working a few years as a secondary school teacher in Essen, he was a Postdoctoral associate at the University of Duisburg-Essen. In 2011, he accepted the call to a professorship of physics education at the RWTH Aachen University. Since 2013, he holds the chair for physics education at Potsdam University.

5) Shifting engagement with science across school and out-of-school settings: What enabled girls to engage with science during school and family visits to science museums?

Authors

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Abstract

Theoretical/conceptual framework: My research focuses on the role of structural factors in shaping girls' engagement with science, with a focus on gender, socioeconomic background and ethnicity. I use an intersectional approach (Crenshaw, 1989) and draw on two main bodies of theory; Pierre Bourdieu's (1984, 1977) concepts of capital, habitus and field, alongside 'science capital' (Archer et al., 2015) and Judith Butler's (1990) concept of 'performativity'. Aims and objectives: In this paper, I focus on 'in-the-moment' engagement, relating to girls' behaviours and participation during the observed science-related activities. The research question addressed in this paper is: In what ways do out-of-school setting enable opportunities for engagement with science for girls from diverse backgrounds? Sample/Participants: The 'core' study participants were female students (n=15) from two science classes from a girls' secondary school in Manchester and from a coeducational secondary school in London. In addition to the students, their parents (n=10) and their science teachers (n=4) were also included in the study. Methodology: This is a qualitative case study with multiple methods of data collection, including interviews, focus groups and observations. Initial data collection explored girls' engagement with science on a 'broad' level, such as how they identified with science and in what ways did science feature the constructions of their current and future selves. Girls then participated in a range of activities delivered by science museums, where the focus was on exploring the shifts in 'in-the-moment' engagement with science. Throughout these activities, data was collected through keeping observation notes and audio recording. The transcripts and observations notes were coded using thematic analysis (Braun and Clarke, 2006) and discourse analysis approach (Burman and Parker, 1993). Results/Discussion: Data have suggested that while science museum activities enabled some girls to better engage with science (vignettes from a case study of 'Cordelia' will be explored in more detail), the opportunities were limited and problematic for others. Outof-school setting were 'risky' for girls already succeeding in occupying the celebrated subject position in the classroom, and for others, reproduced the power relations of the science classrooms. When girls were able to engage with science, this was largely supported by their performances of 'nurturing femininity', such as taking up a role of a teacher of younger siblings during the family visit. Applied significance: This paper will suggest some implications for practice in informal science learning environments about how to better support engagement with science for girls from diverse backgrounds.

Bio

Spela is a PhD candidate in Education Research at King's College London, working across the fields of sociology of education and science education. Prior to doctoral studies, Spela spent a decade working in public health/pharmaceuticals, following a Master of Pharmacy degree. In 2012, Spela completed an MSc in Ethnicity and Multiculturalism (Sociology) at the University of Bristol, and has since been involved in several social research projects, currently working on the 'Enterprising Science' project, a collaboration between King's College London, the Science Museum and BP, that aims to help young people find science more engaging and useful for their lives.

6) Addressing gender differences in college students' attitudes and anxiety about science

Authors

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- Madelynn D. Shell, The University of Virginia's College at Wise, Department of Social Sciences, mjs5ma@uvawise.edu

Abstract

Gender disparities have often been identified in undergraduate Science, Technology, Engineering, and Math (STEM) education (e.g., Bryant et al., 2013). Support and mentorship groups may promote interest and improve the number of women in these fields (Dasgupta & Stout, 2014). However, feelings of anxiety or fear could prevent women from expressing interest and exploring STEM majors (Else-Quest et al., 2010). In preparation for a Women in Science group, we are exploring undergraduate students' attitudes and anxiety about science.

This research will address two questions. First, are gender discrepancies in science anxiety and attitudes found in a relatively isolated rural community? Second, does science anxiety and attitude predict interest in various aspects of a Women in Science group? For example, are students with greater science anxiety less willing to consider presenting research, but equally interested in hearing other students and faculty present research?

Approximately 300 undergraduate students from all majors (including undecided) will be invited to participate in the survey at a small, rural, liberal arts college in the US for extra course credit. Students will indicate interest in various aspects of the proposed Women in Science group (e.g., attending a monthly seminar, presenting their own work) and complete the Science Anxiety Scale (Mallow, 1994), and the Science Attitudes Scale (Bryant et al., 2013). Data collection is ongoing, but will be completed by March 2016.

It is expected that women will demonstrate higher science anxiety and poorer attitudes towards science compared to men. We expect that women will be more interested than men in workshops led by women faculty. However, it is expected that students with poorer attitudes about science and higher anxiety (particularly women) will report less interest in research opportunities.

The data will provide important information about the levels of science anxiety and attitudes on campus, and can help identify points of intervention for the group. Gender differences may be exacerbated in a small community where women have fewer role-models in STEM-related careers. This will highlight the importance of creating a group that can provide such models. In addition, identifying which aspects of the group students are most interested, especially those who have higher science anxiety, can help identify needs that can be addressed. For example, perhaps engaging in workshops and mentorship could encourage science-anxious students to consider research. These findings will help researchers and teachers interested in addressing science-related anxieties by identifying areas that need intervention.

Bio's

Alexandria Reynolds is an Experimental Psychologist and Assistant Professor of Psychology at the University of Virginia's College at Wise. Her research interests include sleep, cognition, and academic performance. Her past research examined sleep extension and cognition in older adults. Currently, she is focusing on sleep extension, cognition, and sleep hygiene in sleep deprived college students. Having been involved with a women in science group in the past, she is working on the development of a support group for women in STEM fields at her institution. Additionally, she is collaborating with colleagues on a gender disparities in science study.

Madelynn Shell is an Assistant Professor of Psychology at the University of Virginia's College at Wise. She is a Developmental Psychologist, and focuses on how social and emotional development are affected by classroom and school climate. Her previous work has looked at social adjustment across the transition to middle school, and she is currently exploring the college transition. As part of this work, she became interested in the gender disparities in science-related fields during college. She is currently collaborating on the development of a group to support women in STEM fields on campus and in middle and high school.

7) Shortage of girls in STEM: Only a matter of gender?

Authors

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- Lieva Vanlangenhove, Department of Textiles, Ghent University, Belgium, Lieva.vanlangenhove@ugent.be

Abstract

A recent study in Flanders showed that, in secondary education, about 30% of the students in STEM-programs are girls. In higher education, only 25% of all students enroll in a STEM-program, again about 30% of them are girls. The small participation of females in STEM-related programs is not unique for Flanders, but a general phenomenon.

Several actions are undertaken to engage girls for STEM: working with role models, specific recruitment events², context -based science teaching, etc., with varying success. However, none of them succeeded in provoking a revolutionary increase of the number of girls choosing STEM.

The methods we would introduce in the workshop combine Transactional Analysis (TA) (dr Eric Berne) and Process Communication Model (PCM) dr. Taiibe Kahler)³. The perceptions, the way we perceive the world, as well as the way we interact with it are different according to our personality types. The preferred perceptions occur in different proportions for males and females. The preferred perceptions for males are *thinking* (39%), *likes & dislikes* (16%), *opinions* (15%), *feelings* (15%), *reflection* (8%) and *action* (7%); for females: *feelings* (44%), *likes&dislikes* (24%), *thinking* (12%), *reflection* (12%) *opinions* (5%) and *action* (4%).

We believe that activities undertaken to promote STEM by youngsters, should be diverse in their communication – addressing the different perceptions of all personality types. Using female role models will not be effective if she doesn't use the preferred perceptions. For girls one reaches 44% by *emotions*, but also *likes & dislikes* (24%) and *thinking* and *reflection* combined (24%) should not be overlooked.

Preliminary results show that, among academic- and research staff at universities (females as well as males) the majority has the preferred perceptions *thinking* and *opinions*, perceptions that are more typically male. As we tend to communicate using our own preferred perception, (for academics; typically male perceptions) *feelings* are often neglected. As a consequence, this means that our STEM-PR activities using *thinking* and *opinions*, will work for only a relatively small number of girls, namely 17.5%. We believe that, when we want to increase the number of girls into STEM, specific communication channels that are preferred by a large number of girls should be used.

Bio's

Katrien Strubbe is professor at the Department of Inorganic and Physical Chemistry at the Faculty of Sciences (Ghent University). Besides electrochemistry, her interests focus on teachers, teacher education and inquiry based science education. She is responsible for the Do-Chemistry Centre at Ghent University. In 2015, she is selected to join the Belgian Delegation for the European festival Science on Stage Europe in London. She is coordinator of the faculty's diversity team.

Marie Claire Van de Velde is responsible for providing policy support to the university board of directors with regard to the strategic goal of stimulating societal valorisation of scientific results. She

² The Influence of a Two-Day Recruitment Event on Female Upper Secondary Students' Motivation for Science and Technology Higher Education *Fredrik Jensen and Maria Vetleseter Bøe International Journal of Gender, Science and Technology, Vol.5, No.3, 317*

³ How to keep more children motivated, Annemie Desoete, *The Learning Teacher Magazine, Vol. 6, No.4, 2015*

holds a PhD in Biology. She held several positions in science and technology policy at Ghent University, scientific institutes and she was Deputy Head of Cabinet for Science and Innovation Policy at the Cabinet of the Flemish Vice-Minister-President. She coordinated a quantitative and qualitative research project on PhD researchers' careers and devoted particular attention to gender aspects in scientific and academic careers. This led to her being member of the policy group that initiated the first gender plan that has resulted into the appointment of a central gender team at UGent.

Lieva Vanlangenhove is senior full professor at the department of textiles, faculty of engineering and architecture. She has five years of experience in industry. In the late 1990's she has started a new research field (smart textiles) as one of the first worldwide. For these outstanding results she was awarded an honorary PhD in 2005. Being a woman in an engineering environment, she can be considered as an expert-by-experience in terms of gender. As a member of the group of female professors that has initiated gender policy at UGent. Prof. Van Langenhove has board experience in Pantarhei, a group of the public schools in Ghent.

8) A new program to recruit and retain women in engineering at UNSW Australia

Authors

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Abstract

The UNSW Women in Engineering Program, which began in 2014, works across three main target groups: school-aged girls with an aptitude for science and maths, women currently enrolled in engineering at UNSW, and female professional engineers. The goal of the program is to increase the proportion of female engineering students at UNSW to 30% by 2020. In 2013, 20% of UNSW Engineering students were female. In first semester 2016, 23% of new students are female.

Recruitment events include visits to schools, on-campus engineering days for girls and a week-long women in engineering camp for girls in years 11 and 12. Since the program started we have hosted approximately 850 young women for on-campus engineering activities and made over 30 school visits to talk to girls about science and engineering. A secondary, but equally important, aspect of recruitment is educating teachers and careers advisers about the opportunities in engineering. To do this, we have organised Science teacher meetups, presented at teacher conferences and provided workshops for teachers at student engineering days.

In 2015/2016 UNSW led a multi-university initiative to change the image of engineering and make it more attractive to young women. The social media campaign "The invisible hand" launches nationally in June 2016 in the form of an interactive music video. The music video, which reveals the engineering behind everyday objects, is supported by a microsite featuring profiles of inspiring engineers and links to more information about studying engineering. The campaign aims to meet teenage girls on their home ground and deliver information about engineering without them searching for it. The project is the result of an unprecedented level of collaboration between eight of Australia's engineering faculties.

Current students are able to enrol in our Women in Engineering Development Program, which provides a supportive community for female engineering students, workshops to improve academic and career skills, networking events and volunteering/outreach opportunities. A central principle of the UNSW Women in Engineering Program's recruitment and retention strategies is the involvement of current and former students in supporting and inspiring those only a few years younger than them. Female engineers donate their time to encourage female engineering students, and undergraduates volunteer for outreach activities, in which they mentor and inspire school aged girls.

Bio

Dr Alex Bannigan has a PhD in biology from the University of Sydney and worked as a researcher and lecturer in the US university system for ten years before returning to Australia to take on the challenge of recruiting and retaining women in engineering at UNSW Engineering, Australia's largest engineering faculty.

Workshops

1) Learning initiatives improving girls' engagement in STEM studies in secondary school & beyond: The PCW Melbourne STEM Project

Authors

Kelly McGurn, PCW Melbourne, kmcgurn@pcw.vic.edu.au

Overview

The objectives of the workshop will be to outline the key initiatives being undertaken by PCW, a girls' secondary College in Melbourne, Australia, as a part of a five year strategy to enhance student engagement in STEM subjects and increase student participation in STEM pathways in the Senior School and beyond. The workshop will outline a range of core and electives programs initiated by the College as a part of a strategic STEM program that includes partnership programs with Primary Schools & Industry. The strategy was established in response to diminishing confidence and engagement levels by students in the Mathematics and Science subjects within Secondary School and consequently lowering transition rates into STEM Tertiary Studies. Participation in the workshop would be suitable for teachers (Primary/Elementary and Secondary) and School Administrators. It will be an opportunity to share knowledge, invite responses, extend ideas and investigate possible partnerships between sectors.

Abstract

Presentation College Windsor (PCW) is a girls' 7-12 Secondary College in inner Melbourne. Some years ago, it became apparent that students at the College were entering secondary school with stanine levels in numeracy well below literacy levels. Many had a negative disposition towards Mathematics & Science, this attitude sometimes mirrored by parents. Based on these trends and school-specific data provided by the STEPS Study (Study of Transition and Education Pathways; www.stepsstudy.org), the National School Improvement Framework (SIF) Program, School Satisfaction Studies and Student Pathway patterns, PCW Melbourne has established a 5-year targeted program aimed at increasing student engagement and retention rates in STEM studies and pathways.

The College has introduced four strategic initiatives that involve both compulsory and elective programs:

- 1) a core Year 7 Mathematics/Science Super Subject;
- 2) Middle Years Elective Semester units including Year 8 Mini Masters and Year 9 STEM subjects;
- 3) a STEM Bright Sparks Program involving Year 9 students from PCW Melbourne and a range of local Primary schools that encompasses collaborative, interdisciplinary, real life learning and problem solving;
- 4) Year 10 core and elective Science units that include Partnerships with Universities and Industry along with Work Experience opportunities in the STEM field.

The objectives of the strategy include: increased student exposure to STEM fields including Industry Partnerships; enhanced student confidence and attitude levels in STEM subjects by students and parents; improved engagement by girls in STEM subjects by Year 10 to increase uptake in VCE and Tertiary Pathways. Data are provided by annual SIF reporting, School Satisfaction data, pre and post testing in STEM subjects including attitudinal differences and learning outcomes. The STEM program is working explicitly to create an educational environment that is inviting to girls, enabling them to embrace Mathematics and Science Subjects. At the early stages for the strategic STEM program results are indicative only, however, students' confidence levels in STEM subjects appear to be increasing across Years 7 & 8 and VCE student numbers in Chemistry, Biology and Specialist Mathematics in 2016 are exceeding those at the adjacent boys' College that PCW Melbourne shares a range of Senior classes with. Early results also indicate increasing numbers in terms of girls' participation in Physics and advanced Mathematics. Results presented will include pre and post testing data for individual cohorts within the program along with trend analysis data across time.

Bio

Kelly McGurn is Deputy Principal Staff at PCW Melbourne and has 17 years teaching experience. She has also been the VCE Pathways Coordinator and Assistant Principal Teaching and Learning. A member of the College Leadership Team, Kelly oversees the Learning Program and Initiatives, Staffing, Learning Technologies and Learning Data Management at her school. She has a particular interest in data informed learning and the development of adolescent emotional intelligence. Kelly

has received the iNet Australia Scholar Award and PAVCSS Memorial Scholarship and has undertaken the Harvard University Future of Learning Program. Kelly is currently completing her Masters in Educational Policy (International) at the University of Melbourne.

2) GenPORT connecting research policy and action

Authors

- Rachel Palmen, NOTUS applied social research, Spain, rachel.palmen@notus-asr.org
- Elizabeth Pollitzer, Portia Ltd., UK, ep@portiweb.org.uk
- Henrietta Dale, Portia Ltd., UK, hd@portiaweb.org.uk

Overview

Objectives of the session.

- 1) Introduce GenPORT as a support tool for the community to help them to connect policy and action.
 - 2) Promote GenPORT as a useful tool to provide greater visibility to good practices and policy approaches to gender and science including STEM.
- Shape the future of GenPORT.

Scholarly or scientific significance. Though the wealth of gender and science resources developed in Europe over the last decade offers enormous potential for knowledge sharing and information these resources are dispersed, and have varying degrees of visibility and usability. GenPORT has been designed to support the Gender and STEM community in Europe.

Structure of the session. Teachers, students and researchers should attend.

Presentation from:

- Henrietta Dale: GenPORT overview
- Dr Rachel Palmén: GenPORT policy briefings and research syntheses
- Dr Elizabeth Pollitzer: Emerging participation arguments

The GenPORT consortium would like to draw on the extensive expertise of the participants to guide how to further and better connect research – policy – action. We'll use this guidance to shape the remaining engagement activities of GenPORT (e.g. e-discussions, guest blogs, etc.) to better serve the community.

Abstract

Introduction. Genderportal is the product of an FP7 funded project, GenPORT which provides access to quality resources on gender and science, covering all STEM fields and the needs of all actors and stakeholders, as research/information producers/users. The unique feature of genderportal is that it has been designed by experts in the area of gender and science and in collaboration with members of the target community, i.e. scientists, policy makers, educators, media etc. and that its aim is to serve as a window into a wide variety of resources available and maintained by the user community.

Theoretical/conceptual framework. Underlying the design is the conceptual framework developed by gender scholars, which was tested through consultation with a wide range of target users, to ensure a systematic organization and access to the resources and their content.

Aims and objectives. GenPORT is community based as stakeholders are encouraged to share and upload useful resources and engage in dialogue about gender and science. GenPORT not only enables the sharing of quality content but is also producing research syntheses, reports, policy briefs, and an expert database to facilitate the process of connecting research to policy and practice in gender and science.

Sample/Data sources. The portal has been developed through a needs assessment with stakeholders from the community, concertation meetings and reviewed by technical and scientific committees.

Methodology. It has been designed and developed from a user-based approach which consulted a wide range of science, gender equality practitioners and policy making stakeholders throughout Europe and beyond.

Results. GenPORT currently has 628 submitted resources, 222 organisations and 151 registered users. It has produced 6 research syntheses and 25 policy briefs which aim to provide evidence based advice and recommendations to national level policy makers.

Scientific and Applied significance. Its scientific contribution includes the development of a gender and science taxonomy – which aims to provide a platform to facilitate the sharing of resources and knowledge in the field. It has an applied focus promoting inter/multidisciplinary research in multiple sectors, connecting experts to experts, and experts to users.

Bio's

Rachel Palmén (workshop presenter) forms part of the GenPORT consortium which is an FP7 support and coordination action to develop an Internet portal for sharing knowledge and inspiring collaborative action on gender and science. She leads Workpackage 2 which involves carrying out a needs assessment with different stakeholders and Workpackage 4 which will produce 5 research syntheses and 25 policy briefs.

Dr Elizabeth Pollitzer (workshop presenter) co-founded Portia in 1999 and continues to serve as Director. Portia Ltd UK is an organization devoted to improving gender equality in STEM and promoting the inclusion of the gender dimension in STEM. Prior to Portia she taught and researched in the Departments of Computing and Management at Imperial College, University of London.

Henrietta Dale (workshop presenter) is Operations Manager and Researcher at Portia Ltd UK. Portia is the partner responsible for Community Building in the GenPORT project which involves engaging the existing communities operating in Gender and STEM, and shaping GenPORT's development to better suit their needs, as well as attracting stakeholders from a wider audience.

“Make a Pitch”

1) Promoting gender equality in University STEM Education

Presenters

- Alessandra Bonoli, University of Bologna, Italy, alessandra.bonoli@unibo.it
- Elena Luppi, University of Bologna, Italy, elena.luppi@unibo.it
- Carlo Tomasetto, University of Bologna, Italy, carlo.tomasetto@unibo.it

Abstract

The University of Bologna is very committed in promoting gender equality in STEM as member and Italian representative of WiTEC, the International Association for Women in Science, Engineering, Technology: an European association with 25 years of history of promoting studies and activities related to empowering women in the field of technology, science and engineering. Moreover, the University of Bologna is coordinating a Horizon 2020 project called PLOTINA whose objective is to develop, implement and assess self-tailored Gender Equality Plans for Research Organizations. Under this framework, an interdisciplinary research group is conducting a research on gender equality in STEM at the University of Bologna. The aim of this project is to assess gender unbalance in STEM Faculties (with a view on students) and Departments (with a view on researchers and professors), investigating the meanings, perceptions and needs of women and men involved, in order to plan some specific educational strategies for reducing gender gap. After briefly presenting the research purposes and aims we would invite the participants to join it or part of it proposing some of the questionnaires that have been realised for assessing students' and professors' opinions and attitudes towards gender and STEM.

Bio's

Alessandra Bonoli (PhD) is Associate Professor in Resources and Recycling at the University of Bologna (Italy), Department of Civil, Chemical, Environment and Material Engineering. She has taught a number of bachelor, master, international master and PHD classes. She has authored more than 200 papers. She coordinates a new research group of “Engineering of Transition” that is developing researches oriented to build a sustainable world by saving and valorizing natural resources: raw materials, water and energy. She created in 2011 the Department Research Center for international Cooperation and Development on Engineering, Environment and Emergency (CODE³) for the international cooperation.

Elena Luppi (PhD) is Researcher and assistant professor on Educational Research at the Department of Education Sciences of the University of Bologna (Italy). She is the Italian representative for the University of Bologna in WiTEC - the European Association for Women in Science, Engineering and Technology. She is Rector delegate for Gender Equality at the University of Bologna. She is member of the Centre for Gender Studies in Education of the Department of Education Sciences of Bologna. She has been conducting empirical researches and training activities concerning the topic Gender and Education. She teaches “Theories and methods of planning and evaluation” and “Methodology of Educational Research”.

Carlo Tomasetto (PhD) is Associate Professor in Developmental and Educational Psychology at the University of Bologna (Italy), Department of Psychology. His research interests are mainly focused on the emergence of a variety of societal stereotypes (e.g., concerning gender, obesity, physical appearance, etc.) and their relations with cognitive functioning in children. With regards to gender and STEM studies, his work is aimed at better understanding how implicit cognitive processes, on the one hand, and parental influences, on the other, affect children's stereotyping of math as a male domain.

2) Females pursuing a STEM-study in higher education: The impact of cultural processes on their career decisions

Presenter

Hanke Korpershoek, University of Groningen, the Netherlands, h.korpershoek@rug.nl

Abstract

I am seeking collaboration with scholars from various countries to study cultural processes that influenced females' decision to enter STEM-studies in higher education. In most Western societies, females are largely underrepresented in these fields, which is undesirable, both from an economical (shortages in the labour market) and a societal point of view (gender equity). In some societies (e.g. most Asian societies) the participation rates are more gender-balanced. By interviewing females that actually pursue a STEM-study in various Western and non-Western societies, the project aims to understand how cultural differences and cultural processes influence students' study decisions. The focus is on females studying, for example, physics or engineering, and/or those studying to become teachers in STEM-courses (e.g. mathematics teacher). Insight in the relevant factors that have influenced females' career decisions in other societies will enhance our understanding of how the government and higher education institutions can increase female' interest in STEM. Topics:

- 1) Career decisions:
 - reasons why students entered a STEM study and expected career perspectives;
 - perceived impact of parents and of cultural and societal context on career decisions;
- 2) Socio-psychological characteristics:
 - self-concept in and attitudes towards mathematics, chemistry, and physics;
 - perseverance and curiosity in math/science learning.

Bio

Hanke Korpershoek (1982) works as an assistant professor at the GION Education/Research institute of the University of Groningen. She finished her PhD project "Search for Science Talent in the Netherlands" in February 2011. Using longitudinal cohort data, she studied students' choice behaviour in secondary education. Based on several decision making theories (e.g. rational choice theory, expectancy-value theory, multi-attribute utility theory), she searched for plausible explanations to find out why few students (particularly few girls) choose advanced mathematics, chemistry, and physics courses and/or enter a science-oriented study in higher education. Since 2011 she has worked on various related projects at GION.

Invited Panel

Inclusive STEM Education & Career Development: Challenges and opportunities

Moderator



Paul Richardson
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Panelists



Caroline Austin
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Kelly McGurn
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Helen Watt
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Paul W. Richardson is Associate Professor in the Faculty of Education, Monash University, and Associate Dean (Research). He previously served as Associate Dean (Education), and on the Faculties of the University of Michigan and University of Sydney. Paul's interests concern professional development and socialisation experiences of beginning teachers (including in STEM and gender issues); teaching and learning in higher education; academic literacy; youth identity development; qualitative and mixed-methods research. He has attracted substantial funding from Australian Research Council Discovery Grants to conduct large-scale longitudinal studies with beginning teachers (www.fitchoice.org) and published in leading journals.

Professor Caroline Austin joined Newcastle University as a Lecturer in 1993 in Biochemistry and Genetics, rising to Professor in 2005. She has an international reputation on DNA topoisomerases (Google scholar *h* index=35). Prior to taking up an academic post at Newcastle she carried out research as a postdoctoral researcher at London University and Harvard. She studied for a Biochemistry BSc and Molecular Biology PhD at the University of London. She serves on the MRC non-clinical career development panel, reviews grants and scientific papers. She has been leader on a range of undergraduate modules and personal tutor to dozens of undergraduates, supervised more than 20 PhD students, and been mentor to many early career scientists. She supports the Athena SWAN charter as a member of national ECU panels and by critically reading applications. As the first member of her family to obtain a degree she understands the importance of widening participation.

Dr Clem Herman is Senior Lecturer in the Department of Computing and Communications at the Open University and Director of eSTEeM, the Open University's Centre for STEM Pedagogy. She has worked in a range of roles and projects as an educator, practitioner and researcher to support women in ICT and science, engineering and technology sectors. Clem's most recent research and publications focus on the employability and careers of women SET professionals especially on the impact of career breaks and experiences of women returners. Her latest project involves a comparative study of gender and skilled migration in IT in India and the UK. She is Editor-in-Chief of the *International Journal of Gender Science and Technology*.

David Howell is Director of Operations for the North East Business and Innovation Centre (BIC) and its customers. David specialises in property management, incubator strategies, marketing, business planning, new idea development and people management. David has ensured the complex has grown in line with business needs and it is now home to over 140 independent firms employing over 1000 people on site. David is also chairman of Sunderland Enterprise Park Management Company (SEP), and the Growth Accelerator and Incubation Network (GAIN). David's interest and that of the BIC is to encourage young people to be more innovative and entrepreneurial. Their "Big Ideas" program had stimulated young adults regarding own future business option. Several "women into entrepreneurship" research projects utilised the businesses on site. David was a member of the ESRC North East Role Model for Innovative Women Advisory Board, and presented at the "Innovating Women: Illuminating Achievement and Success" at the Business School in 2011.

Noortje Jansen holds a degree in psychology and works as policy advisor at *vhto* where she has been busy with practical implications of gender inclusive policy and outreach in vocational and higher STEM education. She has also investigated choice behavior in education and career among higher educated STEM alumni. Currently Noortje is involved in the development of a website/digiboard application which enables children and young adults, their teachers and parents to watch and work with gender inclusive pictures and films of STEM professionals/professions. She keeps track of the research in the Gender & STEM field as to feed VHTO projects with the most up-to-date information and implementation methods. Noortje is responsible for the Gender & STEM Network Secretariat.

Kelly McGurn is Deputy Principal Staff at PCW Melbourne and has 17 years teaching experience. She has also been the VCE Pathways Coordinator and Assistant Principal Teaching and Learning. A member of the College Leadership Team, Kelly oversees the Learning Program and Initiatives, Staffing, Learning Technologies and Learning Data Management at her school. She has a particular interest in data informed learning and the development of adolescent emotional intelligence. Kelly has received the iNet Australia Scholar Award and PAVCSS Memorial Scholarship and has undertaken the Harvard University Future of Learning Program. Kelly is currently completing her Masters in Educational Policy (International) at the University of Melbourne.

Helen Watt is Professor in the Faculty of Education, Monash University, and previously served at the University of Michigan, University of Western Sydney, University of Sydney, Macquarie University. Her interests include motivation, gendered educational and occupational choices, motivations for teaching, teacher self-efficacy, longitudinal research, quantitative methods. Her work has implications for redressing gender imbalances in mathematics-/science-related careers, and supporting career and professional development of beginning teachers.

Onsite information

Registration hours: from 2—3pm Thursday 21 July, Room 8.10

3rd Gender and STEM Conference 2016 will be held at the Newcastle University Business School, Science Central, Newcastle upon Tyne, England

For further information please contact

Email conference@genderandstem.com.

Conference dinner, including Address by: Chi Onwurah, MP, Shadow Cabinet Minister

TIME

Friday, 22 July 2016

6:30pm arrival and reception for 7pm seated dinner

LOCATION

Great North Museum: The Clore

Barras Bridge

Newcastle upon Tyne

NE2 4PT

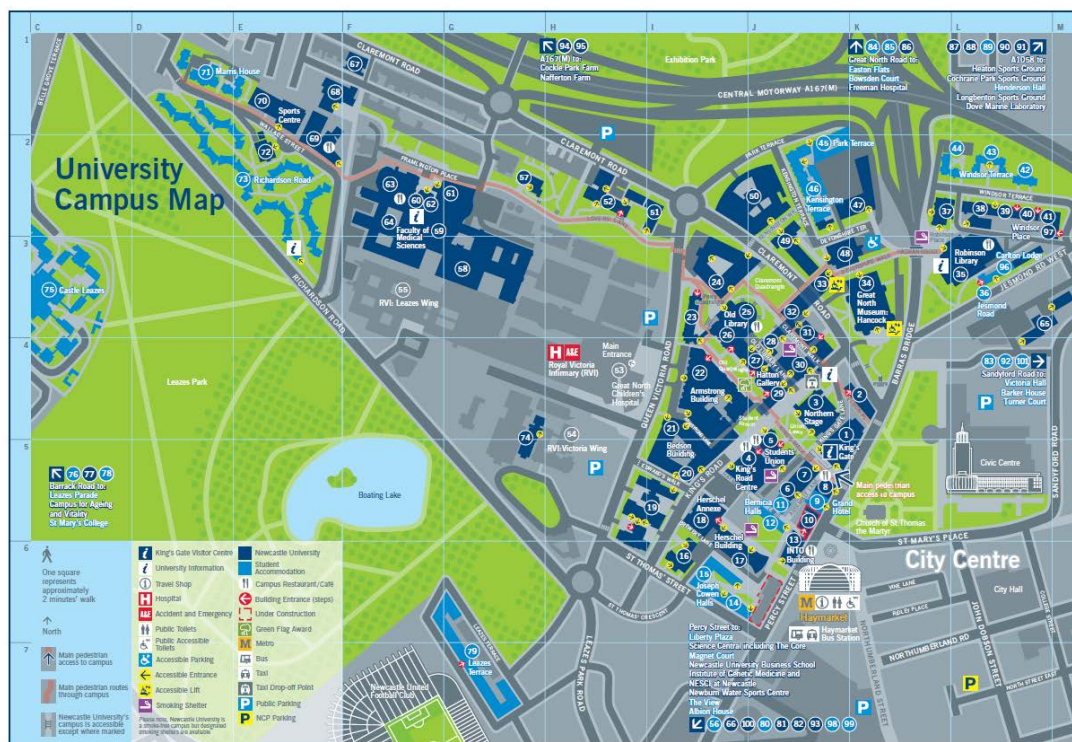
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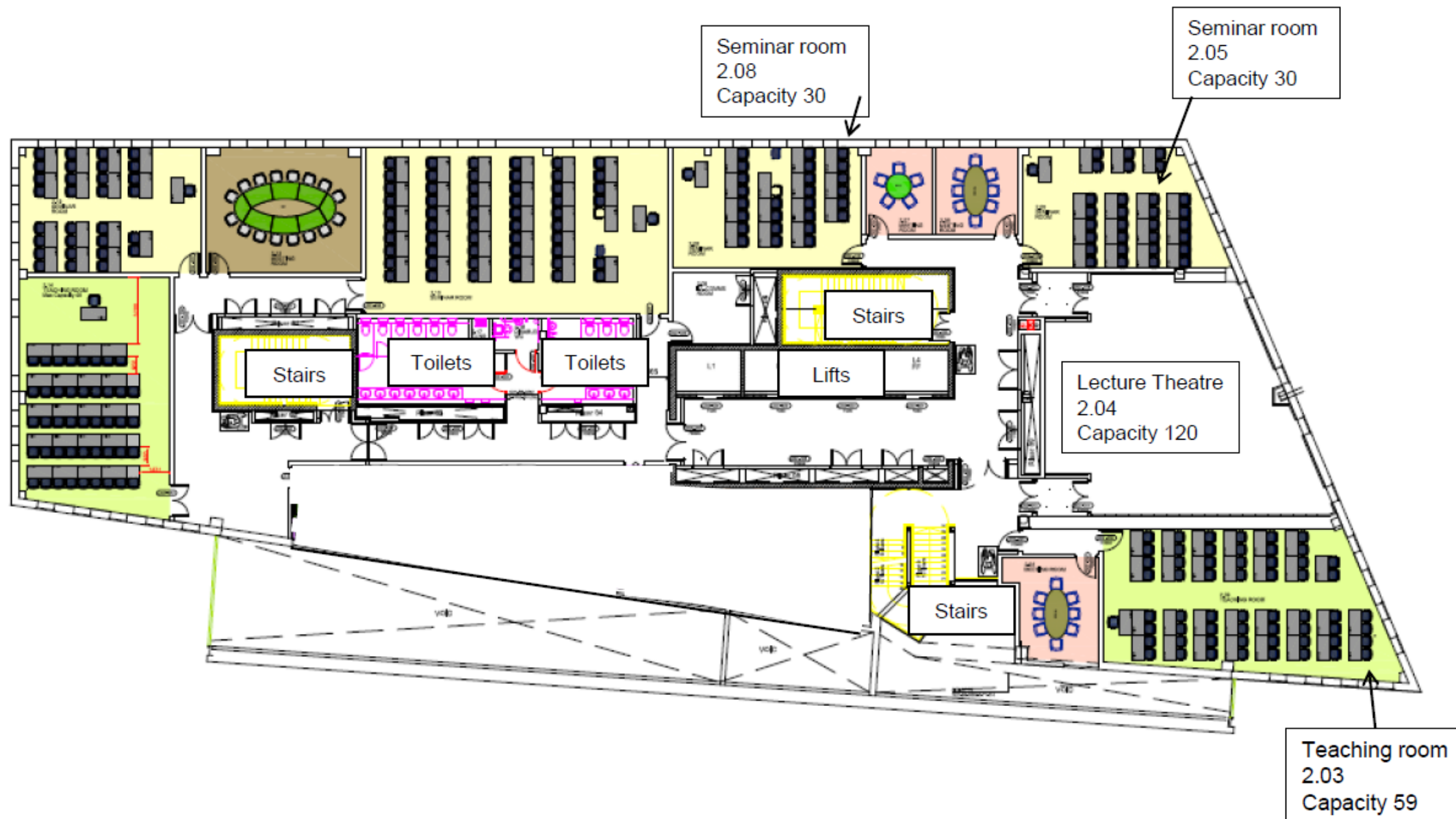
General enquiries: info@greatnorthmuseum.org.uk

<https://greatnorthmuseum.org.uk/>

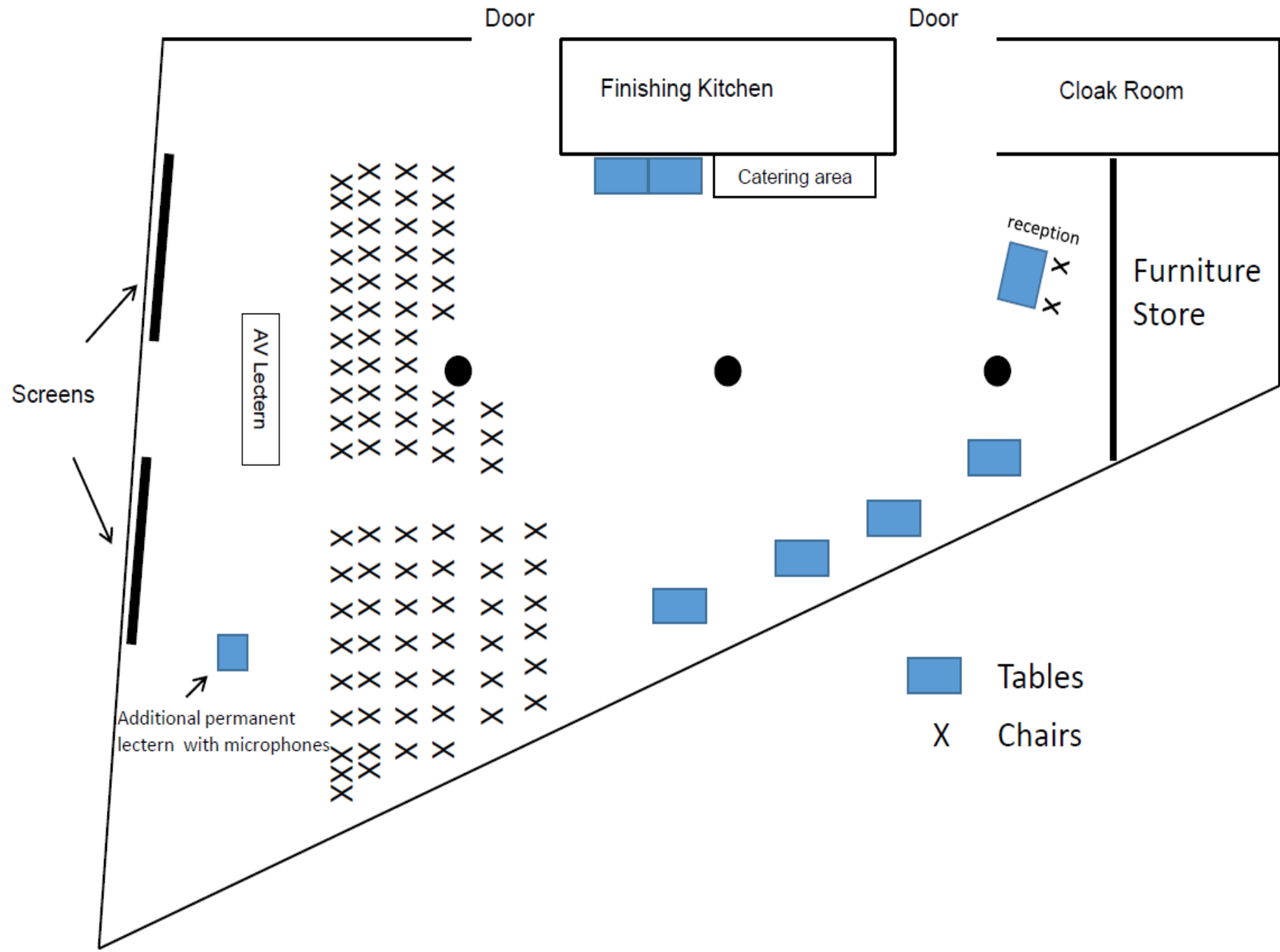
Map



Newcastle University Business School Second Floor Room Plan



Room 8.10, Theatre Style 74



Conference organisers



Helen Watt

Helen M.G. Watt is Professor in the Faculty of Education, Monash University. Previously she served on the Faculties of the University of Michigan, University of Western Sydney, University of Sydney, and Macquarie University. Her interests include motivation, gendered educational and occupational choices, motivations for teaching, teacher self-efficacy, longitudinal research, and quantitative methods. Her current work has implications for redressing the gender imbalance in mathematics- and science-related careers, and for supporting the career and professional development of beginning teachers. Helen is currently Associate Editor for *AERA-Open*, and serves on Editorial Boards of *Contemporary Educational Psychology* and *International Journal of Quantitative Research in Education*; previously for *Educational Research Review*, *Journal of Research on Adolescence*; *Equity, Diversity and Inclusion*; *Journal of Experimental Education*; *Equal Opportunities International* and *Australian Journal of Education*. She received inter/national research awards, and co-edited books and journal special issues recently including *Gender and Occupational Outcomes*; *Understanding Women's Choice of Mathematics- and Science-Related Careers*; and *Motivation for Teaching*.



Noortje Jansen

Noortje Jansen holds a degree in psychology and works as a policy advisor at *vhto*. At *vhto* she has been busy with the practical implication of gender inclusive policy and outreach in vocational and higher STEM education. She has also investigated choice behavior in education and career among higher educated STEM alumni. Currently Noortje is involved in the development of a website/digiboard application which enables children and young adults, their teachers and parents to watch and work with gender inclusive pictures and films of STEM professionals/professions. She keeps track of the research in the Gender & STEM field as to feed VHTO projects with the most up-to-date information and implementation methods. Noortje is responsible for the Gender & STEM Network Secretariat.

Host



Pooran Wynarczyk

Pooran Wynarczyk is the 2016 Conference Host and professor of Small Enterprise Research, Director of Small Enterprise Research Unit (SERU) at Newcastle University Business School, UK and the Chair of the Diversity Consultative Group at Newcastle University. She is an elected Fellow of the Royal Society of Arts, Manufacturers and Commerce (FRSA); Founder of the ESRC sponsored North East of England Role Model Platform for Innovative Women; a Board Director of the Institute for Small Business and Entrepreneurship (ISBE); and a judge of the Formula One (F1) in Schools Challenge. She has published widely in the areas of SMEs, entrepreneurship, innovation, and science, technology, engineering and mathematics (STEM) pipeline (policy, education and employment) with a focus on gender and young people. Her recent research, sponsored by the ESRC Science in Society Programme, has focused on the impact of gender innovation on regional technology, economy and society. Her latest publications include a co-edited book, entitled, "Innovating Women: Contributions to technological advancements", published as part of the Emerald/ISBE book series.

About VHTO

VHTO, the Dutch national expert organization on girls/women and science/technology, aims to increase the participation of women and girls in Science, Technology, Engineering and Mathematics (STEM). VHTO is the co-founder of the Network Gender & STEM.

Since the early 1980s, VHTO has been building up knowledge about the participation of girls and women in the world of STEM, and experience in deploying this knowledge in areas such as education. With our projects and methodology, we aim to break (implicit) stereotypes concerning gender & STEM, increase the growth mindset and self-confidence of girls and young women regarding STEM subjects. VHTO has developed several successful programmes to bring together female students/recent graduates and female professionals (role models) in STEM across the whole education spectrum, from primary to higher education, and from the vocational to the university level.

VHTO currently has a range of activities aimed at increasing the numbers of women in the STEM sector including:

- Organizing training and workshops for teachers and career counsellors to reduce gender bias, increase gender awareness, and provide them with the necessary tools and knowledge to advise and inform girls about a study or career in STEM fields.
- Advising school managers and deans (in primary, secondary and higher education) on implementing gender policy and screening teaching material for gender bias ('gender scans').
- Organizing Girlsday every year, at which girls (aged 10-15) visit technical /engineering companies and STEM research institutes. This gives girls a first-hand experience of what it's like to work in STEM. In 2016, more than 10.000 girls participated in Girlsday.
- Organizing activities to get girls in touch with female STEM professionals, such as "speed-date sessions" in secondary schools, in which small groups of girls talk with role models. To this end, VHTO has built a large database in which nearly 2000 female professionals in STEM are registered (www.spiegelbeeld.net). In 2015, more than 35.000 girls were reached with VHTO's dissemination activities.
- Developing an online database with videos and stories of (mainly) female role-models working in STEM, called "Dit Doe Ik" ("This is what I do", www.ditdoeik.nl). These "portraits" of women working in STEM give a realistic image of what it is like to work in STEM and the wide variety of STEM jobs.

www.vhto.nl

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