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Review Paper: Interventions to Reduce Gendered Norms and Choices in Education



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Alexandra Lux acts as first author in close collaboration with Jenny Veldman, Ruth van Veelen, Colette Van Laar, and Giseline Kuipers. Julia Stekla, Sarah Grootjans, and Felipe Fontana Vieira contributed to the literature review within their role as student assistants. Mertcan Mutlu and Zeynep Şulenur Kaya contributed to the literature review within the scope of their summer internship.

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1. Executive Summary

The present document constitutes **Deliverable 3.2 / Review paper: Interventions to reduce gendered norms and choices in education**. It is the second deliverable of Work Package 3 on De-biasing Education, which is part of the larger REWIRING (**R**ealising girls' and **w**omen's **i**nclusion, **r**epresentation, and **e**mpowerment) project that aims to identify the structural root causes of gendered power hierarchies and create sustainable change to prevent and reverse existing gender inequalities.

The term *gendered choices in education* covers education-related choices that are in line with gender stereotypes and gender-based expectations of how girls and boys *should* feel, think, and act (Brownhill et al., 2015; Eagly & Wood, 2012; Ellemers, 2018; Eccles & Wigfield, 2020). This work package aims to identify key leverages to change gendered norms and decisions in education and to map and develop tools that can help reduce gendered educational choices. The first step towards this aim was Deliverable 3.1, a review of agents involved in gendered norms and choices. The current review of existing tools and interventions to reduce gendered norms and choices is a second step toward the aim of this work package.

It structures interventions to reduce gendered educational choices across two axes, namely *vertical gender segregation* and *horizontal gender segregation* (Bettio & Verashchagina, 2009; Charles & Bradley, 2002; Charles & Bradley, 2009). The reviewed interventions targeted students either via agents or directly. For those interventions that targeted students via agents, relevant roles were played by institutional funding, a safe society and culture, teachers, parents, counsellors, and the school. When interventions targeted students directly, they did so via students' perceptions of the field or students' perceptions of themselves. For students' perception of themselves, stereotype threat and role models, identity and self-concept, and self-confidence and competence beliefs tended to form leverages for change to reduce gendered educational decisions.

This review paper concludes with **five take-home messages**:

- Interventions need to be **chosen wisely** so that they fit the specific cause of gendered choices as well as the context in which this needs resolving.
- A lot of existing approaches can be further harnessed, especially when it comes to interventions that aim to increase **boys' interest in HEED fields**.
- The majority of existing interventions neglect approaches that **incorporate teachers and parents**.

- Applying an **intersectional lens** could further improve existing interventions by taking the full picture of individuals' lived realities into account.
- There are no silver bullets; Single interventions tackling one social agent or contextual cue are in need of further embedding in a **multi-layered systems approach** in order to sustainably debunk gender-biased choices and attain gender equity in education.

The target audience of this review paper consists of:

- Social agents and institutions related to students' education (e.g., schools, teachers, or counsellors) with an interest in de-biasing education.
- Policy makers and other societal stakeholders (e.g., NGOs, educational institutions) around the world with an interest in de-biasing education.
- Family members of children currently in education who want to help them make unbiased educational choices that best meet their true interests and talents.
- Researchers at (applied) universities and other knowledge institutes with an interest in de-biasing education, including – but explicitly not limited to – people involved in the Re-WIRING project.

The structure of this review paper is as follows:

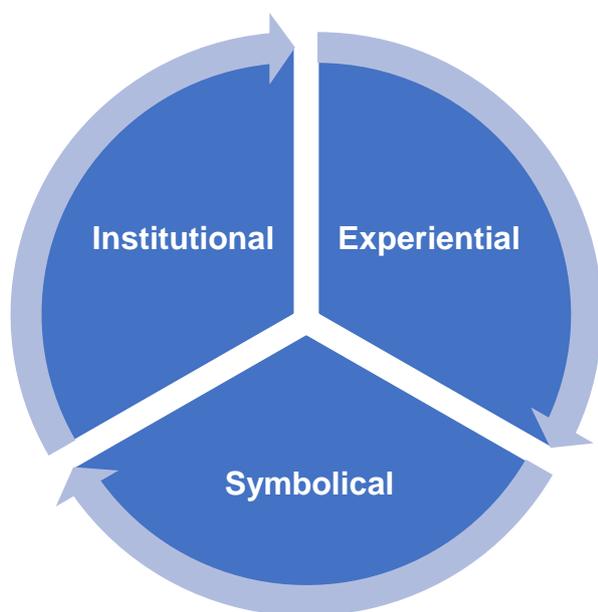
- Section 2 provides a **broader introduction** to the entire **REWIRING project** and framework.
- Section 3 explains the content of this review and **clarifies the concepts** used.
- Section 4 contains the **review paper**.
- Section 5 concludes with **take-away messages, recommendations, and potential future directions**.
- Section 6 lists all used **references**.

2. Introduction to the Project and Framework

The first section of this review provides a general introduction to the REWIRING project. The name “REWIRING” stems from the goal to “re-wire” institutions in order to achieve gender equality. Given the urgency for a shift from being gendered (or gender-blind/gender-neutral) institutions to gender-sensitive and transformative ones, this project focuses on the fundamental rethinking and '**re-wiring**' of existing institutional approaches and systems. In our definition, “Institutions” include not only governments and other public bodies, but also companies, banks, social partners, health institutions, schools and academia, and other private social constellations, including, for instance, women’s organizations and religious groups. The RE-WIRING project goes beyond existing doctrinal and policy transformative equality approaches (e.g., EIGE, 2015; Fredman et al., 2016; OECD, 2021) by taking a holistic, multidisciplinary approach. This approach is based on the groundwork laid within the [Utrecht University interdisciplinary research platform for Gender, Diversity & Global Justice](#).

REWIRING, therefore, presents a three-dimensional framework that builds upon the premise that effective transformation and women’s empowerment can only come about when simultaneous action is taken on institutional, experiential, and symbolical levels:

Figure 1. Illustration of the Three Analytical Levels.



Institutional:

What are responses to inequality and exclusion on the institutional level, including in laws and policies?

Experiential:

How do women and girls, men and boys and others experience the many forms of inequality in the context of social institutions such as the workplace, educational settings, the family, etc.? And how do they experience institutional measures aimed at correcting these inequalities?

Symbolical:

How are women and girls, men and boys and others and their societal roles represented in the linguistic, narrative, and visual structures that shape society?

This novel, three-dimensional approach takes three highly relevant factors into account: intersectionality, culture, and crises. This combined approach enables more in-depth identification of the root causes of gender-based and intersectional social inequalities in differing contexts and the gaps resulting from these in political, socio-economic, and cultural domains. It enables the development and validation of concrete policy responses and practical tools targeted at particular cultural contexts, sectors, and intersectional realities that impact an individual's experience. It will also allow for examining the validity of used concepts and developed tools to explain the impacts of various crises (financial, climate and health, and future of work) on gender equality.

RE-WIRING's ambition is to:

- **Advance scientific theorization and knowledge** of the gendered power relations across the political, social, economic, and cultural spheres, and the key underlying intersectional dynamics and causal mechanisms that shape them.

- **Develop innovative tools and practical solutions** by empirically elaborating sets of actions that not only target women and girls, men and boys but engage relevant actors and stakeholders, to improve political, social, economic, and cultural empowerment and increase sustainability and social resilience.

The original research question and objectives of RE-WIRING are summarized in Table 1.

Table 1

How can gendered, intersectional inequalities in the areas of socialization, education, work, laws and policies, politics, business and media (including in their decision-making), be systemically changed in the institutional, experiential and symbolical realms of society in Europe and (South) Africa, to bring about the sustainable inclusion, representation and empowerment of girls and women?			
Aim	Objectives		WP
Advance scientific theorization and knowledge of gendered power hierarchies	RO1	Assess key concepts and develop a novel, interdisciplinary theoretical framework for an intersectional and cross-cultural Transformative Equality Approach	WP1
	RO2	Develop a systematic and in-depth understanding of the root causes of gendered power hierarchies , including relevant contextual, cultural and crisis factors and impacts	WP2, WP3, WP4, WP5, WP6
	RO3	Analyze the role of education and the media in perpetuating or challenging harmful gender stereotypes	WP3, WP5
Develop innovative tools and practical solutions to improve the political, social, economic and cultural empowerment of women and girls	IO1	Co-create and validate interventions with diverse stakeholders at several geographical and political levels and establish a stakeholder network	WP2, WP3, WP4, WP8
	IO2	Identify and test practical tools and innovative solutions for mainstreaming gender-transformative equality in society and institutional settings	WP2, WP3, WP4, WP5
	IO3	Synthesize findings into tangible policy recommendations for targeted and pragmatic programs that contribute to SDG 5 for the empowerment of women and girls	WP2, WP3, WP4, WP5, WP7

The RE-WIRING project consists of 10 work packages in total. This deliverable is a part of Work Package 3 (WP3) that focuses on gendered norms and choices within the context of education. The following steps in this work package will include developing and testing new interventions in several countries. The goal of these interventions will be to reduce gendered educational choices. Thereby, the project will contribute to the development of concrete policies for de-biasing education, focusing specifically on advanced educational contexts (students between 12-20 years of age). All deliverables forthcoming from this work package can be read and understood as stand-alone products. This implies that the introducing

sections of the deliverables from this work package may contain some overlap in writing given the shared context and aim across deliverables.

3. Setting the Stage

The aim of Chapter 3 is to elucidate the breadth and substance of the review of debiasing interventions in education, offer disclaimers concerning its inherent limitations, and elucidate some of the fundamental concepts employed. Chapter 4 contains the review of interventions to reduce gendered norms and choices in education.

3.1 The Nature of this Review

This review is based on both academic sources (such as peer-reviewed articles published in academic journals), and more practically oriented knowledge sources (such as policy briefs and white papers) related to interventions and tools that can reduce gendered norms and choices in education. The aim was to create a knowledge base as broad as possible, including sources based on both WEIRD (Western, Educated, Industrialized, Rich, and Democratic) and non-WEIRD countries (Henrich et al., 2010); and countries from the Global North and the Global South (Casellato, 2023; Reidpath & Allotey, 2019). Potentially relevant sources were identified via keyword searches on ProQuest (academic sources) and Google (non-academic sources), with additional relevant sources found using a snowballing approach. We also made use of the [Wise Interventions Database](#) and incorporated interventions and tools suggested by reviewers. This review is neither an exhaustive nor systematic review of all literature available – instead, the goal was to provide an overview of relevant approaches that can be used in tools and interventions.

3.2 The Studied Students

This review focuses on interventions that aim to reduce gendered educational choices of students. Hereby, students between 12 and 20 years of age are the target, the described interventions are thus mostly tailored to later stages of education. The educational stages students find themselves in range from the start of high school to their first years in higher education, for instance, at a university. While participants might likely identify as girls/boys at 12 years and as women/men at 20 years, the terms “girls” and “boys” are used throughout this review. This means that the term “girls” as used here also includes young women and that the term “boys” also includes young men (we return to the question of nonbinary gender below).

3.3 Vertical vs. Horizontal Gender Segregation

While this review discusses “choices” within the educational context, students typically do not make educational choices in isolation of their (social) context. Social actors, cues, and representations in the contextual landscape of students’ education shape their, oftentimes gender-segregated) choices (Eccles & Wigfield, 2020). Also, educational gender segregation happens on two separate axes, best captured by the terms *vertical gender segregation* (i.e., spanning from students’ unequal chances to receive education to the clustering of men at the top of occupational hierarchies and women at the bottom) and *horizontal gender segregation* (i.e., spanning from girls’ tendency to steer towards typically feminine occupational fields, and boys tendency to steer towards typically masculine occupational fields, resulting in the clustering of men and women in different types of occupations and tasks at the same level in the occupational hierarchy; Bettio & Verashchagina, 2009; Charles & Bradley, 2002; Charles & Bradley, 2009). In line with this distinction, we also mapped potential interventions and tools along these two axes. Please see Figure 2 for an illustration and a more detailed explanation below. An important reason to organize interventions across these two axes is the extensive review by economists Blau and Kahn (2017) that clearly demonstrates that gender differences in representation in occupations and industries now constitute the largest measured factor accounting for global socio-economic gender gaps.

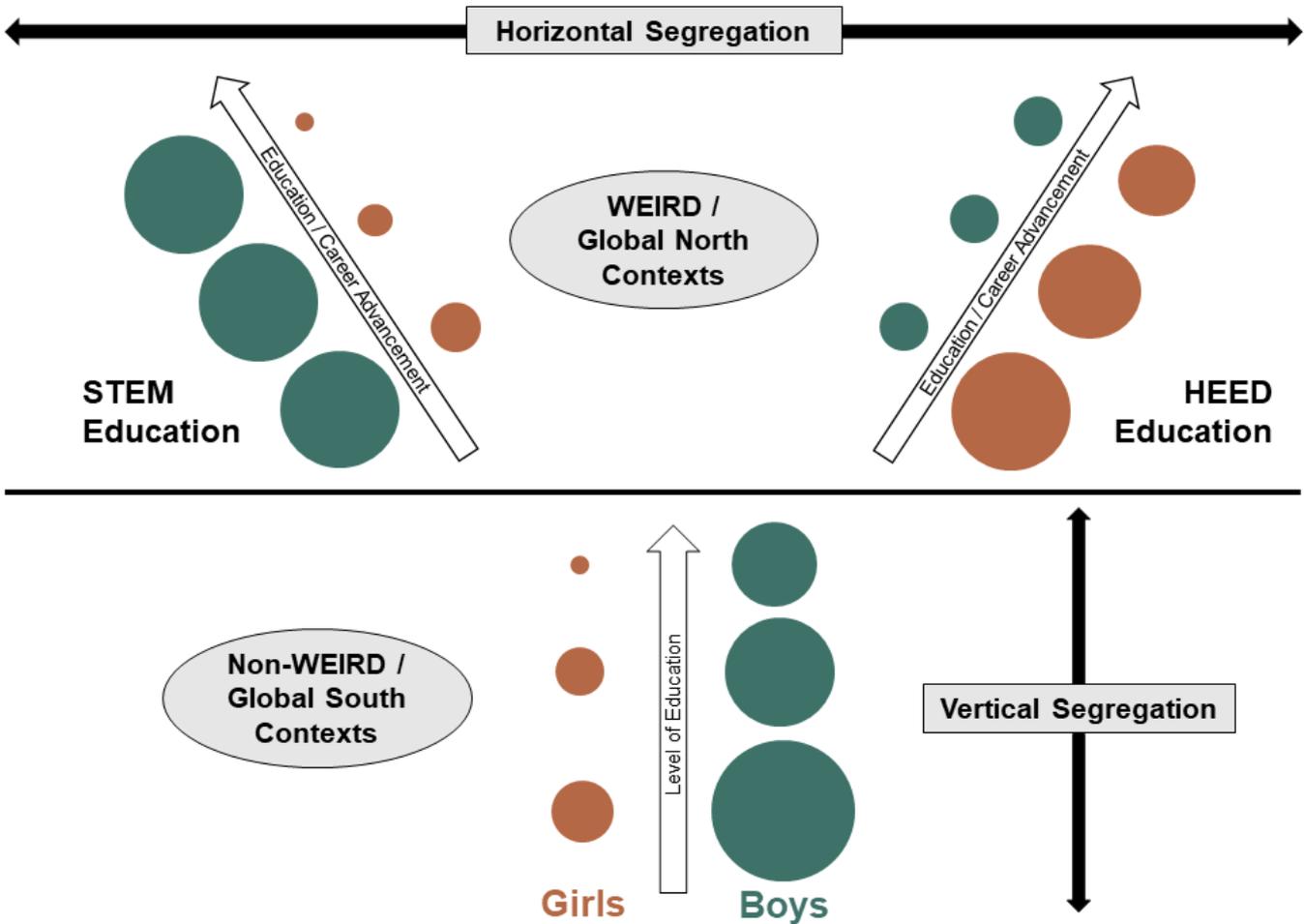
Vertical gender segregation includes interventions that impact students’ general access to education, and these interventions in particular target girls. Vertical gender segregation determines whether students get to attend school at all, and until which level they attend school (i.e., the hierarchical / status level of their education). Vertical gender segregation includes the often insurmountable hurdles that students face in societies in relation to a gendered hierarchy or power distance. An example is that families with very limited financial resources often choose to send their sons instead of their daughters to school. Vertical gender segregation tends to be particularly present in non-WEIRD / Global South contexts and tends to be covered more in the practically oriented literature than in purely academic journal publications.

Horizontal gender segregation takes place once general access to education is achieved and is related to boys’ and girls’ segregated educational and occupational choices. Horizontal means that girls tend to steer and are steered towards typically feminine occupational fields, and boys tend to steer and are steered towards typically masculine occupational fields. This results in an:

1. overrepresentation of boys/men and underrepresentation of girls/women in some fields such as **STEM** (science, technology, engineering, mathematics; Belanger et al., 2020); as well as
2. overrepresentation of girls/women and underrepresentation of boys/men in other fields such as **HEED** (healthcare, early education, domestic; Croft et al., 2015; Meeussen et al., 2020).

The ostensible freedom of choice acts as a breeding ground for existing gender bias and stereotypes to have their effects, and interventions on the level of horizontal gender segregation steer against gendered educational choices based on gender bias and stereotypes. Horizontal gender segregation tends to be particularly present in WEIRD / Global North contexts (Charles, 2003; Rafnsdóttir & Weight, 2019) and tends to be covered more in academic journal publications than in the practically oriented literature.

Figure 2. Vertical and Horizontal Gender Segregation in Educational Contexts.



3.4 The Binary Gender Distinction

Much of the existing research on school environments simplifies gender into a binary system, where children are categorized as either boys or girls (Smith & Payne, 2015). This narrow approach overlooks individuals with non-traditional gender identities, such as transgender or non-binary individuals (Nowakowski et al., 2016). As a result, these voices are excluded from the research process, leading to a lack of understanding and representation. This binary view reinforces social structures that divide children based on traditional gender norms, teaching them societal rules and expectations based solely on this binary classification.

While most research tends to focus on the idea that there are only two genders, some studies highlight the importance of looking beyond this binary view in educational research. For example, Smith and Payne (2015) point out that schools often overlook people who don't fit into traditional gender categories, while traditional gender roles and the way they influence students and their choices are often not looked at closely enough. Woolley (2015) argues that school structures reinforce the idea that there are only two genders through many practices in school, for instance, the way that bathrooms and classrooms are set up and how teachers communicate with students. Rowan and colleagues (2002) suggest that treating boys and girls as if they are all members of the same groups respectively, and the practice of explaining possible differences between boys and girls by relying on “natural” (i.e., inherent, fixed, inborn, or biological) differences as important problems. However, questioning that gender directly follows from sex assigned at birth can also be experienced as threatening and this threat can lead to the reinforcement of the binary gender view (Morgenroth & Ryan, 2021). When it comes to gendered educational choices, the concept of *gender trouble* illustrates well how sticking to the idea of only two genders can limit students' educational choices (Morgenroth et al., 2015; Morgenroth & Ryan, 2021). For example, students tend to pick courses or study programs based on their sex assigned at birth to avoid stigma. Indeed, one problem that accompanies many interventions (such as interventions targeting boys' literary interests, or girls in science) is that they tend to re-establish traditional masculinity norms instead of questioning the binary gender distinction (Martino & Kehler, 2007). Sticking to a binary classification of gender can thus aggravate beliefs about differences between gender groups and stereotypes related to them.

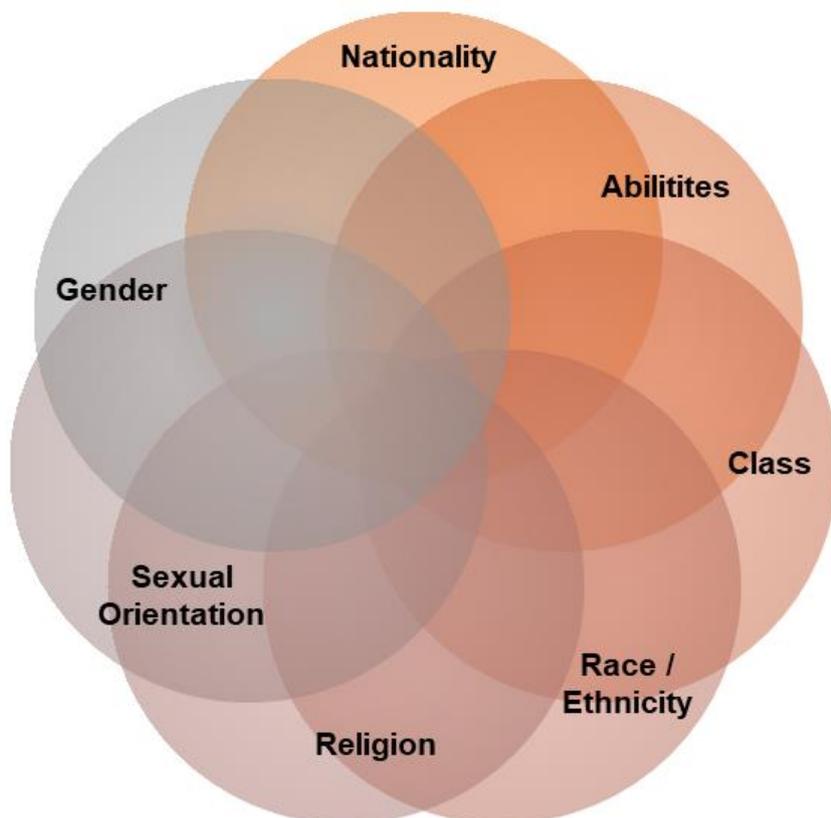
Despite its problematic shortcomings, the binary conceptualization of gender was adopted within the scope of this review given the lack of literature exploring the experiences and perspectives of students with other gender identities. We hope that more future interventions

will go beyond the gender binary in order to provide a more comprehensive understanding of the experiences of individuals with other and broader conceptualizations of gender and gender identities.

3.5 The Intersectional Dimension

Promoting gender equality in education is a vital goal, but it is important to note that inequality goes beyond gender categories alone. There are many documented historical and current disparities in educational opportunities and outcomes between non-dominant and dominant groups that affect their academic performance, well-being, and future career aspirations. For instance, educational discrepancies exist for boys versus girls and people of other genders, but also for students from high versus low-income families, students born in the Global North versus the Global South (Ullah, 2019), students from urban versus rural areas (Urban Institute, 2018; Zeng et al., 2014), students who are considered able versus students who need special education, students who are heterosexual or cisgender versus students belonging to sexual and gender minorities (Francis, 2017), and students from majority ethnic, language, and religious groups versus minority ethnic, language, and religious groups (see, e.g., Cochran-Smith et al., 2016). While this review focuses on girls and boys and interventions to reduce gender-related educational decisions, it is important to recognize that for inequality in education, other group memberships also likely impact gendered norms and educational choices. Taking an intersectional approach can help to understand how different social identities (i.e., class, ethnicity, or gender) overlap and cause different and unique kinds of experiences of inequalities, which cannot be explained by using single-axis frameworks (Crenshaw, 1989). If intersectional identities are not considered at an institutional level, implemented social policies may have shortcomings and may not promote equality for everyone in education to an equal extent (Cho et al., 2013). This also implies that interventions might work better or worse depending on the other identities that students hold. Consequently, interventions should also incorporate other identity aspects of their target groups besides their gender identity, such as their socioeconomic status, ethnicity, or whether they are the first-generation of students to attend that level of education or continuous-generation students.

Figure 3. Illustration of Intersectionality.



4. Review of Interventions to Reduce Gendered Norms and Choices in Education

The term *gendered choices in education* covers education-related choices that are in line with gender stereotypes and gender-based expectations of how girls and boys *should* feel, think, and act (Brownhill et al., 2015; Eagly & Wood, 2012; Ellemers, 2018; Eccles & Wigfield, 2020). A choice within the educational context might, for instance, be the choice between taking an advanced course in Literature versus Physics. On the individual level, **a gendered choice in this context would be if boys disproportionately choose Physics and girls disproportionately choose Literature. In most (if not all) countries, social agents such as teachers and parents are likely to expect children to make gendered choices, common stereotypes will have suggested to them that girls and boys will have more natural talent and higher chances of success in gender-conform fields.** In turn, agents such as media portrayals and textbook images tend to signal men as typical Physicists and women as typical Librarians. On the societal level, gendered educational choices result in an overrepresentation of girls/women and underrepresentation of boys/men in some fields such as HEED (healthcare, early education, domestic; Croft et al., 2015; Meeussen et al., 2020) as well as an overrepresentation of boys/men and an underrepresentation of girls/women in some fields such as STEM (science, technology, engineering, mathematics; Belanger et al., 2020). The aim of this review is not to find a way to make all girls choose Physics and all boys choose Literature. Instead, this report reviews existing tools and interventions that can help boys and girls make choices less constrained by gender-based expectations, norms, and self-efficacy beliefs. Less constrained educational decisions would not only help boys and girls develop talents that might otherwise be neglected but also enrich fields that are currently characterized by unbalanced gender distributions (e.g., HEED and STEM). Greater variety among individuals working in organizations, including more diverse gender representation, brings a broader range of knowledge together and thereby drives innovation (Ain et al., 2021; Nielsen et al., 2018; Ruiz-Jiménez et al., 2014).

Especially in the Global South / non-WEIRD countries, girls and boys tend not to have equal access to education (Shabaya & Konadu-Agyemang, 2004). And even if access to education is ensured, across the world gender inequality is found to be one of the critical elements that determine performance, attainment, and motivation to pursue education, and representation in specific fields (Davies & Ercolani, 2021; Huggins & Randell, 2007; Rhodes et al., 2019).

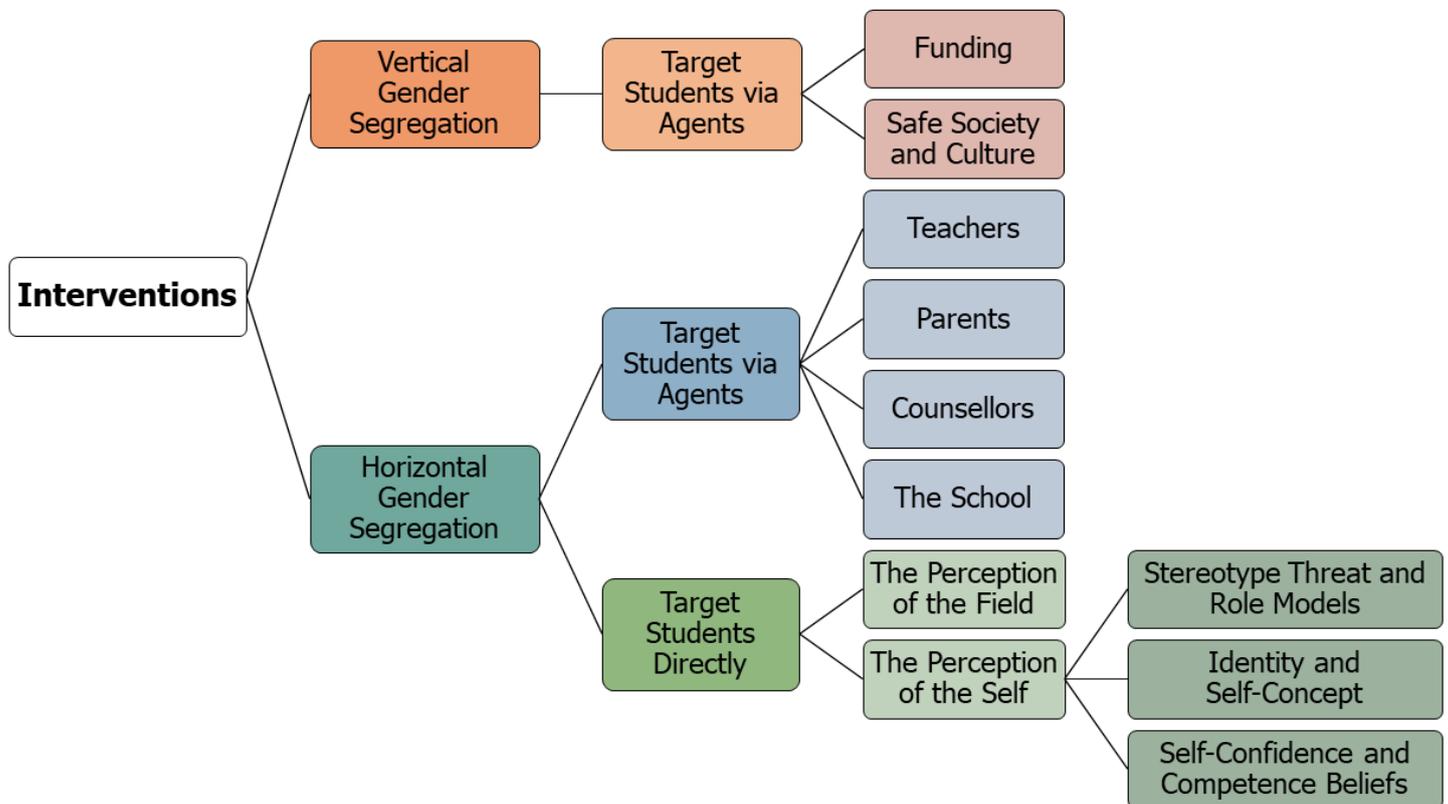
The goal of this review is to provide an overview of interventions aimed at de-biasing educational choices.

We structured this review according to the extent to which interventions tackle vertical versus horizontal gender segregation in education, as can be seen in Figure 4.

All interventions related to vertical gender segregation tend to not relate to students directly but do so via agents. The term “agent” is conceptualized very broadly, including all potential influencing factors such as other people, objects, rules, symbols, beliefs, or media that are not the student himself/herself. For vertical gender segregation, the reviewed interventions targeted students either via the economy, society and culture, or the school environment. Most of those interventions take place on the **institutional level**.

When it comes to the mapping of interventions addressing horizontal gender segregation, the picture is a bit more complex. Here interventions targeted students either directly or via agents such as teachers, parents, counsellors, or the school in a broader sense. The reviewed interventions that targeted students directly either targeted their perception of a specific field or their self-perception, including their self-perception of their skills. Those interventions that target students’ self-perception for example focus on (a) stereotype threat and role models, (b) the renegotiation of identity and the self-concept, or (c) self-confidence and competence beliefs. These interventions tackling horizontal gender segregation mainly take place on the **experiential and symbolical level**.

Figure 4. Overview of Intervention Mapping.



4.1 Vertical Gender Segregation

4.1.1 Targeting Students via Agents

4.1.1.1 Funding for Education via Agents

For many families in low and middle-income countries, the **costs** of schooling are too high for every child to be able to go to school. In this case, boys are often given priority in access to education given their pre-dominant role as “breadwinners” of the family. On the institutional level, countries such as Gambia or Uganda have programs in place to **reduce or eliminate the cost of schooling** for families and communities through **gender-responsive education sector planning, gender-responsive budgeting, and non-governmental initiatives** (Women Deliver, 2019). Another way to reduce liquidity constraints on the institutional level is through **microcredit** programs. Those programs

provide parents with small loans appropriated for their children’s education that do not depend on steady employment or a verifiable credit history, thereby helping parents with fewer resources to pay for their children’s education (Pasqua, 2005). One intervention in the Philippines, the [Third Elementary Education Project](#), consisted of **investment and management reforms** that included classroom construction, textbooks, and teacher training and tracked nearly 3500 students into their later careers. This intervention was successful in increasing women’s income later on (Yamauchi & Liu, 2017). In some countries such as Bolivia, general investments in **WASH promotion** – ensuring the existence of water, sanitation, and hygiene in schools – also can allow girls in particular to attend school on a continuous basis, also during menstruation (Care International, 2022; Women Deliver, 2019).

4.1.1.2 Safe Society and Culture

A lack of **safety** can restrict students’ access to school and education (Goswami, 2015). Something as simple as their further **distance to school**, for instance, can make it more likely for girls to experience gender-based violence and therefore make it less likely that they take the daily risk of this journey (Women Deliver, 2019). Gender-based violence significantly impedes girls’ access to education by causing injuries, trauma, and fear, leading to school avoidance. It also disrupts education trajectories through early or forced marriages and pregnancies, reinforcing gender disparities in schooling, and can foster social exclusion and psychological distress (Yount et al., 2016; Stöckl et al., 2014). Interventions that increase physical safety within the context of education can thus reduce vertical gender segregation. Another way to prevent gender-based violence is to provide **comprehensive sexuality education**. Ideally, such school-based interventions align with the 2018 [International Technical Guidance on Sexuality Education](#) (Women Deliver, 2019). Similar to the institutional level, interventions aiming to prevent gender-based violence can help students identify instances of gender-based violence and seek help. An intervention applied in Rwandan schools taught students about different forms of violence and encouraged them to reflect on their own experiences with violence, including gender-based violence (Promundo and CARE International in Rwanda, 2012). A second part of this intervention focused specifically on boys and discussed how gender-based violence occurs in their lives and families, and how they can prevent it.

One aspect of safety that can be tackled by interventions on the institutional level is the aspect of **reproductive health and sexuality**. In Rwanda, for instance, **sessions with an expert** on reproductive health knowledge allowed students to gain practical knowledge and

learn about **available services** in the community (Promundo and CARE International in Rwanda, 2012). Those sessions also informed students about laws and policies related to gender and gender-based violence. In a similar vein, the [EQUI-X project](#) in Spain, Portugal, Germany, Belgium, and Croatia piloted interventions around the topics of **body image, sexual desire and pornography, sexual consent, and sexual violence** (Vzw Zijn - Beweging tegen Geweld, 2019). Educating students about their bodies and rights can help them realize when their rights are violated and help them take action (Schewe, 2008). By doing so, such interventions can help prevent or reduce unsafe situations as well as make sanctions following gender-based violence more likely. As a consequence, unsafe situations are less likely to occur and thus less likely to hinder students from receiving their education.

Similarly, alcohol and drug abuse in students can lead to unsafe situations for the students themselves and the peers around them. Substance abuse can hinder students' access to education by compromising their health, safety, and social integration, leading to an increased risk of dropout and diminished academic achievement (Gibbs et al., 2018; Kelly et al., 2015). **Interventions that help prevent substance abuse** by teaching about the risks involved, can help retain students (especially boys) at school (Promundo and CARE International in Rwanda, 2012; Vzw Zijn - Beweging tegen Geweld, 2019).

Broader than safety is the **acceptance of girls in education** itself. In Afghanistan, for instance – prior to the renewed takeover by the Taliban, constructively **engaging men** was a key to opening doors for girls' education. In Pashtun communities (the largest ethnic group in Afghanistan), interventions involved **community elders and religious leaders** and included stressing the importance of girls' access to schools and having more female teachers to build trust in the community. When interventions included male leaders, and aimed at fostering a meaningful exchange between the community and school staff when it comes to the curriculum, instruction quality, and other school activities, the community's commitment to girls' education was strengthened (Jamal, 2015).

A broader aspect of culture are media that students are or are not exposed to. **Access to digital devices** allows students to become and remain a key component of a digital society and have access to modern values and gender roles (Hansen et al., 2014; Mariscal et al., 2019). **Automation and technological advancements** in education can also reduce gender inequality (Stepanenko et al., 2021). **Digital connectedness** including access to the internet, social media, and online education reduces gender gaps in education, particularly in the Global South and non-WEIRD contexts where such connectedness is not self-evident (Wajcman et al., 2020). By enabling girls and young women to **self-educate remotely via**

online learning, they are not forced to forego education for domestic and care tasks expected of them. Ensuring access to the internet and online education thus pertains to an interventional measure that can protect access to education.

4.2 Horizontal Gender Segregation

4.2.1 Targeting the Students via Agents

4.2.1.1 Teachers

Teachers are a cause for gendered educational choices as well as potential key social agents towards debiasing such choices. It can thus help to **train teachers to be aware of their own gender biases** in order to reduce their gendering impact on students' educational choices (OECD, 2015). Many teachers are even actually aware of the gender stereotypes they hold but still struggle to treat their students in an unbiased manner (Gajda et al., 2022). An intervention by Lehmann-Grube and colleagues (2023) was able to reduce teachers' bias related to their students' immigration background and low social status. During the intervention, teachers (a) received feedback on their attitudes (based on a previous survey), (b) information on stereotypes, stereotype formation, and stereotype-based expectations, and (c) information on how the newly gained insights can be implemented in practice. In the future, this design could be adjusted to reduce teachers' gender stereotypes and gender bias towards their students. Another intervention project called [Alliantie Worden Wie Je Bent](#) (Becoming Who You Are) developed a workshop for teachers that aims to help them support their students in choosing a profession independent of gender stereotypes. During the workshop, teachers engage with video materials and card decks and are invited to reflect on how gender stereotypes manifest in the classroom. Assessments demonstrate that the sessions increase teachers' awareness of gender stereotypes and increase their willingness to change their behaviour. Similar initiatives aiming at teachers are also taken in the UK, for example by [UK Feminista](#), [Lifting Limits](#), and [Equaliteach](#).

Teachers' own mindset, for instance, **their understanding of intelligence** as either something that is fixed (innate) or malleable (growth mentality) also plays an important role. Particularly math aptitude is often considered an innate or raw talent held more strongly by boys/men than girls/women, while in fact, mounting evidence disproves this biased notion and shows that math ability is trainable, that gender differences are nihil, and if they exist entirely attributable to gendered socialization rather than biological differences (Hyde, 2014; Reardon et al., 2018). When interventions help teachers believe that intelligence is

malleable and can increase with training, this translates into similar beliefs in their students and improves their engagement and performance (Bettinger et al., 2018).

Even the **instructions** that teachers use in their exams influence to which extent their students' performance is hampered by stereotype threat and low self-efficacy beliefs. When teachers framed an exam as part of the learning process and an opportunity to improve skills (versus a way to compare students to identify the best among them), students with low socioeconomic status performed as well as students with high socioeconomic status (Smeding et al., 2013). This approach might likely work in a similar manner to encourage girls and boys in subjects atypical to their gender. In a similar vein, when instructions for a calculus ability test included that it usually yields no gender differences, women performed significantly better than when the instructions did not include this remark (Good et al., 2008). This effect was especially strong in White women.

Another established intervention that targets teachers is the so-called **teacher expectancy intervention** (De Boer et al., 2018; Raudenbush, 1984; Rosenthal & Jacobsen, 1968; Rubie-Davies et al., 2015). This intervention aims to raise students' performance by raising the expectations that their teachers have of them. Teacher expectancy interventions can work by changing teachers' behaviours directly by changing their expectations, informing teachers about the effects that their expectations can have on their students, or addressing the beliefs underlying teachers' expectations (De Boer et al., 2018). These approaches can also be used to improve students' engagement and performance in courses and programs atypical to their gender by raising their teachers' expectations of them.

Teachers also **play an important role in the success of interventions** in general. Their support is often necessary for a chosen intervention to work (De Boer et al., 2018). For instance, for interventions that target students directly (such as growth mindset interventions), teachers' beliefs were crucial for the intervention's effect on students' beliefs (Yeager et al., 2022).

4.2.1.2 Parents

Similar to teachers, parents can either perpetuate or challenge gendered educational choices. It thus makes sense to include parents in intervention efforts that aim to reduce students' gendered educational choices.

When parents value certain subjects, such as STEM-related courses, their children are more likely to become interested in those fields too. It thus makes sense to also **raise parents'**

interest in subjects that are not in line with the gendered expectations they might have for their child's educational choices. One way to raise parents' interest in certain courses is to highlight their usefulness, for instance, through brochures and websites. An intervention by Harackiewicz and colleagues (2012) used this mechanism. During the intervention, parents received information that pointed out the usefulness of math and science courses. The used brochures and website also provided guidance on how parents could talk to their children about potential connections between mathematics and science and their lives, including everyday activities (e.g., video games, driving, and cell phone use). Students whose parents were part of this intervention ended up completing almost an additional semester's worth of science and mathematics courses during the final two years of high school. In a similar intervention (Rozek et al., 2017), **parents learned about the importance and usefulness** of math and science courses for their adolescent children. Children whose parents participated in this intervention performed better in these courses and were also more motivated to pursue a career in STEM later on. In an intervention by Destin & Svoboda (2017), parents observed a panel discussion on the **importance of parents shaping crucial conversations** regarding their child's future and their handling of academic struggles. Students of participating parents had discussions about future opportunities sooner, received more positive responses from their parents during academic difficulties, and obtained better grades.

Interventions can also improve students' skills by **influencing their parents' beliefs in their skills**. When parents learned that their children's skills are flexible instead of fixed and were taught how they can support their children by praising their efforts to improve their skills, their children's skills improved (Andersen & Nielsen, 2016). The improvements offered by the interventions discussed can likely provide needed parental support to students who consider or make academic choices that are not in line with their gender.

4.2.1.3 Counsellors

Helping students look ahead can prevent gendered education choices. Girls, for instance, can struggle with math anxiety and lack of confidence in their own abilities in science and math and thus may avoid STEM education despite their qualification for it (OECD, 2015). Already making students aware of the gender bias in their planned educational choices can reduce that bias (RoSa vzw, 2023). Counselling programs can thus be a helpful tool. A study among German high school students (Erdmann et al., 2023), for instance, tested the impact of individual educational choice counselling offered by qualified counselors. The counseling consisted of several sessions and focused on career and post-secondary education options.

The counsellors supported students with implementing their decisions and tailored the counselling to each individual. Students who participated in the counseling were more likely to choose a career atypical for their gender, and this was especially the case for men. The counselling intervention also helped students persevere in the atypical majors they had chosen.

4.2.1.4 The School

Given that the school is the environment where education primarily takes place, it also offers opportunities to de-bias students' educational decisions.

One source of gender bias in education are the **educational materials** themselves as they often contain gender stereotypes (Blumberg, 2008; Kerkhoven et al., 2016). One suggested intervention entails combating the bias in materials by **teaching students to detect biased language and content** themselves (Blumberg, 2008). The idea behind this intervention is that students' educational choices might be less impacted by gender-stereotypical materials if they are aware of the bias they contain. When it comes to tackling boys' tendency to underperform in reading, giving them a **greater choice in reading options** can foster their interest in books and enhance their reading performance (OECD, 2015).

Making sure that students are not educated separated by their gender also reduces to which extent gender identity is pronounced. **Coeducation – the education of boys and girls together in one classroom** can promote gender parity and gender equality by supporting children in the development of their personality without making their gender salient by separating them based on it (Aragonés-González, 2020). The concept of **reflective coeducation** – taught by the REFLECT program (Kollmayer et al., 2018) – focuses on coeducating boys and girls while ensuring that they are treated equally. By doing so, it offers an evidence-based approach to enable coeducation while reducing teachers' tendencies to treat and grade students in line with the gender stereotypes they hold (see Kollmayer et al., 2018 for more). During specific interventions, however, separating girls from boys can be beneficial (Van Langen, 2015).

4.2.2 Targeting Students Directly

4.2.2.1 The Perception of the Field

How students perceive potential future fields matters a great deal for the extent to which they can see themselves working in these fields and the likelihood of liking and choosing

courses in a particular domain. Already the mere expectation of potential discrimination in a certain field makes it more likely that students avoid these fields (Van Praag et al., 2021). This is not just the case for girls and STEM careers, but also for boys and traditionally female fields such as HEED (Manzi, 2019). Horizontal gender segregation into gender-typical career choices can thus also be altered via students' perceptions of different fields.

The perception of a field already starts with the way in which it is described when students encounter it. If gendered languages (such as Dutch or German) use a masculine generic to describe a job title, readers tend to envision a man as a prototypical example for this occupation (Braun et al., 2005; Formanowicz & Hansen, 2022). An intervention by Vervecken and Hannover (2015) showed that **describing occupations using both a female and male version of the job title** (instead of a generic masculine), strengthened children's self-efficacy beliefs towards a stereotypically male occupation (e.g., being an engineer). In a similar vein, describing a field **using activities instead of an identity** (in this case, *doing science* versus *being a scientist*) increased girls' interest in a stereotypically male domain (Rhodes et al., 2019). Interventions can thus improve students' perceptions of less typical fields by employing more inclusive language. **Avoiding the activation of gender stereotypes in descriptions of potential careers** can also motivate students to consider gender-atypical careers. One prominent example is the stereotype that associates men with brilliance (Bian et al., 2017). When career messages mentioned that brilliance is required, women perceived less fit with the career, anticipated more anxiety and less belonging related to the career, and were hence less interested in it (Bian et al., 2018).

Another way to recalibrate students' perception of a field is to **increase their perceived belonging in that field**. If students think that they do not belong to a certain field, or perceive a lack of fit with the majority of the people, this can negatively impact their interest and academic success in this domain (Fong Lam et al., 2015; Veldman et al., 2021). For example, a boy might be highly interested in nursing and well equipped to succeed in this field but might still struggle to actually persevere and succeed in it because he feels that he does not fit in with most people in this field. Interventions can increase students' sense of fit with the majority of people in a field. Those interventions can **encourage students to reframe how they perceive their environments and to proactively seek ways to fit in** (e.g., by forming social bonds). By helping participants **discover similarities between themselves and other people in a field**, they become more likely to join fields in which they are negatively stereotyped and to persist within those fields (Cheryan et al., 2009). Another manner to intervene in the sense of belonging is **by normalizing experiences of low belonging and adversity** while integrating into a new context. This intervention

approach has been proven to be successful among women in STEM courses. A social belonging intervention can consist of several aspects, but common ones include (1) results of a survey among older students in the field, showing that everyday worries about belonging—such as feeling homesick, struggling academically, or having difficulty interacting with professors—are normal in the transition to college and can lessen with time; (2) exposure to student testimonials describing these worries and how they improved for them; (3) a reflective writing exercise where students reflect on these stories, including how concerns about belonging are normal and typically improve with time; (4) a semi-structured group discussion. This intervention results in increased performance and persistence among everyone but tends to be especially effective in improving women’s outcomes in STEM (Binning et al., 2020; Walton et al., 2015, 2023).

Having **first-hand experiences** related to the field can also dismantle barriers between students and atypical fields. One intervention by Boeve-de Pauw and colleagues (2020) had students of 10-12 years interact with high-tech materials. Within this intervention, students could **engage with exhibits and learn** how technology **can help solve problems in industry and society**. After participating in the intervention, students were more interested in technology and considered it more viable as a career option. For girls – but not boys – the gender stereotypical view that technology is mainly a topic for boys was reversed. These effects became weaker over time but show that simply engaging with a field and learning about it carries the potential to reduce horizontal gender segregation in education.

Some countries, such as Austria, Belgium, Czech Republic, Egypt, Estonia, Ethiopia, France, Hungary, Italy, Japan, Kosovo, Kyrgyzstan, Lebanon, Liechtenstein, Luxembourg, Netherlands, Norway, Poland, Slovenia, South Korea, Spain, and Switzerland dedicated a **national day to reducing horizontal gender segregation**. On **Girls’ Day**, girls are invited to visit technology-related enterprises, universities, and research centers to explore careers in these domains and receive individual advice. On **Boys’ Day**, boys are invited to explore gender-atypical careers in the social, educational, or healthcare domain. They also have the opportunity to participate in activities around life planning and social competencies.

Related to this, interventions can also **alter the value that students ascribe to a field**, either to themselves or to society as a whole. Girls often prioritize communal values, such as cooperation and altruism, due to the gender roles and expectations that they typically encounter while growing up. However, they often feel that these goals cannot be achieved in male-dominated fields (Tellhed et al., 2018). Highlighting the communal impact and altruistic potential within male-dominated fields could thus help attract girls (Tellhed et al., 2018). **Communal goal interventions** aim to link careers in STEM to communal goals,

which can increase girls' interest in STEM (Brown et al., 2015). In such an intervention students read descriptions of STEM fields as careers in which one can help others. In a similar, so-called **prosocial goal intervention** (Zambrano et al., 2020), students read a textbook chapter that emphasized the prosocial utility value of science. Students in a control group read a similar chapter without information on the prosocial utility value of science. Students who also learned about the usefulness of science were more interested in the scientific topic depicted in the text. Students are also more likely to pursue a career if they consider it to be valuable to themselves (Eccles, 2011; Eccles & Wigfield, 2020). **Utility-value interventions** use this mechanism by helping students reflect on the value that courses and topics have for them personally. This usually takes place as a written assignment. When students participated in such an intervention, they were more engaged in the course and also performed better (Asher et al., 2023; Canning et al., 2018; Hulleman & Harackiewicz, 2009; Hulleman et al., 2017; Jang, 2008; Tibbetts et al., 2016; Yeager et al., 2014). This effect was especially strong in students who were already struggling with the course as well as first-generation students and students from underrepresented groups (Hulleman & Harackiewicz, 2009; Hulleman et al., 2017; Tibbetts et al., 2016). Similar interventions have also been suggested to strengthen boys' interest and engagement in care-related careers (Vzw Zijn - Beweging tegen Geweld, 2019; [MITEY](#)). While many interventions of this type of aim at increasing girls' participation in STEM fields, there are still many unused opportunities to apply the same mechanism to attract boys into HEED fields.

Another way to introduce students to a field and to improve their perceived belonging in a field is by offering **mentoring initiatives and role models**. One intervention that did that was part of the [INSPIRA STEAM project](#) (Guenaga & Fernández Álvarez, 2020; Guenaga et al., 2022). In this STEM intervention, students from Spain, aged 10-12 years, followed a program of six sessions in which they were mentored. The intervention improved students' opinions of vocations and professions related to STEM but did not improve the stereotypes that they had about mathematical self-efficacy. While girls' attitudes towards the potential achievements of women in general changed, they still doubted their potential achievements. Another intervention that focused on the impact that mentoring can have showed that **pairing women engineering students with another woman peer mentor** protected their feelings of belonging as well as their self-efficacy beliefs and motivation in the domain of engineering (Dennehy & Dasgupta, 2017). Moreover, it increased retention in engineering studies and also their aspirations to continue in this domain after graduation. In a broader approach, **pairing minority and majority roommates** at a predominantly White university increased students' sense of belonging at university (Shook & Clay, 2012). In minority students, this increased sense of belonging was accompanied by higher grades. Overall,

these interventions show that both **ingroup mentors, as well as intergroup contact**, can increase feelings of belonging as well as performance, making them promising approaches to help students belong and succeed after making gender-atypical educational choices. One intervention project, namely **Project Prism** in partnership with **Actua**, combined several approaches to include girls' belonging in STEM among science camps for junior and high school students (Cyr et al., 2021; Cyr et al., in prep.). During these week-long camps, girls encountered diverse role models, which resulted in increased aspirations to pursue a future career in STEM and a stronger perceived fit with the STEM domain. At the same time, boys followed an intervention that included an illustration of girls' ability in STEM, resulting in reduced stereotyping of girls' STEM abilities afterward (Cyr et al., 2023).

It makes sense to increase students' perceived fit with a certain field, but it is also important to acknowledge that students' expected discrimination in a certain field does not necessarily reflect unrealistic fears. Over time, the discrimination that is expected within a field can also be changed by actually **reducing the prejudice and bias of people working in that field**. For instance, changing attitudes among men can contribute to creating a supportive environment for women (Logel et al., 2009). Changing men's attitudes can, however, be particularly difficult as they tend to be more skeptical towards gender bias research (Handley et al., 2015). Exposure to women scientists helps change prototypes, and videos or virtual reality interventions can provide particularly vivid exposure. **VIDS (video interventions for diversity in STEM)** can be used to address and mitigate gender bias in STEM. In such interventions, participants watch short videos about empirical findings regarding research on gender bias. In a study by Moss-Racusin and colleagues (2018), the videos used narratives, expert interviews, or a hybrid version of both to bring the findings across. Participants who participated in the intervention had lower gender bias, increased awareness regarding gender bias, and were more positive towards women in STEM (Moss-Racusin et al., 2018). Those effects were present independent of participants' gender and their background (general population versus STEM faculty). However, such interventions can also lead to increased stereotype threat and reduced belongingness in women (Pietri et al., 2019). A combination with identity-safe cues was able to alleviate threat, but stereotype threat concerns and general negative feelings remained. It is thus important to apply such interventions carefully and to choose wisely regarding the target group. Men participants, for instance, showed decreased modern sexism without negative consequences.

4.2.2.2 The Perception of the Self

4.2.2.2.1 Stereotype Threat and Role Models

How students perceive themselves also matters for the careers and domains in which they can envision themselves. One possibility to increase students' chances of making ungendered educational choices is to **reduce stereotype threat**. The phenomenon of stereotype threat describes students' tendency to perform worse in a domain that is related to negative performance stereotypes associated with the group they belong to (for instance, the STEM domain for girls; Singletary et al., 2009; Steele & Aronson, 1995). Stereotype threat can thus hamper girls' belief in their capabilities in male-dominated fields and boys' belief in their capabilities in female-dominated fields. Interventions to reduce stereotype threat might involve educating about the phenomenon, stressing similarities between genders rather than differences, and promoting the idea that intelligence and skills are malleable and can be developed (Tellhed et al., 2018). One such intervention (Spinner et al., 2021) focused on primary school students and included **learning about stereotypes and exploring similarities between genders and diversity within genders**. For example, girls would be asked to point out how girls are similar to boys and how some girls might differ from other girls. Girls and boys who followed this intervention felt more similar to boys and girls respectively afterwards and saw the potential to explore a wider variety of career options in the future. An intervention by Ben-Zeev and colleagues (2017) tackled stereotype threat in undergraduate students who belonged to underrepresented minorities. Students in this intervention followed a tutorial that explained the phenomenon of stereotype threat and its harmful consequences and encouraged them to **develop coping strategies based on their personal experiences**. Students who followed this “knowledge as power” approach were more protected against worries about confirming stereotypes and were able to obtain better grades.

Interventions can **also provide students with identity-safe cues**. These are cues that suggest for example that women are valued in STEM fields and that men are valued in HEED fields. One such way to achieve this in an intervention is via **Virtual Reality (VR)**. Such an intervention was tested at the University of Twente in the Netherlands (Baldo, 2020). Female participants (students, doctoral students, or employees in STEM domains) participated in a bias literacy intervention that was paired with identity-safe cues. While the identity-safe cues did not change participants' belonging, trust, negative affect, and growth mindset, it was able to successfully address awareness of gender bias, stereotype threat concerns, and self-efficacy beliefs. The effectiveness of the intervention also depended on the subgroup that participants belonged to (student vs. doctoral student vs. employee),

being most fruitful for doctoral students (Baldo, 2020). These types of interventions do seem to offer promising directions towards reducing horizontal gender segregation.

Virtual Reality can also help students **envision themselves in domains** that stereotypically do not align with their gender. An intervention by Starr and colleagues (2019), for instance, helped students envision their future selves as either highly successful in STEM (math, physical sciences, engineering, and computer science fields) or highly successful in humanities. Students who envisioned themselves as highly successful in STEM (vs. in humanities) and identified with the VR experience were more motivated to take STEM courses and anticipated less stereotype threat (Starr et al., 2019).

Interacting with a role model can also reduce stereotypical beliefs related to a domain, which might also reduce the risk of stereotype threat. In an intervention tested by McGuire and colleagues (2021), women students in the US and the UK interacted with an educator at a science learning site who was either a man or a woman. When female students interacted with a woman (vs. a man), they reported a stronger interest in math (but not science) and a weaker belief that boys are usually better at math. Ideally, the role model behaves in a counter-stereotypical manner, meaning that they are observed in roles atypical for their gender, such as a man who is a kindergarten teacher or a woman who is a scientist (see Olsson & Martiny, 2018 for a review of counter-stereotypical role model interventions).

4.2.2.2 Identity and Self-Concept

When considering different domains and one's fit within these domains it can also help students take a closer look at who they are. Potential interventions could motivate students to take a deeper dive into their own identity (Vzw Zijn - Beweging tegen Geweld, 2019).

Within the scope of the [Young Men Initiative \(YMI\)](#), Namy and colleagues (2015) developed an intervention specifically tailored to **boys and the promotion of healthier masculinities**. Examples of unhealthy masculinities that boys may feel pressured to conform to and that may restrict their educational choices are for example emotional stoicism, risky behavior (including alcohol and drug abuse), aggression when threatened, and physical toughness (Rogers et al., 2021). In a similar vein, the [WiseGuyz Program](#) (Exner-Cortens et al., 2020;) aimed to deconstruct stereotypical gender role expectations for male participants. During 20 sessions that took place within an academic year, participants critically examined norms related to gender and masculinity. At the end of the program, participants reported improved

friendship quality, and some reported a decline in emotional restriction. With less restricted emotions, friendship closeness and satisfaction increased, which, in turn, resulted in higher emotional support and intimate disclosure (Exner-Cortens et al., 2021). The **deconstruction of traditional gender roles and expectations** can also allow students to see themselves fit into a less traditionally male domain, such as HEED fields. The [Young Black Men, Masculinities and Mental Health \(YBMen\) program](#) followed a similar approach. Over 5 weeks, the program provided mental health education and social support to young Black men, and thereby helped them think more inclusively about masculinity and their own definitions of manhood (Watkins et al., 2017). Similarly, the [EquiX project](#) also invites boys to deconstruct their masculine identity, resulting in more freedom for self-development, independent of the rigid binary gender norms (Vzw Zijn - Beweging tegen Geweld, 2019).

It can also help students to connect their current self-concept with a desired future self-concept in a so-called **possible selves intervention**. In an intervention by Oyserman and colleagues (2002; 2006), students completed small group activities over the course of 9 weeks. During these activities, they had to imagine themselves as successful adults and connect these images to their current selves and their school involvement. At the end of the intervention, students reported to have gained plausible strategies to attain their possible selves.

It can also help to start students' **career considerations with** tools that help to refocus on **deep-level (rather than demographic) diversity, by making occupational interests, skills, values, and** traits visible to students. This professional profile can then help to look for a fitting field on the basis of skills and interests, rather than heuristics and biased beliefs about gender and occupational stereotypes. The [Career Compass](#) is an intervention that does this within the scope of tech-related occupations. It captures participants' professional identities and then matches them with a technical occupation. Relatedly, novel research lines investigate how a skills-based approach to job search and recruitment, for example in the transition from school to work, might debiased occupational choice and selection processes, by enabling students to explore potential job options starting from their own interests and values instead of their potentially biased ideas of occupations (Adhikari et al., 2024). It would be important that such interventions lead girls and boys not only to STEM fields, but consider the value of both STEM and HEED domains, and communal and agentic types of work, matching these two interests and possible selves of individuals net of gender roles.

4.2.2.2.3 Self-Confidence and Competence Beliefs

Students' self-confidence and competence beliefs can determine whether they dare to make educational choices that are not in line with gendered expectations.

For girls, initiatives that aim to **increase their self-perceived competence** in male-stereotyped domains like technology and engineering can be encouraging. This could involve that they attend technology and coding courses from an early age, making hands-on experiences, encountering successful women in STEM, and exploring STEM-related interests without feeling threatened by stereotypes (Tellhed et al., 2018). Initiatives to boost girls' confidence and competence in math-related fields have grown significantly over the past 10 years. Yet similar to girls, boys also face discrimination when pursuing traditionally female careers (e.g., in HEED domains), and those tend to be based on negative competency expectations too (Manzi, 2019). While far less research attention and initiative is taken in this domain, it is expected that boys would similarly benefit from at an early age having HEED-related hands-on experiences, encountering successful men in HEED, attending courses related to HEED fields, and exploring HEED-related interests without feeling threatened by stereotypes.

Another way to improve students' motivation is to show students that even successful scientists struggle. An intervention developed by Lin-Siegler and colleagues (2016) used a **storytelling** approach to **teach students about the challenges and hardships** that scientists like Albert Einstein faced. When students learned about the intellectual or private struggles that great scientists had to overcome, their motivation and performance in science courses increased. This was especially the case in low-performing students. Similar approaches might also be used to help students feel more connected to potential role models in domains atypical for their gender. Relatedly, **lay theories about the commonness of difficulties** during one's studies can impact students' motivation and performance. When students learned that it is common to experience and overcome challenges during one's college education, students from disadvantaged backgrounds performed better, sought more support, and developed better relationships with peers and mentors (Yeager et al., 2016). In a similar manner, **using specific metaphors when reflecting on achieved academic goals** was beneficial to students. When they construed their success as a completed journey (versus a reached destination or using no metaphor at all), students were motivated to engage in goal-aligned behaviours and also performed more goal-aligned behaviours two weeks after the interventions (Huang & Aker, 2019). Students also benefit from **reading senior students' real-life stories**, especially if these

highlight the students' social background. In an intervention by Stephens and colleagues (2014), highlighting how senior students' social background (including first-generation and continuing-generation students) mattered for their experience at college increased first-generation students' tendency to seek out resources and improved their grades, eliminating the achievement gap between first-generation students and continuous-generation students. Such intervention approaches appear promising to support boys and girls in gender-atypical fields (such as HEED or STEM, respectively), especially when they acknowledge the specific challenges that students might face in a domain atypical for their gender.

A specific type of intervention that can enhance students' confidence and self-efficacy is a so-called **growth mindset intervention** related to interventions noted also earlier. Such an intervention teaches students a growth mindset which implies that intelligence and skills can improve through effort and challenges, rather than being fixed and unchangeable (Aronson et al., 2002; Blackwell et al., 2007; Dweck, 1999; Dweck, 2006; Good et al., 2006). In many cases, growth mindset interventions consist of meetings with a mentor, sessions administered in person or online, or information texts shared with students. These interventions can improve learning attitudes of students as well as teaching attitudes of teachers (as discussed earlier) and consequently improve students' course performance and grades (Aronson et al., 2002; Blackwell et al., 2007; Chao et al., 2017; Good et al., 2003; Outes et al., 2017; Paunesku et al., 2015). However, the success of growth mindset interventions tends to depend on the characteristics of the participating students, with the best effects in students with low grades and low growth mindset prior to the intervention (Bettinger et al., 2018; Broda et al., 2018; Chao et al., 2017).

Another type of intervention that tends to help when it comes to student's self-worth and self-esteem is a **values-affirmation intervention**. Gender-atypical fields and academic environments can be threatening, especially if students feel that they do not belong. To prevent students from questioning their self-worth, these kinds of interventions broaden students' sense of self beyond the threatening environment and remind them of a difficult task they have already overcome. After such interventions, underrepresented students' motivation and performance in STEM tend to improve (Casad et al., 2018; Peters et al., 2017; Walton et al., 2015). Such interventions often consist of writing exercises and work exceptionally well in students experiencing identity threat (such as women in STEM who strongly endorse the stereotype that men outperform women in STEM) and students with lower performance scores prior to the intervention (Kost-Smith et al., 2012; Miyake et al.,



2010; Sherman et al., 2013). This approach might likely also help underrepresented students in other fields, such as boys in HEED fields.

5. Conclusion and Outlook

Students can strongly benefit from seemingly subtle educational interventions (Garcia & Cohen, 2013) that tackle gender-biased cues and agents in the educational context. The goal of this review was to provide an overview of interventions that reduce gendered norms and decisions in education. Reviewed interventions were mapped within either vertical or horizontal gender segregation and targeted students either via agents or directly. For those interventions that targeted students via agents, relevant roles were played by institutional funding, a safe society and culture, teachers, parents, counsellors, and the school. When interventions targeted students directly, they did so via students' perceptions of the field or students' perception of themselves. For students' perceptions of themselves, stereotype threat and role models, identity and self-concept, and self-confidence and competence beliefs tended to form leverages for change to reduce gendered educational decisions. Please see Table 2 for take-home messages.

Table 2

Take-home messages
<p>1. Choose interventions wisely. Interventions need to be chosen wisely so that they fit the specific cause of gendered choices as well as the context in which this needs resolving.</p>
<p>2. Unleash potential regarding interventions for boys in HEED. A lot of existing approaches can be further harnessed, especially when it comes to interventions that aim to increase boys' interest in HEED fields.</p>
<p>3. A multi-layered systems approach is crucial. There are no silver bullets; Single interventions tackling one social agent or contextual cue are in need of further embedding in a multi-layered systems approach in order to sustainably debunk gender-biased choices and attain gender equity in education.</p>
<p>4. Incorporate teachers and parents more. We identified opportunities for advancement regarding approaches that can influence students via their teachers and parents.</p>
<p>5. An intersectional lens can further enrich interventions. Interventions can further improve by taking the full picture of individuals' lived realities into account.</p>

Interventions need to be chosen wisely

Our first main conclusion from this review is that the pool of existing interventions is generally quite diverse and spans a lot of potential changing agents and mechanisms. It can, however, not be concluded that all interventions are equally helpful to all students and in all contexts (for a similar argument regarding interventions that target students directly, see Easterbrook & Hadden, 2021). Many interventions show great heterogeneity in the effectiveness of the intervention across contexts and groups (Chao et al., 2017; Easterbrook et al., 2021; Kost-Smith et al., 2012; Kizilcec & Cohen, 2017; Yeager & Walton, 2011). A prerequisite for the success of an intervention thus seems to be that it is chosen carefully, for example by first considering whether the issue of constraint is caused by vertical or horizontal gender segregation, and second by analyzing whether the specific context calls for an intervention targeting, for example, the school system, socializing agents, or students' perceptions of the field, or a combination. Moreover, the success of an intervention also depends on the characteristics and beliefs of the agents implementing it (Bettinger et al., 2018; De Boer et al., 2018; Kost-Smith et al., 2012; Yeager et al., 2022). **Interventions are thus optimally considered tailored solutions that are best chosen with careful consideration.** Our mapping can help practitioners and policymakers to first locate themselves on the wide spectrum of potential options and causes for current gender inequalities in education; to then set concrete, timely, and realistic goals for how current disparities are in need of closing, and to then choose a set of most promising approaches to intervene, ideally taking a systematic approach to address different levels of intervention (i.e., funding, institutional communication, educational materials, teachers, students).

Many existing approaches can inspire interventions that aim to increase boys' interest in HEED fields

A second realization that became apparent within this review is that when it comes to interventions aiming to reduce horizontal gender segregation, the bulk of **existing interventions and research to test their effectiveness empirically focus on girls and women in STEM fields rather than on boys and men in HEED fields.** This links well to our conclusion from Deliverable 3.1 (Review of agents involved in gendered norms and choices) also pointing out that much less attention in policy and research is devoted to the horizontal segregation of boys into gender-specific domains – and away from HEED domains (Health, Elementary Education and Domestic domains, Croft et al., 2015). Boys are not facilitated or encouraged into these educational and career paths and face stigma and backlash when they do venture in (Meeussen et al., 2020). Moreover, an over-emphasis on moving girls into traditionally male educational paths and careers such as STEM relative

to boys into traditional female care domains (HEED) implicitly and explicitly communicates that these domains and activities carry higher societal value while caring for others and educating them is less valued in terms of monetary reward. Not only does this act as yet another process maintaining gender inequality, but it also contributes to the increasing difficulty filling vacancies in HEED. This lack of attention also seems to be reflected in the lack of interventions that focus on boys and men and HEED fields. The already existing approaches and findings related to interventions regarding girls' participation in STEM can serve as an excellent starting point for interventions that focus on boys and men in HEED.

A multi-layered systems approach is crucial

The observation that few resources and research activities are invested in the HEED domain coincides with sociological research showing that there is a negative relationship between the percentage of women working in a particular sector and the status and monetary reward in that sector, also referred to as *Sullerot's Law* (Molenaar & van Reijswoud, 2022). An overrepresentation of women in a particular sector is thus associated with less status and financial reward, and vice versa (Cacouault-Bitaud, 2001). To *rewire* this gendered constraint that entangles gender roles, occupational stereotypes, horizontal gender segregation, and educational choice, it is important to align interventions at the institutional (i.e., financial reward for jobs in HEED relative to STEM), symbolical (i.e., cues that signal nursing fits boys and girls equally) and experiential (i.e., re-set belief systems that connect HEED jobs to threatened masculinity)

There is untapped potential for interventions that target teachers and parents

A third insight that stemmed from this review is that despite the relevant role that teachers and parents tend to play in students' (gendered) educational decisions (see also Deliverable 3.1 – Review of agents involved in gendered norms and choices), there seems to be a **lack of interventions focusing on teachers and parents** and their impact within students' educational journey. The vast majority of interventions target students while the return on investment in terms of impact could be much higher when teachers, the school system, and parents are targeted as well.

An intersectional lens can further enrich interventions

A fourth insight is that many, if not most, **interventions lack an intersectional perspective**. This is especially visible in role model interventions as the majority only focuses on one aspect of the role models' identity, which is often gender (e.g., McGuire et al., 2021). Although research on interventions repeatedly shows that other identity components such as ethnicity are a relevant factor for the success of an intervention (Broda et al., 2018; Good

et al., 2008) most existing interventions fail to include other identities (such as ethnicity, socioeconomic status, or psychosexual orientation). Considering how varying identities overlap and interact, it could be crucial for certain groups of students to interact with diverse role models. Tailoring interventions to students' lived realities by incorporating several identity components at once could make them more potent.

Taken together, this review provided an overview of existing intervention approaches to reduce gendered norms and educational decisions. It also mapped them in order to allow readers to identify more promising approaches for specific contexts and student groups. Moving forward, this overview can help others to find relevant interventions and approaches and to implement them. The gained insights are also relevant to the development of additional interventions that will tackle gendered educational choices in both boys and girls.

6. References

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