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Research Synthesis 1

Education and Training

Authors

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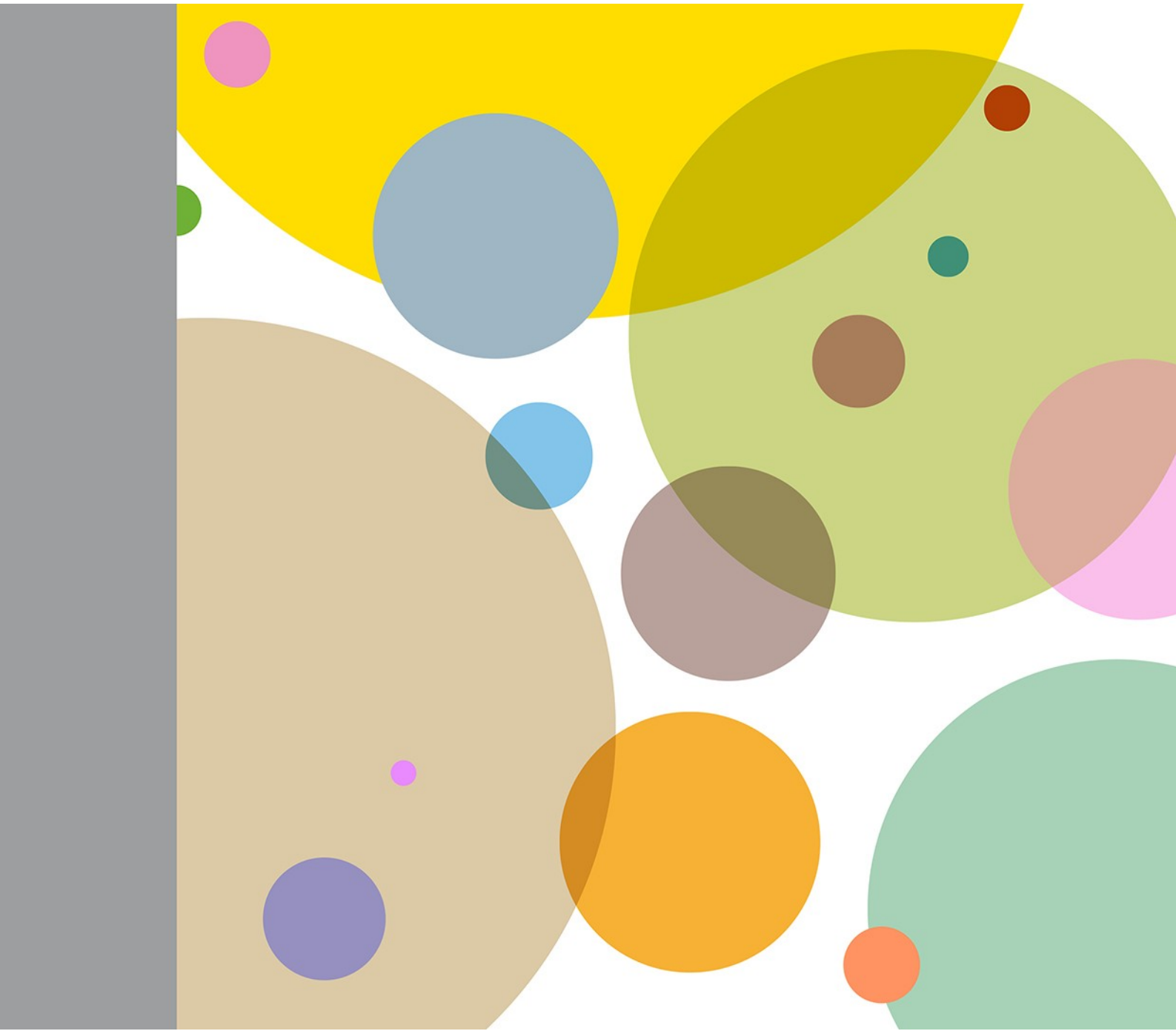
V3.0 – January 2017



Description of the Problem

The aim of this research synthesis is to present a brief overview of recent literature in explaining gendered fields of study patterns, to critically assess recent scientific progress in this field and to identify subsequent policy implications.

Real progress has been made in women's participation in higher education over recent decades – girls currently access higher education in greater numbers than their male peers – by 2012, 34% of women across OECD countries had attained a tertiary education compared with 30% of men (OECD, 2015:23). Gender gaps however persist: too many boys, especially working class boys and boys from some minority ethnic and migrant backgrounds, drop out of school – or leave school with low skills that are not matched to the labour market requirements whilst horizontal segregation in education continues to be problematic. For example, in the U.S. in 2005 almost 11% of males age 16-24 dropped out in comparison to 8% of females (Snyder & Dillow, 2007). Girls less frequently opt for studies in science, technology and engineering whilst boys tend to opt out of education, health and welfare, and the humanities. This does however vary according to country context – for example higher levels of girls' participation in SET (Science, Engineering and Technology) can be seen in some parts of Central and Eastern Europe (EC, 2013:50).

"Horizontal segregation in education matters- it is a key driver of gendered occupational segregation."

Horizontal segregation in education matters – it is a key driver of gendered occupational segregation. Occupational segregation is a key aspect of gender inequality specifically impacting on the gender wage gap whilst also constraining careers. Change in this field is necessary from a social justice perspective and in order to achieve a more efficient use of human resources.

Horizontal segregation in higher education is partly attributed to gendered patterns of study fields in secondary education (Caprile et al., 2012:72). Despite the vast amount of research carried out to examine the reasons for gender segregation in education – there is no single explanatory factor (ibid). The majority of research focuses on girls opting out of STEM subjects (Henrikson et al., 2015; Regan & Dewitt 2015; Yazilitas et al., 2013), and is less concerned with boys' under-representation in

education, health and humanities. There continues to be less research on boys' 'atypical choices' and why boys' choices tend to be less evenly distributed than girls.

In the past, some authors explained gendered patterns of choice as a result of gender differences in mathematic performance. This however has shown to be problematic on numerous levels:

- Gender gaps in mathematics performance tend to be closing.
- Achievement in mathematics at school is not a good predictor of choice of study field in higher education – as high performing girls tend to make more diverse choices than equally talented boys (Alaluf et al., 2003a; Xie & Shauman, 2003).
- Research has demonstrated how gendered mathematics performance can be linked to the national gender equality culture – as measured by the level of women's participation in the labour force, women's political empowerment, gender differences in who does the housework, and general attitudes to gender equality. Those countries with a greater gender equality culture also tend to have narrower gaps in mathematics performance (Guiso et al., 2009; Nollenberger & Rodríguez Planas, 2014; González de San Román & Del la Rica, 2012; OECD, 2015:147).
- Cross- national research in this field has examined the impacts of the structure of the educational system – in terms of levels of differentiation on gendered patterns of achievement (particularly in science and mathematics) (Van Langen et al., 2006). In general, this strand of research argues that the more integrated the educational system – the smaller the gap in mathematics and science achievements of girls and boys.

Current research in this field can be broadly categorized into three different approaches: micro-level explanations which deal with the psychology of individual study choices, meso-level approaches that deal with the institutional characteristics of educational systems (Yazilitas et al., 2013), and macro-level explanations which mainly focus on culture, gender, socialization, structural gender inequality and social context.

Recent and New Insights from Research

Stereotypes

> Stereotypes are cognitive schema or prototypes; clusters of perceived personal traits applied to social groupings, such as occupational categories. It can be cognitively efficient to describe groups using labels; however stereotyping exaggerates group differences and underestimates within group variability (DeLamater & Myers, 2007). In this sense stereotypes reflect shared social beliefs, values and norms that dictate the roles of men and women in society. (GenSET, 2011)

There is a significant strand of literature which recognizes the impact of gender stereotypes on girls and boys, and women and men's study and occupational choices. Gender stereotyping is based on a dualistic notion of gender which, at its most reductive, equates women with reproductive work and men with productive work in society. Whilst the origins of gender stereotypes are hotly debated, there is a broad recognition of their pervasiveness (Charles, 2011:364). There are two main ways that stereotypes support gendered segregation in field of studies: "biasing evaluations of self and others and creating standards of femininity and masculinity to which people feel accountable" (ibid).

Fewer girls choose to study in the science fields even when there are programmes to encourage girls to go into the sciences. At undergraduate level, girls dominate in the health sciences and biological sciences, they are still in low numbers in computer science, mathematics, physical science, and lowest of all in engineering. These are all disciplines perceived to be "male subjects".

Stereotypes however are not fixed but are permeable to time and place. The majority of the literature looks at how gender stereotypes are reproduced – and how this impacts on girls' and boys' study choices – there is much less literature that charts the dynamic processes of challenging and changing stereotypes (Caprile, 2012; Lenton et al., 2009).

Role of Significant Others

Stereotyping and role modelling are closely interconnected: gender differences in career choices have been explained by role modelling where behaviour of significant others is encoded and copied (Bandera, 1986). Parents, teachers and friends have been identified as key role model and stereotype "carriers" – that influence the study choice of individuals (GenSET, 2011; Zwick & Renn, 2000). All three groups have been identified as key socialization agents that tend to reproduce traditional gender stereotypes and roles.

In the literature, parents are seen to influence young people's choice of subjects through role modelling and projecting expectations of career choice. This works in various ways: through differential treatment of boys and girls, evaluating ability differently (NAS, 2007), holding different expectations for their sons and daughters, and direct role modelling. The enduring links between parents' expectations and their young adult children's gender-typed occupational choices has also been demonstrated (Jacobs et al., 2006). Recent research has shown how parents are more likely to expect their sons, rather than their daughters to work in a STEM field (OECD, 2015:139). Direct role modelling also has an impact. Research has shown that girls are more likely to undertake scientific-technical studies if someone in the family has already done so (Hapness & Ramussen, 2000), whilst children are more likely to undertake doctoral studies if someone in the family has also completed a doctorate (Högskoleverket, 2006). This research also highlights the key relevance of patterns of class background and class mobility, especially in societies with large economic class and income differences. Levels of gender equality within the household have also been identified as impacting positively on girls' greater interest in mathematics (Jacobs & Eccles, 1992; NAS, 2007) whilst girls brought up in households with greater gender equality are more likely to pursue non-traditional careers (Weisner & Wilson-Mitchell, 1990).

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Teachers are seen to be particularly crucial – especially in the early years of secondary education – when a teacher can have a great impact on students' views of science and related careers (Cerini et al., 2004; Regan, 2015:74). Research explores how stereotypes are transmitted in the classroom – and highlights how teachers are often unaware of their role in perpetuating this bias. This can impact on students' choice of studies – for example girls are discouraged from choosing options that run counter to traditional gender stereotyping of subjects. Other research notes how teachers tend not to be informed about careers in general (Stagg, 2007), and do not perceive themselves to be sources of careers information for their students (Munro & Elsom, 2000). This lack of solid information about careers, combined with a lack of recognition of the influential role they play in young people's decisions, means teachers are not only ill-prepared to play this vital role, but may unwittingly perpetuate bias. Bias is also perpetuated in pupil–teacher interaction, which has been identified as being magnified in mathematics and science classes (Tobin & Gallagher, 1987).

Research has also examined the impact of peers as role models in adolescence – at that key time when educational choices are first made. Teenagers tend to look to their friends and peer group as a key reference point. Research has shown how gender stereotypes are reinforced – and non-conformity is punished whilst same-gender friendships have tended to intensify gender differences in educational choice in mixed school settings (Kessels 2005). Technical subjects tend to be unpopular – when it comes to choices to be made, and tend to be associated with masculinity. There can be pressure on girls not to take such subjects and this may be amplified by their increased susceptibility to perceptions of social acceptance (Håpnes & Rasmussen, 2000).

Individual Study Choice

Different approaches have attempted to explain the complex relationships between abilities, skills, interests, expectations of success and academic choices. One strand of research examines how gendered patterns of academic choice in Mathematics, Science and Technology can be largely attributed to differences in men and women's beliefs about their abilities and skills in mathematics (Bussey & Bandura 1999; Yazilitas et al., 2013:4). The OECD PISA study and other studies find that even when girls perform just as well as boys they tend to have less belief in their own abilities in mathematics and science (OECD, 2015). These self-beliefs then impact on students'

learning and performance on various different levels including students' motivation and perseverance, emotional life and crucially affects the choices students make about coursework, additional classes, and even education and career paths (Bandura, 1997; Wigfield & Eccles, 2000). Recent PISA findings however highlight the important role that gender stereotyping plays in mathematics self-confidence:

> Gender differences in self-confidence are particularly large when considering the ability to solve applied mathematics tasks that have gender-stereotypical content (e.g. petrol-consumption rate of a car). No gender differences in self-confidence were demonstrated in more abstract-classroom content (e.g. solving a linear or a quadratic equation). (OECD, 2015:2/3)

The views of teachers including stereotypes encourage girls and boys into particular careers; and a lack of role models of women in science helps to maintain the status quo.

Educational Systems and Institutions

Gendered patterns of fields of studies are also affected by the type of educational system and institutional factors like the curriculum, pedagogy and quality of teaching.

The degree of differentiation/ integration of an education system has been linked to its impact on both boys' and girls' educational expectations. The more differentiated an education system is, the lower the expectations of students. This holds for both boys and girls (McDaniel, 2010). It has also been argued that educational systems that force young people to make "choices" during puberty – (when young people are particularly susceptible to gender stereotypes) – reinforce gender segregation in education which then goes on to determine university and professional paths (Van Langen et al., 2008).

The formal and hidden curriculum, pedagogy, and the quality of teaching have all been identified as impacting on gendered fields of study. Regarding curricula in science subjects, there has been a push towards an inquiry-based approach to learning. Research has shown how this approach may impact on learning gains particularly minimising the gender gap (Laursen et al., 2014:412). Context-based approaches to science teaching, that emphasise the links between science, technology and society, are also being introduced by educational reforms to increase motivation in science. In their systematic review, Bennett et al. (2007) relate this

approach to increased positive attitudes in both girls and boys, whilst they also emphasise its role in reducing gender differences. Other research has shown how a high school curriculum that is strong in mathematics and science may provide a partial antidote to gender stereotyping and the discouragement of girls' interest in STEM (Legewie & DiPrete, 2014:275).

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The concept of the hidden curriculum refers to a set of values, attitudes and norms, implicitly conveyed to pupils by teachers' actions and by the organizational processes operating within schools. Research has shown how this "transmits messages that often reinforce gender stereotyping and the dominance of boys regarding the school space" (Caprile et al., 2012:77). Research by Legewie and Diprete (2014) has shown how gender integrated extra-curricular activities can mitigate against established gender stereotypes. Pedagogy and the quality of science teaching have also been identified as impacting on student's engagement with science and subsequent decisions to pursue further science study (Pike & Dunne 2011; Tytler & Osborne 2012; Tai et al., 2006).

Culture, Gender, Socialization and Structural Inequality

The relationships between gendered identities, stereotypes, societal development and gendered choice patterns have been studied in an attempt to explain gendered patterns of fields of studies.

Links between levels of societal development and the sex typing of Mathematics, Science and Technology – has been explored by Charles & Bradley (2009) who examined sex segregation in higher education by field of study in 44 countries with differing levels of development and concluded that "sex typing of curricular fields is stronger in more economically developed contexts". They claim that this is due to a gender essentialist ideology combined with value systems that favour self-expression. This strand of research argues that in advanced industrial societies,

vertical inequality forms have generally decreased more than horizontal forms – perhaps because hierarchical distinctions are seen to be less legitimate and are subject to greater scrutiny (Charles, 2011).

Other research links identity construction to societal development. Schreiner & Sjøberg's (2007) research centres on identity construction of young people and their subject interests, which they deem as crucial for understanding gendered patterns in Mathematics, Science and Technology. It has been argued that students in late modern societies may make fundamentally different educational choices than students in traditional and modern societies (Schreiner & Sjøberg, 2007). Educational and academic choices of students from late modern societies are guided less by concerns for material security and more by the question: “Who do I want to be?”. Core identity is therefore used to explain gendered differences in Mathematics-Science-Technology take-up in these types of societies.

Moreover, local and national patterns of horizontal gender segregation need to be understood within the broader framework of structural gender inequalities, and the extent of, and indeed variation in, male domination across different European societies. There are considerable variations across Europe in this respect. In general terms, greater horizontal gender segregation tends to be associated with greater gender inequality at the societal level. However, this is not a one-to-one relation. Less horizontal gender segregation in education and training occurs in some countries not known for societal gender equality, with, for example, relatively high levels of girls’ participation in SET in some parts of Central and Eastern Europe; likewise, some countries known for societal gender equality, such as some Nordic countries, can have strong horizontal gender segregation in education and training (Scambor et al., 2013), facilitated in part by the gendered labour markets in education, health and welfare.

From a cultural point of view, in some cultures girls are not viewed as having the same aptitude as boys in science, and it has not always been seen to be necessary to educate girls in science. Girls are not encouraged to enter scientific careers and parents chose to send boys to school instead of girls. In some societies girls often bear the burden of domestic chores and early marriage; pregnancy may interrupt the schooling of girls.

Implications for Policy

Research in this field tends to suggest three main levels where policy intervention can make an impact and promote a more gender balanced field of studies: at the first level regarding the influence and role of parents, teachers, peers and media (including social media and online) actors; a second at the institutional level (the school context); and the third level being the educational system within its societal context.

For parents, teachers, peers and media (including social media and online) actors, it seems imperative that they become aware of and reflect on their own biases and the possible effects these can have. Training could be provided in the local school context about a) the role they play in career choice of adolescents and b) challenging sex-typing of occupations. This may include educating parents and teachers about the satisfaction found by both males and females engaged in non-typical occupations, and the full range of occupational options open to both boys and girls. Teachers also need to be made aware of the crucial role they play in providing informal career guidance and need to know where to find reliable information on careers.

An increasing focus on the institutional high school context in some empirical research may open concrete avenues for effective policy intervention. The curricular (formal and hidden), extra-curricular activities, pedagogy, and the quality of teaching are all areas which can impact on a more gender balanced distribution of field of study. In terms of curriculum, it seems as though those reforms that benefit girls also benefit boys, for example the push towards inquiry based learning tackles the gender gap in interest and motivation in science, whilst being beneficial to both boys and girls.

In terms of the educational system, research has shown how a more integrated education system that delays choice and does not allow an early specialization – can contribute to more gender-balanced fields of studies. Policymakers with responsibilities for the education system need to take this into account when enacting educational reforms. Career and guidance services also need to be strengthened within the education system. One way to do this is to encourage partnerships between schools, career guidance services and local businesses to facilitate students’ visits to the workplace and encourage professionals from a range of fields to visit schools. In some situations, to facilitate girls' access to higher

education, those responsible for educational systems must provide scholarships and guarantee access to university housing.

As a concluding comment – given the predominance of the literature in this field concerned with attracting more girls to STEM/ MST, attempts to achieve gender balance in study fields should not mean a re-alignment to the male model. Instead, there is a vital need to problematise the taken-for-granted assumptions of boys' and young men's given relation to SET and similar fields. Indeed, there is also a danger of reproducing stereotypes in both research approaches and policy. This may be challenged in various ways, for example, by research and policy on LGBTQ students and learners, and research and policy connecting educational choices to broader societal patterns of gender inequality and power beyond education and training, for example, in politics and public spheres, and in class and ethnic mobility.

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Note: The present document gives a brief overview of recent research findings regarding Education and Training for gender equality in science. Further research synthesis on (2) Academic & Science Careers, (3) Institutional Practices and Processes, (4) Gender in Research Content and Knowledge Production, (5) Policy Setting and Implementation, and (6) Historical Perspectives and Future Scenarios are available at www.genderportal.eu

An **up to date version** of the bibliography and further relevant resources can be found at the following address:

http://www.genderportal.eu/tags/research-synthesis-1-education-and-training

GenPORT is funded by the European Union FP7-SCIENCE-IN-SOCIETY-2012-1 programm grant agreement nº 321485. Information given in this document reflects only the author's views.The European Community is not liable for any use that might be made of the information contained therein.