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ORIGINAL RESEARCH

Gender Representation in HEED and STEM Occupations: A Longitudinal Analysis of German Language Arts and Mathematics Textbooks (1960–2017)

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Abstract

Gender stereotypes in educational materials can influence children's and adolescents' career aspirations, contributing to persistent occupational gender segregation. However, large-scale, longitudinal studies examining gender representation in stereotypical occupational domains in textbooks across different school subjects remain scarce. This study addresses this gap by analyzing the gender representation in two key occupational domains: science, technology, engineering, and mathematics (STEM) and health care, early education, and domestic work (HEED) across 820 German language arts and mathematics textbooks from 1960 to 2017. Using a binomial generalized linear mixed model with a discontinuity design we tested how representation was related to time, the 1986 governmental resolution on gender equity, subject area, and occupational domain. Results revealed substantially lower female representation in STEM than HEED occupations throughout the study period. Female STEM representation increased from 0.0% to 9.1%, while HEED representation increased from 12.2% to 23.1%. The 1986 resolution had divergent effects across subjects: female representation increased in German language arts textbooks but decreased in mathematics textbooks. A significant three-way interaction revealed that temporal changes in female representation relate to both subject area and occupational domain. In German language arts textbooks, female representation increased in both HEED and STEM domains, while in mathematics textbooks, female HEED representation increased (from 7.4% to 20.5%), but female STEM representation remained stable (from 1.4% to 1.0%). After 1986, the odds of a STEM occupation mention being female were almost six times higher in German language arts than in mathematics textbooks. These findings demonstrate that progress toward gender-equitable representation is context-dependent, with mathematics textbooks perpetuating stronger occupational stereotypes.

Keywords Gender representation · Occupational segregation · HEED · STEM · Textbook analysis · Longitudinal trend

Contemporary occupational gender segregation is characterized by pronounced disparities between two polarized domains: the occupational domain of science, technology, engineering, and mathematics (STEM) and the occupational domain of health care, early education, and domestic work (HEED) (Charles & Bradley, 2009; Croft et al., 2015; England, 2005). Across industrialized nations, women only constitute approximately 17% of the STEM workforce while representing over 70% of the HEED workforce, creating gender wage gaps and limiting career mobility (Bundesagentur für Arbeit, 2024; National Science Board & National Science Foundation, 2024; World Health Organization, 2024).

This segregation reflects pervasive cultural associations between these occupational domains and gender-stereotypical attributes (Froehlich et al., 2020). Gender-typed occupational aspirations emerge during childhood and adolescence, when individuals form career-relevant identities that predict later educational and occupational choices (Eccles, 2009, 2011; Fagot et al., 2000; Wicht et al., 2022). Social role theory (Eagly, 1987; Eagly & Wood, 2012) explains this pattern through the cyclical relationship between occupational observations and stereotype formation. Repeated societal observations of women and men in distinct roles create

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strong gender-occupation associations that become culturally embedded over time.

Educational textbooks represent influential sources of occupational gender messages during these formative periods. Textbooks serve dual functions as pedagogical tools and cultural transmitters, communicating implicit messages about occupational gender appropriateness through visual representations, narrative choices, and linguistic patterns (Apple, 1987; Höhne, 2005; Ott, 2016). Research shows that exposure to counter-stereotypical representations in learning materials improves girls' performance and engagement in STEM domains (Good et al., 2010). Furthermore, gender-neutral occupational language has a significantly positive influence on career perceptions, compared to gender-stereotypical language, particularly in grammatically gendered languages like German (Liben et al., 2001; Vervecken et al., 2013, 2015). However, not only occupational domains, but also school subjects are associated with gendered connotations. For example, mathematics is a stereotypical masculine school subject, and language arts is a stereotypical feminine school subject (Plante et al., 2009). Thus, textbooks in different subject areas might potentially amplify occupational gender messages (Plante et al., 2009; van der Vleuten et al., 2016).

While previous textbook studies have documented imbalances in gender representation, systematic examination of gender representation in specific occupational domains related to contemporary occupational segregation remains rare. First, most studies rely on simplistic 'typically male/female' categorizations rather than focusing on theoretically meaningful domains like HEED and STEM (Fruehwirth et al., 2024; Ott, 2017b). Second, only a few studies employ longitudinal designs capable of capturing representational changes over extended periods (Finsterwald & Ziegler, 2007; Lindner & Lukesch, 1994; Ott, 2017b). Finally, comparative research examining subject-specific variation in occupational portrayals remains underdeveloped, despite evidence that different school subjects perpetuate distinct gender stereotypes (Moser & Hannover, 2014).

The present study addresses these limitations by examining female and male HEED and STEM occupational representations as indicators of how established gender segregation patterns manifest in mathematics and German language arts books over time. Using computational text analysis of 820 German textbooks spanning 1960–2017, we systematically examine how proportional representation within these occupational domains has evolved across textbooks in these subject areas. Rather than measuring underlying stereotype dimensions, such as typical male or female, we analyze forms of representation that reflect broader HEED and STEM segregation trends, providing empirical evidence regarding educational materials' potential role in reinforcing or challenging occupational gender associations during critical developmental periods.

Gender Stereotypes and Their Role in Occupational Segregation

Gender functions as a fundamental structural and social category that profoundly shapes contemporary societies (Aulenbacher, 2008; Deaux, 1984; Risman, 2004; Schmader & Nater, 2025; West & Zimmermann, 1987). Central drivers are gender stereotypes, which are culturally embedded cognitive schemas that encompass societal beliefs about attributes, characteristics, and behaviors perceived as either typical or appropriate for women and men (Ashmore & Del Boca, 1979; Eckes, 2004). These stereotypes significantly influence individual experiences, opportunities, and life paths, with particularly pronounced effects on occupational aspirations and choices (Watt, 2010).

Gender stereotypes include both descriptive elements (indicating how women and men are typically perceived) and prescriptive elements (defining how women and men are expected to behave) (Eagly & Wood, 2012; Prentice & Carranza, 2002). This dual nature means they not only reflect observed patterns but also create expectations that guide behavior. Through socialization, individuals often internalize these stereotypes, perpetuating gendered societal structures and constraining occupational pathways to those deemed gender-appropriate (Schneider, 2005).

Social role theory (Eagly, 1987; Eagly & Wood, 2012) explains how gender stereotypes emerge and persist through societal observations of women and men occupying distinct social roles. Repeated observations create strong associations between role-based behaviors and inherent gender attributes, eventually embedding these stereotypes culturally (Eagly et al., 2020). Historical societal frameworks, particularly the gendered division of labor and the public-private dichotomy (Rubin, 1975; Weber, 2019) positioned women and men within specific occupational spheres, reinforcing stereotypical attributes. Such divisions contributed to what Hausen (1976) termed a "polarization of gender characters," creating deeply ingrained associations that inform perceptions of occupational gender-appropriateness and drive contemporary occupational segregation patterns (Klinger, 2012).

The Two Poles of Occupational Segregation: HEED and STEM

Occupational gender segregation—the tendency for women and men to work in distinct occupational domains and industries—remains a key characteristic of labor markets worldwide (Charles & Bradley, 2009; Charles & Grusky, 2004; Levanon & Grusky, 2016; Lippa et al., 2014; Wong & Charles, 2020). This segregation closely aligns with societal

gender roles and associated stereotypes, perpetuating disparities in pay, status, and career progression opportunities (England, 2010; Ridgeway, 2011). Particularly illustrative of this gendered occupational divide are two domains that represent extreme poles of gender segregation: health care, early education, and domestic work (HEED) and science, technology, engineering, and mathematics (STEM) (Croft et al., 2015; Stewart-Williams & Halsey, 2021; Tellhed et al., 2017).

HEED domains encompass occupations primarily centered around care, nurturing, education, and social support (Croft et al., 2014, 2015). HEED occupations include roles in health care (e.g., nursing, social work), early education (e.g., preschool, elementary education, childcare), and domestic work (e.g., household management). These roles represent key forms of care work, defined as activities involving the support, development, and welfare of individuals, that fulfill essential functions related to health promotion, individual development, and community cohesion (Aulenbacher et al., 2018; Brückner, 2010; England, 2005). In most Western societies, HEED occupations are female-dominated (Charles, 2011), with women comprising around 70% of the global health and social workforce, 74% in U.S. education and health services, and 77% in German health and social work (Bundesagentur für Arbeit, 2024; U.S. Bureau of Labor Statistics, 2023; World Health Organization, 2024). This concentration reflects associations of these occupations with stereotypically feminine attributes such as nurturing, warmth, empathy, and relationship orientation. Accordingly, male underrepresentation persists, often due to restrictive societal norms around masculinity, with men entering HEED domains potentially experiencing social penalties (Abele et al., 2016; Heilman & Wallen, 2010).

The acronym STEM collectively describes domains characterized by scientific inquiry, technological innovation, engineering problem-solving, and mathematical reasoning. These domains include diverse occupational roles, from research scientists (e.g., physicists, chemists) and engineers to computer science professionals, mathematicians, and specialized technicians (Fayer et al., 2017). Despite concerted efforts to increase women's participation, STEM remains male-dominated, with women constituting approximately 29% of the global workforce, 18% in the United States, and 17% in Germany (Bundesagentur für Arbeit, 2024; National Science Board & National Science Foundation, 2024; World Economic Forum, 2023). STEM occupations emphasize analytical thinking, independence, and problem-solving, attributes which align with stereotypically masculine attributes, contributing to perceptions of STEM domains as inherently masculine (Abele et al., 2016; Cheryan et al., 2009, 2017; Moss-Racusin et al., 2012; Nosek et al., 2009).

HEED and STEM domains represent extreme manifestations of occupational gender segregation, with stereotypical gender associations contributing to their persistence. Building on social role theory, ongoing observations of gendered occupational roles reinforce stereotypical perceptions of women's and men's suitability for HEED or STEM occupations, creating a self-perpetuating cycle where stereotypes both reflect and reproduce occupational gender patterns. These domains, therefore, serve as particularly revealing indicators of how gender stereotypes manifest in occupational contexts in a society.

Developmental Origins of Occupational Stereotypes: The Role of Textbooks

Occupational stereotype adoption begins early in life and solidifies during formative developmental periods such as preschool, primary school, and adolescence (Fagot et al., 2000; Koenig, 2018; Martin, 2000; Olsson & Martiny, 2018). During these critical stages, children and adolescents internalize societal beliefs about gender-appropriate roles, subsequently aligning their identities and interests with these internalized beliefs. Girls typically orient towards communal, care-oriented roles, while boys gravitate towards agentic, technical, or scientific roles (Klaczynski et al., 2020; Korlat et al., 2022; Su et al., 2009). This early internalization significantly impacts educational choices and eventual career pathways, making the sources of gender messages during these formative years particularly influential (Eccles, 2009, 2011; Wicht et al., 2022).

Textbooks serve as crucial socializing agents due to their daily, widespread use in classroom instruction. They not only shape pedagogical methods but also transmit social values and norms (Apple, 1987; Gräsel, 2010; Stará et al., 2017; Zala-Mezö et al., 2021). Through visual imagery, narratives, and linguistic choices, textbooks communicate both implicitly and explicitly occupational stereotypes and have the potential to reinforce gender-specific career aspirations and identities (Gottfredson, 2002; Höhne, 2005).

Prior research shows the influence of gendered representations on children's and adolescents' occupational aspirations, perceived self-efficacy, and scientific understanding and performance (Scott, 1986; Scott & Feldmann-Summers, 1979; Trepanier-Street & Romatowski, 1999; Witt, 2001). For instance, Good et al. (2010) found that girls showed better understanding and performance on chemistry tasks when learning materials included counter-stereotypical representations, such as female scientists, suggesting that representation impacts engagement and self-efficacy in specific domains. Similarly, experimental studies show that exposure to female STEM role models can positively influence

girls' self-concept and interest in STEM fields (Ziegler & Stoeger, 2008). Beyond visual representation, linguistic details also significantly influence perceptions of occupations (Stahlberg et al., 2007). The use of gender-neutral job titles encourage more inclusive understandings of occupational accessibility, an effect particularly pronounced in languages with grammatical gender, such as German (Liben et al., 2002; Vervecken et al., 2015).

School subjects are also associated with inherent gender stereotypes, influencing children's and adolescents' occupational perceptions indirectly (Kollmayer et al., 2017). Mathematics and sciences are stereotypically viewed as masculine, reinforcing their association with STEM careers, whereas language arts is perceived as more feminine, similar to HEED occupations. Research supports these associations. For example, Plante et al. (2009) found that students, regardless of gender, perceived language arts as strongly feminine and mathematics as relatively more masculine. These gendered perception of school subjects is closely tied to children's and adolescents' motivation, preferences, and ultimately, their educational and occupational trajectories (Kollmayer et al., 2018; Plante et al., 2009, 2019). Therefore, examining occupational representations within textbooks across subject-specific contexts, especially mathematics and language arts, provides critical insights into how gender stereotypes are perpetuated or challenged within educational systems.

In summary, textbooks are understood to play an important role in shaping children's and adolescents' occupational perceptions and aspirations. For this reason, analyzing their content through their visual, textual, and linguistic elements is crucial. Doing so provides valuable insight into the subtle mechanisms by which gendered occupational segregation is reproduced or challenged in educational settings.

Perspectives on Gender Representation in Occupational Roles in Textbooks

Research on gender representation in educational textbooks has undergone significant evolution since the 1960s, reflecting broader trends in feminist scholarship and sociocultural awareness (Mills & Mustapha, 2015; Moser, 2016). Initial studies focused on highlighting the substantial underrepresentation and, later, the stereotypical portrayal of women and girls. Over time, research methodologies have grown increasingly sophisticated, integrating linguistic and psychological frameworks to critically examine how textbooks reinforce gender stereotypes, particularly within occupational roles (Fichera, 1996; Hunze, 2003; Moser, 2016; Ott, 2021). Given the vast body of international research, this review concentrates on the literature most relevant to the present study's design. We primarily draw from foundational and contemporary studies from German-speaking and Anglophone contexts. This focus is justified by the direct relevance of German-language research to our corpus and the influential role of early Anglophone studies in shaping the field's methodologies. Consequently, this review does not include the extensive body of research from other linguistic and cultural contexts (e.g., Scandinavia, Asia), as a comprehensive global overview is beyond the scope of this paper's specific focus. This review also includes some highly influential studies of related educational media (e.g., picture books, online resources) that have shaped theoretical and methodological approaches within textbook research. Furthermore, we prioritize studies that align with our research focus on specific school subjects (particularly language arts and mathematics), different school types (e.g., primary and secondary), and textbook types (e.g., reading books and subject-specific textbooks). Our review will first provide a chronological overview of general findings on occupational representation before focusing on the more specific literature on subject-specific differences.

Early textbook studies from the 1960s to the 1980s (Elbracht & Mosler, 1972; Ohlms, 1984; Sollwedel, 1968, 1971), inspired by second-wave feminism, primarily aimed to expose the invisibility and stereotypical portrayals of women, often using content analysis grounded in ideological critique (Apple, 1978; Bernstein, 1975). Influential Anglophone analyses, such as Weitzman et al.'s (1972) content analysis of 18 picture books for preschool children, highlighted severe imbalances, finding 261 pictures of men compared to only 23 of women, with a ratio of 11:1, and no instances of women in an occupational role. Similar patterns were reported for German textbooks: In a content analysis of 20 German elementary school reading books, Karsten (1976) found significant male dominance in character representation (71%) and occupational mentions (87%). Occupational mentions predominantly portrayed men in traditionally male domains (technical and production roles), with female roles restricted to service-oriented occupations. In a content analysis of 131 texts from three English language arts textbooks used in German secondary schools, Hellinger (1980) found that men were depicted across a broad spectrum of demanding careers, including car builders, bankers, engineers, scientists, and explorers. In contrast, women were confined to lower-status occupational roles such as waitress, office worker, nurse, maid, or housewife, with only two women in all three textbooks achieving high educational and professional status (as teacher and astronaut). Studies in this early period focused mainly on documenting baseline disparities in representation and the prevalence of traditional gender stereotypes.

In the 1990s, researchers began investigating whether earlier criticism of gender inequality in school textbooks (Clark

et al., 2005; Fichera, 1996; Preinsberger & Weisskircher, 1997; Witt, 1997) had prompted changes in gender portrayals, but found only minor improvements (Moser, 2016). For example, a study of Swiss textbooks by Bühlmann (2009) found in his content analysis of 203 texts in three textbooks of three publication cycles (1929, 1970, and 1990) that only 12% women were shown in an occupational role. While male characters were shown in a full range of professions, women were almost exclusively portrayed as farmers, saleswomen, cooks, or domestic servants. It was not until the 1990 textbook that teaching was added as a fifth occupation, and occupations like medicine, law, or skilled trades remained almost entirely male-dominated throughout the decades studied. In another key German study, Lindner and Lukesch (1994), in their content analysis of 72 German textbooks published between 1971 and 1992, covering German, mathematics, basic sciences, and religious education textbooks, also found persistent occupational gender segregation. Despite an increased general visibility of women (32% at the text level, 39% in pictures), women represented only 13% of textual occupational roles and 16% of pictorial occupational roles. The distribution of these roles was highly gendered. Of all occupations shown, 35% were in typically female domains (such as social care), and women were shown holding 62% of these typical female jobs. In contrast, 36% of the occupations were in typically male domains (such as academic positions), with women being shown in only 12% of these roles.

Research from 2000 to the present confirms the persistence of gender stereotypes, particularly concerning occupational portrayals, despite incremental improvements in the general visibility of women (Denny, 2011; Evans & Kimberly, 2000; Moser & Hannover, 2014; Ott, 2017b). A large-scale historical analysis of German textbooks by Ott (2017b) conducted a discourse-linguistic multilevel analysis of 88 German textbooks published between 1871 and 2014. While the study covers a vast historical period, her findings from the 2000s (2000–2013) are particularly revealing. In these modern textbooks, women's general mentions neared parity at around 42–43% of all personal references. However, a significant gap in occupational representation persisted, as a mention of a man was twice as likely to be in an occupational capacity (6% of all male mentions) than a mention of a woman (3% of all female mentions). In the U.S. context, Hamilton et al. (2006) conducted a content analysis of 200 popular children's picture books from the turn of the 21st century and found significant disparities in occupational representation. The analysis revealed that 75% of adult women were depicted without paid employment, compared to 51% of men. Additionally, men were portrayed in a substantially broader range of occupations (32 different jobs) versus women (12 jobs). These occupational disparities reflected a broader pattern of gender under-representation, with male titles and main characters outnumbering females by nearly 2-to-1. Recent European studies confirm these findings. In their content analysis of nine current and widely used textbooks (five mathematics and four language arts textbooks) from five European countries, Jehle et al. (2024) found that female characters were significantly underrepresented in occupational contexts; only 22% of the characters with an occupation were female, and they appeared in fewer occupational categories than male characters (20 vs. 35). In a qualitative content analysis of illustrations in seven German geography textbooks from 2011 to 2020, Cruz Neri et al. (2024) found similar stereotypical patterns. In the category "Occupation and Activity," over 70% of illustrations depicted only or predominantly male figures.

There are only two recent studies examining gender representation in HEED and STEM, one focusing on online educational websites (Kerkhoven et al., 2016), the other on textbooks (Fruehwirth et al., 2024). Both reveal pronounced disparities. In a visual content analysis of 60 open-access science education resources (from the websites of Scientix and OERcommons; e.g., demonstrations, games, experiments) for the primary school level, Kerkhoven et al. (2016) identified significant male dominance in STEM roles (75%), alongside female dominance in teaching roles classified as non-STEM occupations. In a computer-aided quantitative text analysis of 202 current German language arts textbooks, Fruehwirth et al. (2024) employed a specific HEED and STEM categorization and reported male dominance not only in STEM occupations, where female representation was minimal, but also within the HEED domain, suggesting an overall portrayal of employment as a masculine sphere.

Studies comparing textbooks from different school subjects, while historically limited, have emerged more frequently in recent years, revealing nuanced differences in gender portrayals (Bittner, 2011; Jochim, 2014; Markom & Weinhäupl, 2007). This is especially the case for comparison between language and mathematics textbooks (Jehle et al., 2024; Ott, 2017b; van de Rozenberg et al., 2023). In their content analysis of 185 German textbooks, Lindner and Lukesch (1994) found that the proportional share of female characters in occupational roles was substantially higher in primary school German language arts textbooks (40.5%) than in mathematics textbooks (18.9%). However, this proportion declined sharply in textbooks for higher grade levels and more advanced school tracks. In a more recent German study, Moser and Hannover (2014) also found subject differences, with male characters being overrepresented in occupational roles across both subjects, but with men being described 1.8 times more frequently in occupational roles than women

in German language art textbooks and 2.1 times more frequently in mathematics textbooks. Furthermore, in both subject areas, men were portrayed with greater occupational diversity than women. Jehle et al. (2024) also found subject differences, with females only comprising 14% of occupational roles in mathematics textbooks compared to 25% in language arts textbooks.

Although textbook research has documented an increase in women's overall visibility since the 1960s, substantial gender disparities persist, particularly regarding occupational representation. Men remain significantly more likely to appear in a broader range of occupational contexts, particularly in STEM-related occupational roles. At the same time, women are typically depicted in traditionally feminine occupations. These differences seem even bigger in mathematics textbooks than in language arts textbooks.

However, significant thematic and methodological gaps remain in the literature. First, although earlier work has distinguished occupational roles by areas of activity (Hopfgartner, 1982; Silbermann & Krüger, 1971), existing analyses often lack a systematic focus on contemporary relevant domains like HEED and STEM (except Fruehwirth et al., 2024; Kerkhoven et al., 2016). Second, large-scale quantitative text analysis approaches have rarely been applied to examine gendered occupational portrayals, and if so, they were not applied across extensive time periods (Ott, 2017b). Third, comparative studies examining how these portrayals differ across specific school subjects that are gender connotated, notably language arts versus mathematics, are scarce (Lindner & Lukesch, 1994; Moser & Hannover, 2014; Ott, 2017b). The present study addresses these gaps through a large-scale, longitudinal, and comparative analysis of gender representation in the HEED and STEM domains employing quantitative corpus linguistic methods.

Current Study

To address the limitations identified in prior research, the present study investigates gender representations in a substantial corpus of 820 German language arts and mathematics textbooks spanning from 1960 to 2017, specifically analyzing diachronic trends within the HEED and STEM domains and assessing subject-specific variations. Our primary goals were to quantitatively assess how the proportional representation of women relative to men in HEED and STEM domains has evolved over time and whether these temporal patterns differ significantly between German language arts and mathematics textbooks, potentially reflecting subject-specific gender stereotypes. We also examined parallel trends in the normalized frequencies (mentions per 1000 words) of female and male terms to understand changes in absolute rates of mention.

Based on findings on occupational gender segregation (Froehlich et al., 2020; Hsu et al., 2021; Weisgram et al., 2011), we developed six hypotheses to examine how these societal patterns manifest in textbooks. Our first hypothesis tests whether textbooks reflect occupational gender-domain associations:

> *Hypothesis 1*. The frequency of female mentions in STEM occupations in textbooks is significantly lower than the frequency of female mentions in HEED occupations.

Based on documented societal shifts toward increased female labor force participation (Blau et al., 2014), changing gender roles (Eagly et al., 2020), and textbook research, indicating slow increases in female representation (Moser, 2016; Ott, 2021), our second set of hypotheses addresses temporal trends. We first posited a general, linear increase in female representation over the entire period:

> *Hypothesis 2a*: The frequency of female mentions in occupational roles (independent of the occupational domain) has significantly increased over the period 1960–2017.

In addition to this general trend, we sought to more precisely test the impact of the 1986 governmental resolution on gender equity in textbooks (KMK, 1986). Therefore, we also hypothesized a clear discontinuity in representation corresponding to this date:

> *Hypothesis 2b*: There is a jump in the female mentions in occupational roles across subjects and domains in textbooks published after the governmental resolution on gender equity in 1986.

However, given the persistent gender gaps in STEM occupational domains compared to the gradual progress in other domains (England et al., 2020; Fayer et al., 2017; World Economic Forum, 2023), we anticipated that temporal trends would differ significantly between HEED and STEM. Therefore, in our third hypothesis, we tested the interaction between domain and time:

> *Hypothesis 3*. The frequency of female mentions in STEM occupational roles has increased less than the frequency of female mentions in HEED occupational roles between 1960 and 2017.

Based on findings that school subjects show gender connotations (i.e., mathematics being a stereotypical masculine subject and language arts being a typical feminine subject)

(Chaffee & Plante, 2021; Plante et al., 2009) and that the temporal differences in gender occupational representation are more persistent in mathematics textbooks than in language arts textbooks (Moser & Hannover, 2014), we hypothesized subject-specific differences:

> *Hypothesis 4*. The frequency of female mentions in occupational roles (independent of occupational domain) in mathematics textbooks has increased less than in German language arts textbooks between 1960 and 2017.

Finally, based on the differences concerning occupational gender representations in subject areas and occupational domains over time, we also hypothesized a three-way interaction:

> *Hypothesis 5*: The increase in the frequency of female mentions over time is most pronounced in German language arts textbooks for HEED occupations and least pronounced in mathematics textbooks for STEM occupations.

Method

Sample

We created the textbook corpus as part of the project *Gender & Care in the Media* within the Bavarian research association *ForGenderCare* and funded by Bavarian State Ministry of Science and the Arts.

The original corpus included over 2,000 German language arts, mathematics, English, and science textbooks. For the present study, we analyzed a sub-corpus of 820 textbooks from primary schools (*Grundschule*), secondary schools (intermediate track) (*Mittelschule* and *Realschule*), and secondary schools (academic track) (*Gymnasium*) in the subjects of German language arts (n = 523) and mathematics (n = 297). This specific selection was made to directly compare a subject stereotyped as feminine (language arts) with one stereotyped as masculine (mathematics), a core objective of our research design. Table 1 provides a detailed overview of the textbook corpus, including information on school type, time of publication, number of textbooks, and word counts.

Textbook Selection

We included all textbooks that were approved as learning resources by the Bavarian State Ministry of Education and Cultural Affairs for use in Bavarian schools between 1960 and 2017. Textbooks published after 1986 were subject to the resolution on gender-equitable representation in textbooks. The distribution of textbooks published in different periods varies due to production processes and curriculum connections. There is a gap in the textbook corpus between 1997 and 2000 due to the introduction of the new Bavarian curriculum,

Table 1 Textbook Corpus: German Language Arts and Mathematics by School Type and Time (1960–2017)

School type	1960–1975	1976–1985	1986–1995	1996–2005	2006–2017
German Language Arts					
Primary school	52	28	17	9	56
Secondary school (intermediate track)	80	7	30	46	49
Secondary school (academic track)	51	21	7	13	40
no specification	10	7	0	0	0
Total (Books)					
	193	63	54	68	145
Total (Word count)					
	12,137,611	2,632,590	2,763,139	3,880,878	8,413,958
Mathematics					
Primary school	9	14	3	0	60
Secondary school (intermediate track)	16	18	9	22	49
Secondary school (academic track)	22	16	16	9	28
no specification	6	0	0	0	0
Total (Books)					
	53	48	28	31	137
Total (Word count)					
	1,673,849	1,378,688	997,272	1,241,815	3,819,234

Note. Textbooks without specified school types, or with types lacking modern equivalents, are labeled "no specification". To maintain consistency despite changes in the German school system, textbooks were reclassified by school type: those from intermediate-level schools (*Mittelschule*, *Realschule*) were combined into "secondary schools (intermediate track)"; those from primary and lower secondary schools (*Volksschule*, *Hauptschule*) were categorized as either "primary school" or "secondary school (intermediate track)" based on grade levels; and those from college-preparatory schools (*höhere Lehranstalt*) became "secondary school (academic track)". Word counts represent the sum of words across all textbooks in each category

as textbook publishers typically delay the release of new editions until new curricula are finalized and implemented.

Corpus Composition

The corpus spans the period from 1960 to 2017 and for descriptive analysis it was divided into five intervals: 1960–1975, 1976–1985, 1986–1995, 1996–2005, and 2006–2017. All textbooks in the corpus were digitized using the OCR software ABBYY Fine Reader 16 and converted into text files using UTF-8 encoding. A script was used to convert gender-fair abbreviations of occupational terms used in the German language (e.g., *Lehrer/-in* [female and male teacher]) into feminine-masculine word pairs (e.g., *Lehrerin und Lehrer* [female teacher and male teacher]).

Procedure

Data Collection

To collect the data, we used the word lists of terms for HEED and STEM occupations developed by Fruehwirth et al. (2024). The word lists are based on the official occupational classification of the German Federal Employment Agency (Bundesagentur für Arbeit, 2011) and capture the full range of HEED and STEM occupation domains. The word list for HEED occupation terms contained 523 male terms (e.g., *Lehrer* [male teacher], *Arzt* [male doctor]) and 535 female terms (e.g., *Lehrerin* [female teacher], *Ärztin* [female doctor]). The word list for STEM occupations contained 286 male terms (e.g., *Physiker* [male physicist], *Chemiker* [male chemist]) and 286 female terms (e.g., *Physikerin* [female physicist], *Chemikerin* [female chemist]).

Our analysis was based on a token-based approach, counting each occurrence of a term from these lists. We analyzed only the running text of the textbooks; text within illustrations was not included. The analysis focused on these grammatically gendered nouns and did not capture occupational activity described in sentence-like expressions (e.g., "she works in a drugstore"). Following this logic, potentially generic masculine forms were counted as male, and gender-neutral terms (e.g., Feuerwehrdienstleistende [fire fighters]) were not included in our analysis.

Our reliance on these binary word lists necessitates a binary operationalization of gender. This approach is necessitated by the specific word lists employed for data collection, which are derived from official binary occupational categories. Furthermore, it aligns with the theoretical conceptualization of gender as a structural category in occupational segregation research (Aulenbacher, 2008; Jarman et al., 2012; Wong & Charles, 2020). A more detailed discussion of this binary focus and its limitations with respect to contemporary understandings of gender (Schmader & Nater, 2025) is provided in the discussion.

We used the word-counting functionality of the text analysis program *LIWC-22* (Boyd et al., 2022) to calculate the frequency of matching terms in the corpus. Each token was lemmatized to its nominative singular form before counting. The results were exported to an Excel file and subsequently integrated into SPSS and R (R Core Team, 2024) for further statistical analysis.

Data Analysis

Descriptive Analysis We conducted descriptive analyses using SPSS version 29. This included calculating the absolute frequencies (*n*), means (*M*), and standard deviations (*SD*) of the male and female HEED and STEM occupations per textbook. To account for differences in textbook length, we normalized frequencies per 1000 words and calculated the proportional share of the female mentions relative to total mentions. To complement these aggregated metrics, we also identified the most frequent specific occupational titles. These descriptive statistics were calculated for the combined sample of German language arts and mathematics textbooks, which we refer to as the 'combined' sample, as well as the sample of German language arts and mathematics textbooks separately. For temporal comparison, we divided the data into the five intervals: 1960–1975, 1976–1985, 1986–1995, 1996–2005, and 2006–2017. The rationale behind these splits is based on both methodological and theoretical considerations. First, this division allowed for a more balanced distribution of textbooks across periods, which helped prevent data skew and proved beneficial for subsequent model fitting. Second, in 1986, the German Standing Conference of the Ministers of Education and Cultural Affairs passed a resolution stating that genders should be represented equally in German school textbooks (KMK, 1986). Accordingly, we sought to distinguish between textbooks published before and after the resolution to assess its potential impact.

Inferential Analysis To test the study's hypotheses and explore changes over time and differences related to occupational domain (HEED vs. STEM) and textbook subject (German language arts vs. mathematics), we employed an interrupted time series analysis using generalized linear mixed effects models (GLMMs) in R (version 4.4.2; R Core Team, 2024). Interrupted time-series analyses have proven highly useful for contrasting temporal changes before and after a specific point in time, e.g., a medical intervention, as such models technically allow for changes in intercepts and/or slopes after that point (Hategeka et al., 2020). The passage of a normative resolution marks a crucial point in time after which we would expect changes in both the intercept and the slope. GLMMs have been increasingly used in corpus-linguistic research (Tagliamonte & Baayen, 2012), which is concerned with observational and

often non-independent, i.e., grouped, data points (Gries, 2015). We conducted analyses on the subset of $N = 759$ textbooks containing relevant occupational mentions.

To test our hypotheses, we fitted a GLMM using the GLMER function from R's LME4 package (version 1.1–35.1.1.1; Bates et al., 2015). The binary outcome variable was GENDER (female vs. male [reference]). As fixed effects, we submitted SUBJECT (German language arts [reference] vs. mathematics), DOMAIN (HEED [reference] vs. STEM), and TIME (numeric, ranging from 1960 to 2017). To test whether there was a jump in female mentions after the 1986 resolution, we created a binary variable, post (no [reference] vs. yes), with years before 1986 coded as *no* and years after 1986 coded as *yes*. We accounted for hierarchical data structures arising from multiple tokens per textbook by adding random intercepts for each textbook, resulting in the following formula for the maximal model: GENDER ~ SUBJECT * DOMAIN * TIME * POST + (1|TEXTBOOK ID). We followed Zuur et al.'s (2009) recommendations for model building by starting with a maximal model that contained all main effects and potential interactions and subsequently removing non-significant terms. We assessed model fit using the Akaike information criterion (AIC) and the Bayesian information criterion (BIC) obtained via the PERFORMANCE package (Lüdecke et al., 2021).

To assess the overall significance of the fixed effects, we used type III ANOVAs from the CAR package (version 3.1-2.1; Fox & Weisberg, 2018). Results were considered statistically significant at $\alpha = .05$. We assessed model assumptions for the binomial GLMM by examining simulated scaled residuals using the DHARMA package (Hartig, 2024). No significant deviations were observed (KS test [$p = .812$], dispersion test [$p = .520$], outlier test [$p = .663$]). Post-hoc testing of pairwise contrasts between individual predictor levels was conducted using the EMMEANS package (Lenth, 2025). We adjusted the *p*-values using the Tukey method. Effects plots were created using the packages GGPLOT2 (Wickham, 2016), GGEFFECTS (Lüdecke, 2018), and COWPLOT (Wilke, 2015).

Results

This section presents the descriptive and inferential results of our analyses examining the gender representation of occupational terms within the HEED and STEM domains in German language arts and mathematics textbooks published between 1960 and 2017. Descriptive statistics for female and male occupational mentions across time are presented in Table 2 (combined sample) and Table 3 (by subject). A brief descriptive overview is provided first, followed by the main inferential results, which are structured around the five study hypotheses.

Table 2 Descriptive Statistics of Female and Male HEED and STEM Occupations Across Time (1960–2017) in the Combined Sample of German Language Arts and Mathematics Textbooks

Time	*N*	HEED							STEM						
		Female				Male			Female				Male		
		n	*M*	*SD*	1000W	*n*	*M*	*SD*	1000W	*n*	*M*	*SD*	1000W	*n*	*M*	*SD*	1000W
1960–1975	246	858	3.49	5.12	0.062	6162	25.05	28.70	0.446	5	0.02	0.14	0.000	887	3.61	6.31	0.064
1976–1985	111	254	2.29	4.49	0.063	1506	13.57	17.66	0.375	5	0.05	0.31	0.001	427	3.85	7.62	0.106
1986–1995	82	367	4.48	5.89	0.098	1932	23.56	23.78	0.514	8	0.1	0.60	0.002	280	3.41	6.87	0.074
1996–2005	99	730	7.37	8.70	0.143	2632	26.59	25.16	0.514	11	0.11	0.38	0.002	287	2.9	5.93	0.056
2006–2017	282	1572	5.57	9.56	0.129	5250	18.62	25.45	0.429	81	0.29	1.54	0.007	859	3.05	5.59	0.070
1960–2017	820	3781	4.61	7.53	0.097	17482	21.32	25.71	0.449	110	0.13	0.95	0.003	2740	3.34	6.28	0.070

Note. *N* = Number of textbooks. *n* = total raw count of mentions; *M* = mean number of mentions per textbook; *SD* = standard deviation of mentions per textbook. HEED = health care, early education, and domestic work. STEM = science, technology, engineering, and mathematics. 1000W = Number of mentioned occupations per 1000 words of text

Table 3 Descriptive Statistics of Female and Male HEED and STEM Occupations by Subject and Time (1960–2017)

Time	*N*	HEED						STEM					
		Female				Male							
		n	*M*	*SD*	1000W	*n*	*M*	*SD*	1000W	*n*	*M*	*SD*	1000W
German Language Arts													
1960–1975	193	846	4.38	5.44	0.070	6015	31.17	29.58	0.496	4	0.02	0.14	0.000	771	3.99	6.73	0.064
1976–1985	63	239	3.79	5.48	0.091	1416	22.48	19.09	0.538	3	0.05	0.38	0.001	148	2.35	3.98	0.056
1986–1995	54	360	6.67	6.20	0.130	1780	32.96	22.86	0.644	8	0.15	0.74	0.003	115	2.13	5.07	0.042
1996–2005	68	697	10.25	9.14	0.180	2477	36.43	23.44	0.638	9	0.13	0.42	0.002	155	2.28	3.90	0.040
2006–2017	145	1465	10.10	11.60	0.174	4835	33.34	28.36	0.575	79	0.54	2.12	0.009	496	3.42	6.63	0.059
1960–2017	523	3607	6.90	8.60	0.121	16523	31.59	26.92	0.554	103	0.20	1.18	0.003	1685	3.22	5.99	0.057
Mathematics																	
1960–1975	53	12	0.23	0.72	0.007	147	2.77	2.46	0.088	1	0.02	0.14	0.001	116	2.19	4.16	0.069
1976–1985	48	15	0.31	0.78	0.011	90	1.88	1.94	0.065	2	0.04	0.20	0.001	279	5.81	10.39	0.202
1986–1995	28	7	0.25	0.65	0.007	152	5.43	12.39	0.152	0	0.00	0.00	0.000	165	5.89	9.03	0.165
1996–2005	31	33	1.06	0.93	0.027	155	5.00	11.77	0.125	2	0.06	0.25	0.002	132	4.26	8.84	0.106
2006–2017	137	107	0.78	1.08	0.028	415	3.03	3.29	0.109	2	0.01	0.12	0.001	363	2.65	4.21	0.095
1960–2017	297	174	0.59	0.97	0.019	959	3.23	5.98	0.105	7	0.02	0.15	0.001	1055	3.55	6.77	0.116

Note. *N* = Number of textbooks. *n* = total raw count of mentions; *M* = mean number of mentions per textbook; *SD* = standard deviation of mentions per textbook. HEED = health care, early education, and domestic work. STEM = science, technology, engineering, and mathematics. 1000W = Number of mentioned occupations per 1000 words of text

Descriptive Overview

Overall trends in the total frequency of occupational mentions, irrespective of gender, are presented in the Appendix in Tables 4, 5, 6.This data provides context for our main analysis and shows that the normalized frequency of total HEED mentions fluctuated but ended slightly higher at the end of the study period (from 0.508 to 0.558 per 1000 words), while total STEM mentions remained considerably lower and relatively stable (from 0.065 to 0.077 per 1000 words) (Table 4).

Furthermore, German language arts textbooks (Table 5) contained a higher overall frequency of occupational mentions, particularly within HEED, compared to mathematics textbooks (Table 6), which, despite lower overall frequencies, showed a proportionally higher emphasis on STEM mentions in some periods.

Regarding specific occupational titles, within HEED domain, the teaching profession played a central role for both genders; the term *Lehrerin* [female teacher] became increasingly prominent over time (total n = 2,201), while *Lehrer* [male teacher] was one of the most frequent male terms (total n = 11,081). In the STEM domain, male

Table 4 Total Occupational Mentions (HEED and STEM) Across Time (1960–2017): Combined Sample

Time	Number of textbooks	*n*	*M*	*SD*	1000W
Combined (HEED + STEM)					
1960–1975	246	7912	32.16	36.06	0.573
1976–1985	111	2192	19.75	22.57	0.546
1986–1995	82	2587	31.55	30.58	0.688
1996–2005	99	3660	36.97	34.79	0.714
2006–2017	282	7762	27.52	37.54	0.635
1960–2017	820	24113	29.41	34.67	0.619
HEED					
1960–1975	246	7020	28.54	32.35	0.508
1976–1985	111	1760	15.86	21.19	0.439
1986–1995	82	2299	28.04	28.55	0.611
1996–2005	99	3362	33.96	32.48	0.656
2006–2017	282	6822	24.19	33.78	0.558
1960–2017	820	21263	25.93	31.57	0.546
STEM					
1960–1975	246	892	3.63	6.34	0.065
1976–1985	111	432	3.89	7.64	0.108
1986–1995	82	288	3.51	6.94	0.077
1996–2005	99	298	3.01	6.02	0.058
2006–2017	282	940	3.33	6.36	0.077
1960–2017	820	2850	3.48	6.55	0.073

Note. Shows total occupational mentions regardless of gender for combined sample (German language arts and mathematics textbooks). n = total raw count of mentions; M = mean number of mentions per textbook; SD = standard deviation of mentions per textbook. HEED = health care, early education, and domestic work. STEM = science, technology, engineering, and mathematics. 1000W = Number of mentioned occupations per 1000 words of text

Table 5 Total Occupational Mentions (HEED and STEM) Across Time (1960–2017): German Language Arts Textbooks

Time	Number of textbooks	*n*	*M*	*SD*	1000W
Combined (HEED + STEM)					
1960–1975	193	7636	39.56	37.35	0.629
1976–1985	63	1806	28.67	25.05	0.686
1986–1995	54	2263	41.91	30.21	0.819
1996–2005	68	3338	49.09	33.76	0.860
2006–2017	145	6875	47.41	43.43	0.817
1960–2017	523	21918	41.91	37.22	0.735
HEED					
1960–1975	193	6861	35.55	33.23	0.565
1976–1985	63	1655	26.27	23.17	0.629
1986–1995	54	2140	39.63	27.64	0.774
1996–2005	68	3174	46.68	30.91	0.818
2006–2017	145	6300	43.45	37.99	0.749
1960–2017	523	20130	38.49	33.24	0.675
STEM					
1960–1975	193	775	4.02	6.78	0.064
1976–1985	63	151	2.40	4.03	0.057
1986–1995	54	123	2.28	5.25	0.045
1996–2005	68	164	2.41	4.02	0.042
2006–2017	145	575	3.97	7.82	0.068
1960–2017	523	1788	3.42	6.42	0.060

Note. Shows total occupational mentions regardless of gender for German language arts textbooks only. *n* = total raw count of mentions; *M* = mean number of mentions per textbook; *SD* = standard deviation of mentions per textbook. HEED = health care, early education, and domestic work. STEM = science, technology, engineering, and mathematics. 1000W = Number of mentioned occupations per 1000 words of text

Table 6 Total Occupational Mentions (HEED and STEM) Across Time (1960–2017): Mathematics Textbooks

Time	Number of textbooks	*n*	*M*	*SD*	1000W
Combined (HEED + STEM)					
1960–1975	53	276	5.21	5.60	0.165
1976–1985	48	386	8.04	10.84	0.280
1986–1995	28	324	11.57	19.66	0.325
1996–2005	31	322	10.39	18.58	0.259
2006–2017	137	887	6.47	6.79	0.232
1960–2017	297	2195	7.39	10.93	0.241
HEED					
1960–1975	53	159	3.00	2.78	0.095
1976–1985	48	105	2.19	2.44	0.076
1986–1995	28	159	5.68	12.58	0.159
1996–2005	31	188	6.06	11.90	0.151
2006–2017	137	522	3.81	3.90	0.137
1960–2017	297	1133	3.81	6.28	0.124
STEM					
1960–1975	53	117	2.21	4.18	0.070
1976–1985	48	281	5.85	10.40	0.204
1986–1995	28	165	5.89	9.03	0.165
1996–2005	31	134	4.32	8.92	0.108
2006–2017	137	365	2.66	4.24	0.096
1960–2017	297	1062	3.58	6.79	0.117

Note. Shows total occupational mentions regardless of gender for mathematics textbooks only. *n* = total raw count of mentions; *M* = mean number of mentions per textbook; *SD* = standard deviation of mentions per textbook. HEED = health care, early education, and domestic work. STEM = science, technology, engineering, and mathematics. 1000W = Number of mentioned occupations per 1000 words of text

representation was typified by subject-specific roles such as *Ingenieur* [male engineer; total *n* = 711] and *Physiker* [male physicist; total *n* = 479] in German language arts textbooks, and *Mathematiker* [male mathematician; total *n* = 719] in mathematics textbooks. In contrast, female STEM titles were marginal; for instance, *Ingenieurin* [female engineer] appeared only 22 times in total across six decades.

Inferential Analysis of Gender Occupational Representation

To formally test our hypotheses, we fitted a binomial generalized linear mixed-effects model. The random effect standard deviation for TEXTBOOK ID was 0.55, indicating substantial variation between individual textbooks. All model assumptions were met. Detailed model coefficients are presented in Table 7 and full descriptive statistics, including raw counts (*n*), means (*M*), standard deviations (*SD*), and normalized frequencies (1000W), were previously shown in Tables 2 and 3. In the following sections, each hypothesis is presented as a subheading. For each, we first report the result of the omnibus test (i.e., the χ^2 value), followed by supporting evidence from the descriptive proportional shares (Table 8) and specific post-hoc pairwise comparisons (Odds Ratios).

Table 7 Binomial GLMM Estimates (Log-Odds) for Gender of Occupational Terms

Predictor	*B*	*SE*	*z*	*p*
(Intercept)	–1.82	0.08	–21.50	<.001***
Time	0.02	0.01	3.91	<.001***
Post	0.16	0.16	1.03	304
Domain				
STEM (ref = HEED)	–2.79	0.40	–6.92	<.001***
Subject				
Mathematic	0.38	0.30	1.28	202
Time × Domain STEM	0.04	0.02	2.48	<.013*
Time × Subject Mathematics	0.06	0.01	4.14	<.001***
Post × Domain STEM	1.11	0.63	1.76	079
Post × Subject Mathematics	–1.98	0.58	–3.42	<.001***
Time × Subject Mathematics × Domain STEM	–0.10	0.02	–5.24	<.001***

Note. β = log-odds; *SE* = standard error. The outcome variable is Gender, with "male" as the reference category; positive β values indicate higher odds of a term being "female." Random effect *SD* (ID) = 0.55. AIC = 19917.9; BIC = 20007

* *p* < .05. ** *p* < .01. *** *p* < .001

Table 8 Descriptive Proportion (%) of Female Occupational Mentions by Domain Subject, and Time (1960–2017)

Time	Overall HEED (%)	Overall STEM (%)	German language arts HEED (%)	German language arts STEM (%)	Math HEED (%)	Math STEM (%)
1960–1975	12.2	0.0	12.4	0.0	7.4	1.4
1976–1985	14.4	0.9	14.5	1.8	14.4	0.5
1986–1995	16.0	2.6	16.8	6.7	4.4	0.0
1996–2005	21.8	3.5	22.0	4.8	17.8	1.9
2006–2017	23.1	9.1	23.2	13.3	20.5	1.0
1960–2017	17.8	3.9	17.9	5.8	16.4	0.7

Note. Values represent the percentage of female occupational mentions relative to total mentions (female + male) within each category, calculated from normalized frequencies per 1000 words. HEED = health care, early education, and domestic work. STEM = science, technology, engineering, and mathematics

Hypothesis 1: Frequency of Female Mentions in STEM Occupations in Textbooks is Significantly Lower Than the Frequency of Female Mentions in HEED Occupations

Confirming our first hypothesis, female mentions were significantly less frequent in STEM occupations than in HEED occupations, $\chi^2(1) = 47.92$, $p < .001$. The descriptive data, summarized in Table 8 (proportional shares) and visualized in Figure 1 (proportional shares) and Figure 2 (normalized frequencies), illustrate this disparity. Overall, the proportional share of female mentions in HEED was 17.8%, compared to just 3.9% in STEM. The odds of an occupational mention being female were approximately nine times higher in the HEED domain than in the STEM domain (OR = 9.78, $p < .001$).

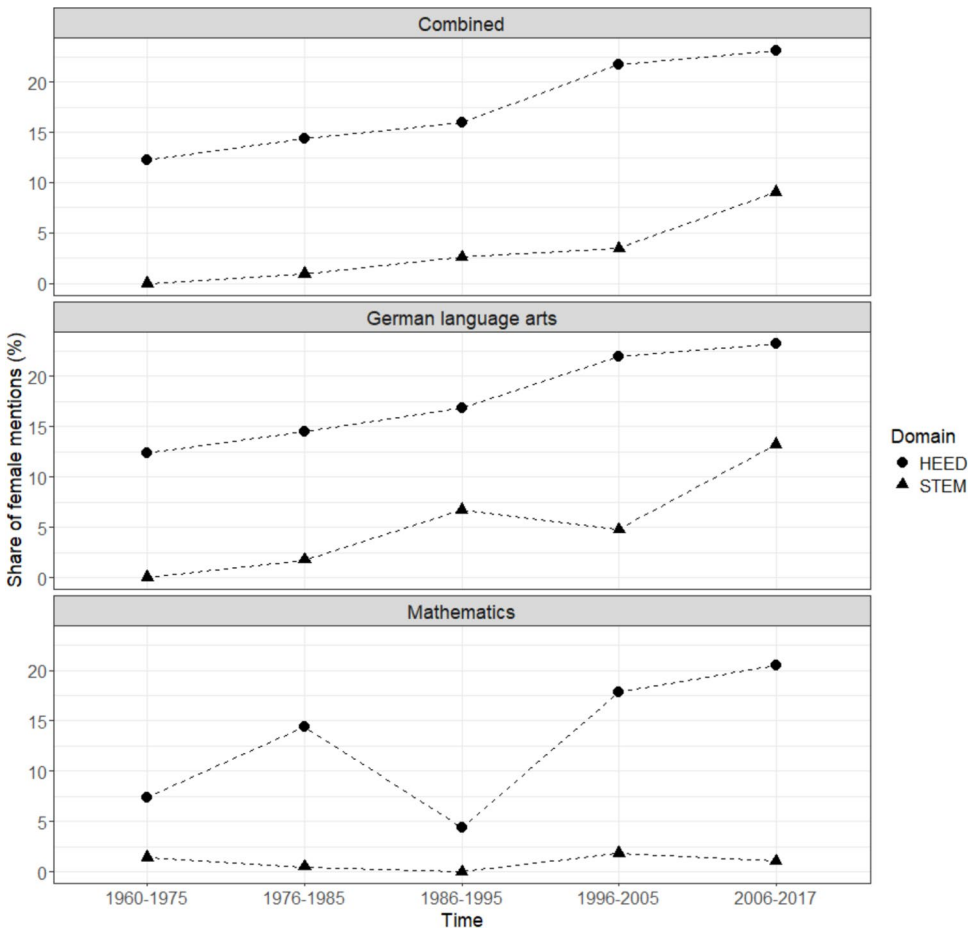

Figure 1 Share of Female Mentions (%) in HEED and STEM Occupations by Subject and Time (1960–2017). *Note*. Points represent the descriptive proportional share of female mentions relative to total mentions within each time period, subject, and domain. The 'combined' panel displays data aggregated across both German language arts and mathematics textbooks. HEED = health care, early education, and domestic work. STEM = science, technology, engineering, and mathematics

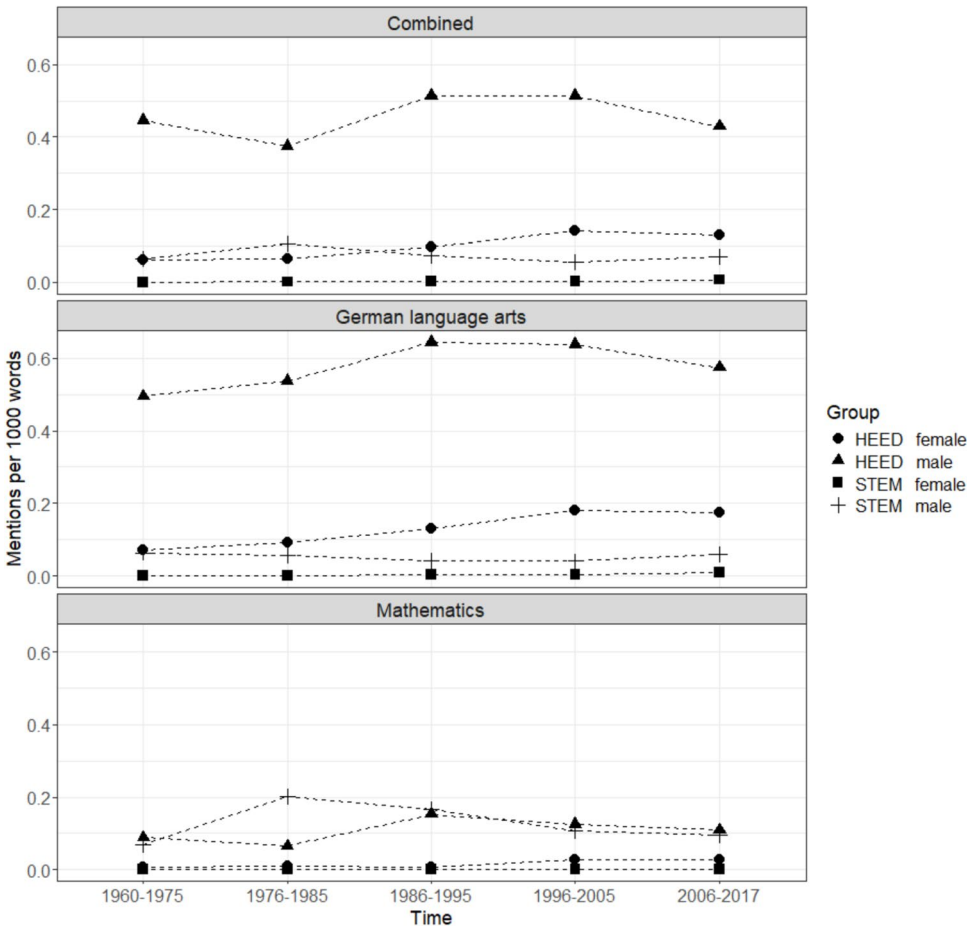

Figure 2 Rate of Male and Female Mentions in HEED and STEM Occupations by Subject and Time (1960–2017). *Note*. Rates shown as mentions per 1000 words. The 'combined' panel displays data aggregated across both German language arts and mathematics textbooks. HEED = health care, early education, and domestic work. STEM = science, technology, engineering, and mathematics

Hypothesis 2a: The Frequency of Female Mentions in Occupational Roles (Independent of the Occupational Domain) has Significantly Increased over the Period 1960–2017

In line with our second hypothesis, the frequency of female mentions increased significantly over the study period, $\chi^2(1) = 15.32$, $p < .001$. The descriptive data show that the combined proportional share of female mentions across all domains and subjects rose from 11.4% in 1960–1975 to 21.3% in 2006–2017 (Table 8). The time trend was significant, with the odds of a female mention increasing by 4% per year (est = 0.04, $p < .001$). Visual inspection of the descriptive data (Figures 1 and 2) suggests the increase may have been more pronounced from the mid-1990s onward.

Hypothesis 2b: There is a Jump in the Female Mentions in Occupational Roles across Subjects and Domains in Textbooks Published after the Governmental Resolution on Gender Equity in 1986

Overall, we do not find a significant main effect of the factor POST, $\chi^2(1) = 1.05$, $p = .304$, but the factor interacted significantly with SUBJECT, $\chi^2(1) = 11.71$, $p < .001$. In German language arts books, the odds for female mentions doubled after 1986 (OR = 2.04, $p < .038$), whereas in mathematics textbooks, female mentions decreased substantially, being 3.5 times higher before 1986 than after (OR = 0.28, $p < .031$). These differences are illustrated in Figure 3, which shows a positive jump for German language arts textbooks across domains in 1986, and a noticeable drop in mathematics textbooks, especially in the HEED domain.

Hypothesis 3: The Frequency of Female Mentions in STEM Occupational Roles has Increased Less Than the Frequency of Female Mentions in HEED Occupational Roles Between 1960 and 2017

The model revealed a significant TIME × DOMAIN interaction, $\chi^2(1) = 6.12$, $p < .013$, indicating that temporal trends differed between HEED and STEM domains. The descriptive data (Table 8) show that the proportional share of female mentions increased from 12.2% to 23.1% in HEED and from 0.0% to 9.1% in STEM. However, post-hoc comparisons

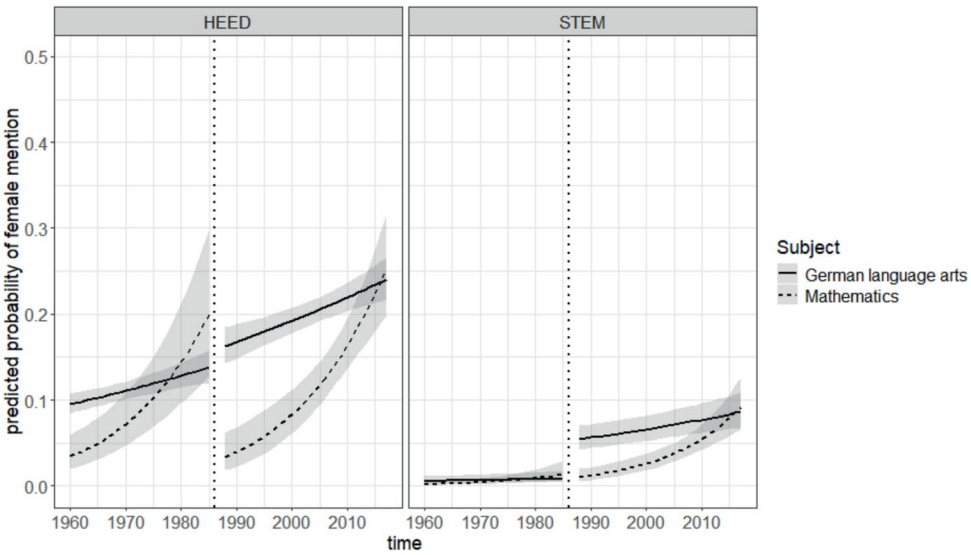

Figure 3 Predicted Probability of Female Occupational Terms by Domain and Subject Across Time (1960–2017). Note. Lines show predicted probabilities from an interrupted time-series analysis based on a binomial GLMM; error bands show 95% confidence intervals; the vertical dotted line represents 1986. HEED = health care, early education, and domestic work. STEM = science, technology, engineering, and mathematics

of the temporal slopes between HEED and STEM were non-significant when averaged across subjects (est = 0.01, p = .427). This apparent discrepancy arises because TIME and DOMAIN are involved in a three-way interaction with SUBJECT, meaning that the domain-specific trends differ between German language arts and mathematics textbooks (see Hypothesis 5).

Hypothesis 4: The Frequency of Female Mentions in Occupational Roles in Mathematics Textbooks Increased Less Than in German Language Arts Textbooks Between 1960 and 2017

As hypothesized, the increase in female representation in occupational roles was significantly less pronounced in mathematics than in German language arts textbooks, which is supported by a significant TIME × SUBJECT interaction, $\chi^2(1) = 17.10$, $p < .001$, and by a significant POST × SUBJECT interaction, $\chi^2(1) = 11.71$, $p < .001$. The model's predictions (Figure 3) show that this subject-specific divergence intensified over time, particularly driven by differing trends within the STEM domain. The descriptive data show that the proportional share of female STEM mentions in German language arts textbooks rose from 0.0% to 13.3%, while in mathematics textbooks it remained at a consistently low level (1.4% to 1.0%) throughout the study period (Table 8). Post-hoc tests confirmed that no significant differences existed between the two subjects before 1986 (OR = 0.67, p = .225), but a substantial gap emerged after the passage of the 1986 resolution, with the odds of an occupational mention being female were almost 5 times higher in German language arts than in mathematics textbooks ($OR = 4.81$, $p < .001$).

Hypotheses 5: The Increase in the Frequency of Female Mentions Over Time is Most Pronounced in German Language Arts Textbooks for HEED Occupations and Least Pronounced in Mathematics Textbooks for STEM Occupations

Our analysis revealed a significant three-way interaction of TIME × SUBJECT × DOMAIN, $\chi^2(1) = 27.42$, $p < .001$, which uncovered a complex pattern. For German language arts textbooks, female mentions were 14 times more likely in the HEED domain than in the STEM domain before 1986 (OR = 14.12, $p < .001$), and 4.6 times more likely after 1986 (OR = 4.65, $p < .001$). For mathematics textbooks, female mentions were nearly 21 times more likely in the HEED domain than in the STEM domain before 1986 (OR = 20.58, $p < .001$), and almost 7 times more likely after 1986 (OR = 6.78, $p < .001$). This pattern indicates that the HEED-STEM gap narrowed over time in both subjects, suggesting a steeper increase in female STEM representation than in HEED. This runs counter to our initial hypothesis, although the absolute levels of female STEM representation remained very low throughout the study period.

Discussion

This study provided the first comprehensive longitudinal analysis of gender representation in HEED and STEM occupations across 820 German language arts and mathematics textbooks spanning nearly six decades (1960–2017). Our findings reveal persistent gender occupational segregation: women remain underrepresented in occupational

roles, especially in STEM occupations, compared to HEED occupations throughout the study period. This was particularly evident in mathematics textbooks, where virtually no change occurred in the representation of females in STEM domains. Furthermore, the 1986 governmental resolution on gender equity had divergent effects across subjects: while female representation saw a sharp spike in German language arts textbooks, it underwent a sudden plunge in mathematics textbooks.

Underrepresentation of Women in Occupational Roles

Our analysis revealed that women are mentioned significantly less in STEM occupations than in HEED occupations across the whole study period (H1). This finding aligns with previous evidence from textbook research documenting severe underrepresentation of women in STEM occupations (Fruehwirth et al., 2024; Kerkhoven et al., 2016) and technical occupations (Cruz Neri et al., 2024; Finsterwald & Ziegler, 2007; Ott, 2017b). Furthermore, beyond this domain-specific disparity, our data also reveal that women are systematically underrepresented across all domains compared to men. Overall, female mentions comprised only 3.9% in STEM and even in HEED occupations, traditionally a feminine work sphere, women comprised only 17.8% of mentions overall, reaching just 23.1% by 2006–2017. It is especially concerning that female underrepresentation was found throughout our study period of nearly six decades. This indicates that even current textbooks primarily construct paid work as masculine, with women's labor participation rendered largely invisible.

The systematic underrepresentation of women may constrain children's and adolescents' ability to envision gender-diverse HEED and STEM careers. Research confirms that counter-stereotypical representations can positively influence girls' STEM engagement and performance (Good et al., 2010), while the absence of female role models leads to perceptions that STEM is a male occupational domain (Lindner & Makarova, 2024). Other research indicates similar effects for HEED occupations, where the absence of male role models constrains boys' engagement in health, education, and care fields (Puzio & Valshtein, 2022). Through daily classroom use, textbooks communicate implicit messages about occupational gender-appropriateness, potentially crystallizing beliefs about who belongs in HEED and STEM domains throughout students' educational careers (Curdt-Christiansen, 2017; Eagly & Wood, 2012; Watt & Eccles, 2008). In terms of future research, it would be useful to examine long-term effects of textbook exposure (Behnke, 2018) on HEED and STEM career aspirations.

Differential Temporal Development Across HEED and STEM Domains

Our findings confirm that female occupational representation increased significantly over the study period (H2a), yet this development proved highly uneven across the two occupational domains (H3). While the proportional share of female mentions increased in both domains, the nature of this change differed substantially. In HEED occupations, female representation showed a consistent, substantial increase in proportional share, increasing from 12.2% to 23.1%. In STEM, the increase was from a starting point of zero, making the relative fold-increase appear large, but the absolute endpoint of 9.1% remained low, falling short of the level HEED had already achieved in the 1960s. This indicates that while both domains saw change, the progress in STEM was not sufficient to meaningfully alter its status as a male-dominated field within the textbook landscape.

This finding contributes a critical longitudinal dimension to existing textbook research. Whereas past studies have often categorized occupations into broad "typically female/male" domains (Finsterwald & Ziegler, 2007; Lindner & Lukesch, 1994; Ott, 2017b), our study provides the first direct demonstration of the differential pace of change specifically within the contemporary occupational domains of HEED and STEM. The results suggest that these domains operate as self-reinforcing systems within educational media. Culturally feminized work (Puzio & Valshtein, 2022), such as the HEED domain, proved more permeable to increases in female representation over time. This may be because including more women in domains already conceptualized as "appropriate" for them—and often societally devalued—does not fundamentally challenge existing gender schemas or status hierarchies (Bern, 1981; Starr & Zurbriggen, 2017). In contrast, the slower absolute progress in STEM suggests its strong masculine associations created greater cultural resistance to change. This indicates that the patriarchal and hierarchical gender order, where masculinity is positioned as superior to femininity (e.g., Connell, 1987; Risman, 2004, as cited in Puzio & Valshtein, 2022), remains a powerful and persistent element within textbooks. This is a notable finding, as it suggests that the content of educational media stays static and may not fully reflect the dynamic and evolving nature of gender stereotypes that have been documented in broader society (Diekman & Eagly, 2000; Eagly et al., 2020).

Subject-Specific Differences: Mathematics Versus Language Arts

A particularly notable finding of this study was the significant divergence in gender representation between German

language arts and mathematics textbooks over time (H4). While both subjects began with similarly low levels of female representation in the 1960s, their developmental paths diverged significantly. Our discontinuity analysis pinpoints the 1986 governmental resolution on gender equity (KMK, 1986) as the critical juncture for this divergence (H2b). Rather than a uniform effect, the results revealed that the resolution's impact was subject-specific: in German language arts textbooks, female representation showed a positive jump immediately after 1986, whereas in mathematics textbooks, the probability of female mentions dropped immediately after 1986, though the general upward trend continued over time. Consequently, while no significant differences existed between the two subjects before 1986, a substantial gap emerged thereafter. By the final period (2006–2017), the odds of an occupational mention being female were almost five times higher in German language arts than in mathematics textbooks. This finding does not simply confirm that mathematics textbooks are more gender-stereotypical (Jehle et al., 2024; Moser & Hannover, 2014). Our longitudinal data demonstrate that subject-specific gender disparities in occupational representation have intensified over the last six decades: while German language arts textbooks showed substantial progress towards greater gender equity, mathematics textbooks showed only minimal change.

One interpretation is that textbooks act as key mechanisms within larger, self-reinforcing cycles of educational gender stereotyping (Kollmayer et al., 2017), School subjects themselves are culturally coded: mathematics is associated with masculine-rational attributes, while language arts is associated with feminine-expressive attributes (Colley & Comber, 2003). This gendered context likely influences the production and content of the textbooks themselves. Authors and publishers creating materials for a subject perceived as masculine may be more likely, whether consciously or unconsciously, to select content that aligns with these existing stereotypes. This pattern reflects the complex nature of textbook production, involving intricate interactions between policy mandates, curriculum development, publishing cycles, and authorial choices (Höhne, 2018; Matthes et al., 2024; Young & Muller, 2016). Textbooks then present this stereotyped view to teachers, parents, and students, whose own biases and expectations are in turn reinforced (van de Rozenberg et al., 2024; van der Vleuten et al., 2016; Wolter et al., 2015), thereby creating a self-perpetuating cycle in which the stereotypes within mathematics textbooks are both a product of, and a contributor to, the subject's gendered culture. Future research should investigate these subject-specific production mechanisms (Herrmann, 2016) to better understand how educational policy is interpreted and implemented differently across subject areas (Matthes & Schütze, 2016; Ott, 2017b).

Compounding Effect of Subject and Domain

The intersection of subject area and occupational domain reveals compounding effects on gender representation over time (H5). Female STEM representation in mathematics textbooks remained statistically static over nearly six decades (from 1.4% to 1.0%), a notable result considering many gender equality efforts (Guthridge et al., 2022). Over the same period, this occupational domain showed substantial progress in German language arts textbooks (from 0.0% to 13.3%). While we hypothesized that HEED would show the largest increases, the three-way interaction revealed that the gap between HEED and STEM narrowed over time in both subjects. This pattern reflects the much lower starting point for STEM, which allowed for larger relative gains, even though absolute levels of female STEM representation remained very low. This finding partially contradicts our initial hypothesis. These results provide the first direct demonstration of how subject and domain jointly influence gender representation over time. In our view, the most compelling explanation is that gender stereotypes in textbooks intertwine (McCall, 2005; Yuval-Davis, 2006) with multiple biased contexts (Collins, 1998; Salem, 2018). Within mathematics textbooks, female HEED representation remained lower than in German language arts textbooks, and the difference was even more pronounced in STEM, suggesting that the masculine framing of mathematics constrains female representation even in traditionally feminine occupational domains (Puzio & Valshtein, 2022). This intersectional lens, which examines how multiple forms of bias compound each other, opens new avenues for textbook analysis. This understanding of interconnected contexts and categories (Klinger & Knapp, 2008) is increasingly recognized as a vital, yet still infrequent, perspective in textbook research (Alter et al., 2021; Burden, 2023; Knudsen, 2005, 2006; Koster et al., 2023). There is a need for research to explore educational material with a perspective that goes beyond simple gender representation and includes different biased contexts and categories (Ferree & Hall, 1996).

Practice Implications

Our results have important theoretical and practical implications. From a theoretical perspective, our findings are compatible with social role theory (Eagly & Wood, 2012) by documenting gender-stereotypical textbook representations that may constitute inputs into processes of gender role socialization. Our longitudinal evidence reveals that textbooks may contribute to these divisions through systematic gender-specific representations. The underrepresentation of women in STEM occupations over six decades demonstrates how educational materials can uphold gender stereotypes

that persist despite temporal change (Charlesworth & Banaji, 2022). Most critically, the stagnation of female representation in mathematics textbooks identifies a specific educational context in which the transformation of gender roles appears to fail. While Eagly's framework predicts role change through women's increasing workforce participation (Eagly et al., 2020), progress may be significantly impeded within certain subject-specific contexts. One possible interpretation is that the compounding effect of a masculine-coded subject presenting a masculine-coded occupation creates a context that is highly resistant to reflecting societal change.

Second, our findings provide empirical support for critiques of knowledge production in educational contexts (Apple, 1987; Lässig, 2010; Ott, 2017a). Research on knowledge transmission in educational media (Höhne, 2005; Stein, 1977) emphasizes how textbooks are embedded within political and sociocultural contexts that determine legitimate knowledge. Our results establish that textbook knowledge maintains existing gender hierarchies over a long period of time. The persistent marginalization of women in STEM, particularly in mathematics textbooks, exemplifies what feminist scholars identify as the sociology of knowledge dimension: certain knowledge forms and producers receive systematic privilege over others (Code, 1991; Hill Collins, 2002; Smith, 1987). The uneven progress across subjects and the divergent response to the 1986 policy illustrate the structural resistance of gendered knowledge hierarchies that feminist scholarship identifies (Mills & Mustapha, 2015), particularly in masculine-coded domains like mathematics.

The stagnation of female representation in mathematics textbooks underscores the need for subject-specific interventions in textbook development. From a practical standpoint, publishers and educators must recognize that progress in one domain does not automatically transfer to others. Zala-Mezö et al. (2021), for example, propose implementing formative evaluations during the textbook production process. This approach would be excellent for improving not only the pedagogical content knowledge but also the sociocultural knowledge embedded within school textbooks.

Limitations and Future Research Directions

The present study provides the first large-scale, longitudinal evidence of how gender representation in HEED and STEM occupations has evolved in German language arts versus mathematics textbooks. Despite the overall support for our hypotheses, several limitations of our computational text analysis approach must be acknowledged. First, our computational approach was limited to the running text of textbooks and did not include pictorial elements. Visual representations of occupational roles constitute an important dimension of gender representation in educational materials (Cruz Neri et al., 2024; Finsterwald & Ziegler, 2007; Moser & Hannover, 2014) and may communicate gender stereotypes in ways different from textual content. Similarly, our word-list-based method captured only explicit occupational nouns and did not identify occupational activity described through sentence-like expressions (e.g., "she works in a drugstore"). Future research combining textual and visual analysis, as well as more sophisticated natural language processing techniques, could provide a more comprehensive picture of occupational gender representation.

Second, our method quantified each occupational mention as an independent data point. Consequently, the analysis did not distinguish between a single character mentioned multiple times within a text and multiple unique characters appearing once. This approach, while necessary for a large-scale corpus analysis, may inflate the frequency counts of characters who are central to a particular narrative. Future research employing more fine-grained text analysis, such as labeling each unique character with an ID, could provide a more nuanced count of individual representations and complement the present frequency-based findings.

Third, our study focused on the presence and proportional share of female versus male occupational terms, but it did not analyze the gender-stereotypical attributes associated with these roles. While our findings reveal who is represented, they do not capture how they are described. Examining whether HEED and STEM roles are described with, e.g., communal or agentic attributes (Abele & Wojciszke, 2007), represents an important gap in understanding how stereotypes are subtly communicated through descriptive language. In terms of future research, it would be useful to extend the current findings by examining gender-stereotypical attribute dimensions (Formanowicz et al., 2017; Pietraszkiewicz & Formanowicz, 2023; Pietraszkiewicz et al., 2019) related to occupational mentions, which would provide deeper insight into the qualitative nature of these occupational portrayals.

Fourth, our analysis was limited to binary gender based on grammatical markers and did not examine gender-fair language use. This included our consistent coding of all potentially generic masculine nouns as male, as disambiguating their specific referent was not feasible across the large corpus. Both elements significantly impact children's and adolescents' occupational perceptions (Sczesny et al., 2016; Vervecken & Hannover, 2015; Vervecken et al., 2013) and constitute integral components of textbook research (Kiesendahl & Ott, 2015; Moser & Hannover, 2014; Moser et al., 2013). Our binary focus, while reflecting the source material's linguistic structure, cannot capture non-binary or gender-diverse individuals. Future research should combine occupational role analysis with gender-inclusive language investigation and develop methodologies for identifying

non-binary representations in educational materials (Höhne & Heerdegen, 2018; Koster et al., 2025).

Despite these limitations, the merit of the present study lies in its corpus linguistic quantitative approach, which enabled a complete analysis of all approved Bavarian mathematics and German language arts textbooks from 1960 to 2017. By evaluating a substantially larger number of textbooks than previous studies and employing a discontinuity design to test the impact of the 1986 policy, this work provides a comprehensive comparison of subjects (mathematics vs. German language arts) and domains (STEM vs. HEED), offering a more detailed longitudinal perspective on the persistence of occupational gender stereotypes.

Conclusion

Our findings establish that while female occupational representation has generally increased since 1960, this trend is significantly moderated by both occupational domain and subject. Notably, the 1986 governmental resolution on gender equity had divergent effects: German language arts textbooks showed a positive change, while mathematics textbooks showed no improvement or even a decline of female representation. German language arts textbooks show progress in representing women across both HEED and STEM domains. In contrast, mathematics textbooks showed slower progress in HEED representation compared to German language arts textbooks, and maintain STEM as an almost exclusively male domain, a trend unchanged for nearly six decades. This complete stagnation in female representation in STEM occupational roles highlights cause for action, especially as textbooks serve as crucial socializing agents during formative developmental periods when children and adolescents internalize occupational stereotypes that can shape their career trajectories. Our results call for targeted efforts by publishers and educators to create materials that reflect and encourage a more inclusive vision of the modern workforce.

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Data Availability The data that support the findings of this study are available from the corresponding authors upon reasonable request.

Declarations

Ethics Approval and Consent No human participants or animals are involved in this study, and no informed consent was required.

Research Involving Human Participants and/or Animals No human participants or animals are involved in this study.

Informed Consent No informed consent was required.

Competing Interests The authors declare that there is no conflict of interest.

References

Abele, A. E., Hauke, N., Peters, K., Louvet, E., Szymkow, A., & Duan, Y. (2016). Facets of the fundamental content dimensions: Agency with competence and assertiveness-communion with warmth and morality. *Frontiers in Psychology*, *7,* Article 1810. https://doi.org/10.3389/fpsyg.2016.01810

Abele, A. E., & Wojciszke, B. (2007). Agency and communion from the perspective of self versus others. *Journal of Personality and Social Psychology, 93*(5), 751–763. https://doi.org/10.1037/0022-3514.93.5.751

Alter, G., König, L., & Merse, T. (2021). All inclusive? Eine kritische Lehrbuchanalyse zur Repräsentation von Diversität in Englischlehrbüchern der Klassenstufe 9 [All inclusive? A critical textbook analysis of the representation of diversity in English textbooks for 9th grade]. *Zeitschrift Für Fremdsprachenforschung (ZFF), 31*(1), 81–104.

Apple, M. W. (1978). Ideology, reproduction, and educational reform. *Comparative Education Review, 22*(3), 367–387. https://doi.org/10.1086/445993

Apple, M. W. (1987). *Teachers and texts: A political economy of class and gender relations in education* (1st ed.). Routledge. https://doi.org/10.4324/9781315862774

Ashmore, R. D., & Del Boca, F. K. (1979). Sex stereotypes and implicit personality theory: Toward a cognitive—Social psychological conceptualization. *Sex Roles, 5*(2), 219–248. https://doi.org/10.1007/BF00287932

Aulenbacher, B., Dammayr, M., & Riegraf, B. (2018). Care und care work [Care and care work]. In F. Böhle, G. G. Voß, & G. Wachtler (Eds.), *Handbuch Arbeitssoziologie: Band 2: Akteure und Institutionen* (2nd ed., pp. 747–766). Springer VS. https://doi.org/10.1007/978-3-658-21704-4_22

Aulenbacher, B. (2008). Geschlecht als Strukturkategorie: Über den inneren Zusammenhang von moderner Gesellschaft und Geschlechterverhältnis [Gender as a structural category: On the internal connection between modern society and gender relations]. In S. M. Wilz (Ed.), *Geschlechterdifferenzen — Geschlechterdifferenzierungen* (pp. 139–166). Springer VS. https://doi.org/10.1007/978-3-531-90831-1_5

Bates, D., Mächler, M., Bolker, B., & Walker, S. (2015). Fitting linear mixed-effects models using lme4. *Journal of Statistical Software*, *67*(1). https://doi.org/10.18637/jss.v067.i01

Behnke, Y. (2018). Textbook effects and efficacy. In E. Fuchs & A. Bock (Eds.), *The Palgrave handbook of textbook studies* (pp. 383–398). Palgrave Macmillan. https://doi.org/10.1057/978-1-137-53142-1_28

Bern, S. L. (1981). Gender schema theory: A cognitive account of sex typing. *Psychological Review, 88*, 354–364. https://doi.org/10.1037/0033-295X.88.4.354

Bernstein, B. (1975). Class and pedagogies: Visible and invisible. *Educational Studies, 1*(1), 23–41. https://doi.org/10.1080/03055697500 10105

Bittner, M. (2011). *Geschlechterkonstruktionen und die Darstellung von Lesben, Schwulen, Bisexuellen, Trans* und Inter (LSBTI) in Schulbüchern: Eine gleichstellungsorientierte Analyse von Melanie Bittner* [Gender constructs and the representation of lesbian, gay, bisexual, transgender, and intersex (LGBTI) people in school textbooks]. Gewerkschaft Erziehung und Wissenschaft. https://www.gew.de/fileadmin/media/publikationen/hv/Gleichstellung/Lesben__Schwule__Bisexuelle__Trans_und_Inter/Schulbuchanalyse_web.pdf

Blau, F. D., Ferber, M. A., & Winkler, A. E. (2014). *The economics of women, men, and work* (7th ed.). Pearson.

Boyd, R. L., Ashokkumar, A., Seraj, S., & Pennebaker, J. W. (2022). *The development and psychometric properties of LIWC-22.* University of Texas. https://www.liwc.app/

Brückner, M. (2010). Entwicklungen der Care-Debatte - Wurzeln und Begrifflichkeiten [Developments in the care debate - roots and terminology]. In U. Apitzsch & M. Schmidbauer (Eds.), *Care und Migration: die Ent-Sorgung menschlicher Reproduktionsarbeit entlang von Geschlechter- und Armutsgrenzen* (pp. 43–58). Barbara Budrich. https://doi.org/10.2307/j.ctvdf0h5f.6

Bühlmann, M. (2009). Geschlechterrollenstereotype in Lesebüchern: Eine qualitative Inhaltsanalyse von Schulbuchtexten aus drei Generationen von Schweizer Lesebüchern [Gender role stereotypes in reading books. A qualitative content analysis of textbook texts from three generations of Swiss reading books]. *Schweizerische Zeitschrift Für Soziologie= Revue Suisse De Sociologie= Swiss Journal of Sociology*, *35*(3), 593–619. https://doi.org/10.5167/uzh-27126

Bundesagentur für Arbeit. (2011). *Klassifikation der Berufe 2010 - Band 1: Systematischer und alphabetischer Teil mit Erläuterungen* [Classification of professions 2010 - Volume 1: Systematic and alphabetical section with explanations].

Bundesagentur für Arbeit. (2024). *Berichte: Blickpunkt Arbeitsmarkt: Die Arbeitsmarktsituation von Frauen und Männern 2023* [Reports: Labor market focus. The labor market situation of women and men 2023]. Bundesagentur für Arbeit.

Burden, A. (2023). *Intersections of Gender and Ethnicity in English Language Learning Texts*. Lexington Books. https://doi.org/10.5771/9781666916799

Chaffee, K. E., & Plante, I. (2021). How parents' stereotypical beliefs relate to students' motivation and career aspirations in mathematics and language arts. *Frontiers in Psychology*, *12*, Article 796073. https://doi.org/10.3389/fpsyg.2021.796073

Charles, M. (2011). A World of difference: International trends in women's economic status. *Annual Review of Sociology, 37*(1), 355–371. https://doi.org/10.1146/annurev.soc.012809.102548

Charles, M., & Bradley, K. (2009). Indulging our gendered selves? Sex segregation by field of study in 44 countries. *American Journal of Sociology, 114*(4), 924–976. https://doi.org/10.1086/595942

Charles, M., & Grusky, D. B. (2004). *Occupational ghettos: The worldwide segregation of women and men*. *Studies in Social Inequality*. Stanford University Press.

Charlesworth, T. E. S., & Banaji, M. R. (2022). Patterns of implicit and explicit stereotypes III: Long-term change in gender stereotypes. *Social Psychological and Personality Science, 13*(1), 14–26. https://doi.org/10.1177/1948550620988425

Cheryan, S., Plaut, V. C., Davies, P. G., & Steele, C. M. (2009). Ambient belonging: How stereotypical cues impact gender participation in computer science. *Journal of Personality and Social Psychology, 97*(6), 1045–1060. https://doi.org/10.1037/a0016239

Cheryan, S., Ziegler, S. A., Montoya, A. K., & Jiang, L. (2017). Why are some STEM fields more gender balanced than others? *Psychological Bulletin, 143*(1), 1–35. https://doi.org/10.1037/bul0000052

Clark, R., Ayton, K., Frechette, N., & Keller, P. J. (2005). Women of the world, re-write! Women in American world history high school textbooks from the 1969s, 1980s, and 1990s. *Social Education, 69*(1), 41–45.

Code, L. (1991). *What can she know?* Cornell University Press.

Colley, A., & Comber, C. (2003). School subject preferences: Age and gender differences revisited. *Educational Studies, 29*(1), 59–67. https://doi.org/10.1080/03055690303269

Collins, P. H. (1998). Moving beyond gender: Intersectionality and scientific knowledge. In M. M. Ferree, J. Lorber, & B. B. Hess (Eds.), *Revisioning gender* (pp. 261–284). AltaMira Press.

Connell, R. (1987). *Gender and power: Society, the person, and sexual politics*. Stanford University Press.

Croft, A., Schmader, T., Block, K., & Baron, A. S. (2014). The second shift reflected in the second generation: Do parents' gender roles at home predict children's aspirations? *Psychological Science, 25*(7), 1418–1428. https://doi.org/10.1177/0956797614533968

Croft, A., Schmader, T., & Block, K. (2015). An underexamined inequality: Cultural and psychological barriers to men's engagement with communal roles. *Personality and Social Psychology Review, 19*(4), 343–370. https://doi.org/10.1177/1088868314564789

Cruz Neri, N., Schwenzer, F., Sprenger, S., & Retelsdorf, J. (2024). Geschlechterdarstellungen in Geographie-Schulbüchern: Von mangelnder Repräsentation weiblicher Figuren und Reproduktion von Geschlechterstereotypen [Gender representation in geography textbooks: The lack of representation of female figures and the reproduction of gender stereotypes]. *Zeitschrift Für Erziehungswissenschaft, 27*(4), 977–994. https://doi.org/10.1007/s11618-024-01223-w

Curdt-Christiansen, X. L. (2017). Language socialization through textbooks. In P. A. Duff & S. May (Eds.), *Language socialization* (pp. 1–16). Springer International Publishing. https://doi.org/10.1007/978-3-319-02327-4_15-1

Deaux, K. (1984). From individual differences to social categories: Analysis of a decade's research on gender. *American Psychologist, 39*(2), 105–116. https://doi.org/10.1037/0003-066X.39.2.105

Denny, K. E. (2011). Gender in context, content, and approach: Comparing gender messages in girl scout and boy scout handbooks. *Gender & Society, 25*(1), 27–47. https://doi.org/10.1177/0891243210390517

Diekman, A. B., & Eagly, A. H. (2000). Stereotypes as dynamic constructs: Women and men of the past, present, and future. *Personality and Social Psychology Bulletin, 26*(10), 1171–1188. https://doi.org/10.1177/0146167200262001

Eagly, A. H., & Wood, W. (2012). Social role theory. In P. van Lange, A. Kruglanski, & E. Higgins (Eds.), *Handbook of theories of*

social psychology (pp. 458–476). SAGE Publications Ltd. https://doi.org/10.4135/9781446249222.n49

Eagly, A. H., Nater, C., Miller, D. I., Kaufmann, M., & Sczesny, S. (2020). Gender stereotypes have changed: A cross-temporal meta-analysis of U.S. Public opinion polls from 1946 to 2018. *The American Psychologist*, *75*(3), 301–315. https://doi.org/10.1037/amp0000494

Eagly, A. H. (1987). *Sex differences in social behavior: A social-role interpretation*. Erlbaum.

Eccles, J. (2009). Who am I and what am I going to do with my life? Personal and collective identities as motivators of action. *Educational Psychologist, 44*(2), 78–89. https://doi.org/10.1080/00461520902832368

Eccles, J. (2011). Gendered educational and occupational choices: Applying the Eccles et al. model of achievement-related choices. *International Journal of Behavioral Development*, *35*(3), 195–201. https://doi.org/10.1177/0165025411398185

Eckes, T. (2004). Geschlechterstereotype: Von Rollen, Identitäten und Vorurteilen [Gender stereotypes: About roles, identities and prejudices]. In R. Becker & B. Kortendiek (Eds.), *Handbuch Frauen- und Geschlechterforschung: Theorie, Methoden, Empirie* (pp. 165–176). Springer VS. https://doi.org/10.1007/978-3-322-99461-5_20

Elbracht, M., & Mosler, I. (1972). Femina non est homo? Zum Frauenbild in Grund- und Hauptschullesebüchern [Femina non est homo? On the image of women in elementary and secondary school textbooks]. In P. Braun (Ed.), *Literatur in der Gesellschaft: Vol. 5. Neue Lesebücher - Analyse und Kritik* (pp. 82–96). Bertelsmann Universitätsverlag.

England, P. (2005). Emerging theories of care work. *Annual Review of Sociology, 31*(1), 381–399. https://doi.org/10.1146/annurev.soc.31.041304.122317

England, P. (2010). The gender revolution. *Gender & Society, 24*(2), 149–166. https://doi.org/10.1177/0891243210361475

England, P., Levine, A., & Mishel, E. (2020). Progress toward gender equality in the United States has slowed or stalled. *Proceedings of the National Academy of Sciences of the United States of America, 117*(13), 6990–6997. https://doi.org/10.1073/pnas.1918891117

Evans, L., & Kimberly, D. (2000). No sissy boys here: A content analysis of the representation of masculinity in elementary school reading textbooks. *Sex Roles, 42*(3/4), 255–270. https://doi.org/10.1023/A:1007043323906

Fagot, B. I., Rodgers, C. S., & Leinbach, M. D. (2000). Theories of gender socialization. In T. Eckes & H. M. Trautner (Eds.), *The developmental social psychology of gender* (pp. 65–89). Erlbaum.

Fayer, S., Lacey, A., & Watson, A. (2017). *STEM occupations: Past, present, and future.* U.S. Bureau of Labor Statistics. Spotlight on Statistics 1. https://www.bls.gov/spotlight/2017/science-technology-engineering-and-mathematics-stem-occupations-past-present-and-future/pdf/science-technology-engineering-and-mathematics-stem-occupations-past-present-and-future.pdf

Ferree, M. M., & Hall, E. J. (1996). Rethinking stratification from a feminist perspective: Gender, race, and class in mainstream textbooks. *American Sociological Review, 61*(6), 929–950. https://doi.org/10.2307/2096301

Fichera, U. (1996). *Die Schulbuchdiskussion in der BRD - Beiträge zur Neugestaltung des Geschlechterverhältnisses: Bestandsaufnahme und Sekundäranalyse* [The textbook discussion in the FRG - contributions to the reorganization of gender relations] (Europäische Hochschulschriften, Reihe 11, Bd. 670). Peter Lang.

Finsterwald, M., & Ziegler, A. (2007). Geschlechtsrollenerwartungen vermittelt durch Schulbuchabbildungen in der Grundschule [Gender role expectations conveyed through textbook illustrations in primary school]. In P. H. Ludwig & H. Ludwig (Eds.), *Erwartungen in himmelblau und rosarot: Effekte, Determinanten und Konsequenzen von Geschlechterdifferenzen in der Schule* (pp. 117–141). Juventa Verlag.

Formanowicz, M., Roessel, J., Suitner, C., & Maass, A. (2017). Verbs as linguistic markers of agency: The social side of grammar. *European Journal of Social Psychology, 47*(5), 566–579. https://doi.org/10.1002/ejsp.2231

Fox, J., & Weisberg, S. (2018). *An R companion to applied regression* (3rd ed.). SAGE Publications Ltd.

Froehlich, L., Olsson, M. I. T., Dorrough, A. R., & Martiny, S. E. (2020). Gender at work across nations: Men and women working in male-dominated and female-dominated occupations are differentially associated with agency and communion. *Journal of Social Issues, 76*(3), 484–511. https://doi.org/10.1111/josi.12390

Fruehwirth, B., Heilemann, M., & Stoeger, H. (2024). The gender representation of women and men in the occupational areas of STEM and care work in German textbooks. *Linguistics and Education*, *80*, Article 101284. https://doi.org/10.1016/j.linged.2024.101284

Good, J. J., Woodzicka, J. A., & Wingfield, L. C. (2010). The effects of gender stereotypic and counter-stereotypic textbook images on science performance. *The Journal of Social Psychology, 150*(2), 132–147. https://doi.org/10.1080/00224540903366552

Gottfredson, L. S. (2002). Gottfredson's theory of circumscription, compromise, and self-creation. In D. Brown (Ed.), *Career choice and development* (4th ed., pp. 85–148). Jossey-Bass.

Gräsel, C. (2010). Lehren und Lernen mit Schulbücher - Beispiele aus der Unterrichtsforschung [Teaching and learning with textbooks - examples from classroom research]. In E. Fuchs, J. Kahlert, & U. Sandfuchs (Eds.), *Schulbuch konkret: Kontexte - Produktion - Unterricht* (pp. 137–148). Julius Klinkhardt.

Gries, S. T. (2015). The most under-used statistical method in corpus linguistics: Multi-level (and mixed-effects) models. *Corpora, 10*(1), 95–125. https://doi.org/10.3366/cor.2015.0068

Guthridge, M., Kirkman, M., Penovic, T., & Giummarra, M. J. (2022). Promoting gender equality: A systematic review of interventions. *Social Justice Research, 35*(3), 318–343. https://doi.org/10.1007/s11211-022-00398-z

Hamilton, M. C., Anderson, D., Broaddus, M., & Young, K. (2006). Gender stereotyping and under-representation of female characters in 200 popular children's picture books: A twenty-first century update. *Sex Roles, 55*(11–12), 757–765. https://doi.org/10.1007/s11199-006-9128-6

Hartig, F. (2024). *DHARMa: residual diagnostics for hierarchical (multi-level/mixed) regression models.* University of Regensburg. https://cran.r-project.org/web/packages/DHARMa/vignettes/DHARMa.html

Hategeka, C., Ruton, H., Karamouzian, M., Lynd, L. D., & Law, M. R. (2020). Use of interrupted time series methods in the evaluation of health system quality improvement interventions: A methodological systematic review. *BMJ Global Health*, *5*(10), Article e003567. https://doi.org/10.1136/bmjgh-2020-003567

Hausen, K. (1976). Die Polarisierung der "Geschlechtscharaktere" - Eine Spiegelung der Dissoziation von Erwerbs- und Familienleben [The polarization of "gender characters" - A reflection of the dissociation of work and family life]. In W. Conze (Ed.), *Industrielle Welt. Schriftreihe des Arbeitskreises für moderne Sozialgeschichte: Vol. 21. Sozialgeschichte der Familie in der Neuzeit Europas: Neue Forschungen herausgegeben von Werner Conze* (pp. 363–393). Ernst Klett Verlag.

Heilman, M. E., & Wallen, A. S. (2010). Wimpy and undeserving of respect: Penalties for men's gender-inconsistent success. *Journal of Experimental Social Psychology, 46*(4), 664–667. https://doi.org/10.1016/j.jesp.2010.01.008

Hellinger, M. (1980). 'For men must work, and women must weep': Sexism in English language textbooks used in German schools. *Women's Studies International Quarterly, 3*(2–3), 267–275. https://doi.org/10.1016/S0148-0685(80)92323-4

Herrmann, B. (2016). Entstehung eines Lehrwerks für die Grundschule: Kontext und Einflüsse, Produktion und Zulassung [Development of a textbook for elementary school: context and influences, production, and approval]. In E. Matthes & S. Schütze (Eds.), *Beiträge zur historischen und systematischen Schulbuchforschung. Schulbücher auf den Prüfstand: Textbooks under Scrutiny* (pp. 51–63). Julius Klinkhardt.

Hill Collins, P. (2002). *Black feminist thought: Knowledge, consciousness, and the politics of empowerment*. Routledge. https://doi.org/10.4324/9780203900055

Höhne, T. (2005). Über das Wissen in Schulbüchern - Elemente einer Theorie des Schulbuchs [On knowledge in textbooks - Elements of a theory of the textbook]. In E. Matthes & C. Heinze (Eds.), *Das Schulbuch zwischen Lehrplan und Unterrichtspraxis* (pp. 65–93). Julius Klinkhardt.

Höhne, M. S., & Heerdegen, D. (2018). On normativity and absence: Representation of LGBTI* in textbook research. In E. Fuchs & A. Bock (Eds.), *The Palgrave handbook of textbook studies* (pp. 239–249). Palgrave Macmillan.

Höhne, T. (2018). Educational media, reproduction, and technology: Towards a critical political economy of educational media. In E. Fuchs & A. Bock (Eds.), *The Palgrave handbook of textbook studies* (pp. 115–125). Palgrave Macmillan. https://doi.org/10.1057/978-1-137-53142-1_8

Hopfgartner, P. (1982). *Die Darstellung der Arbeits- und Berufswelt in den Lesebüchern der Hauptschule* [The portrayal of the world of work and careers in secondary school reading books] [Disseration, Universität Innsbruck, Innsbruck].

Hsu, N., Badura, K. L., Newman, D. A., & Speach, M. E. P. (2021). Gender, "masculinity", and "femininity": A meta-analytic review of gender differences in agency and communion. *Psychological Bulletin, 147*(10), 987–1011. https://doi.org/10.1037/bul0000343

Hunze, A. (2003). Geschlechtertypisierung in Schulbüchern [Gender typification in textbooks]. In M. Stürzer, H. Roisch, A. Hunze, & W. Cornelißen (Eds.), *Geschlechterverhältnisse in der Schule* (pp. 53–82). Leske+Budrich. https://doi.org/10.1007/978-3-322-90921-3_3

Jarman, J., Blackburn, R. M., & Racko, G. (2012). The dimensions of occupational gender segregation in industrial countries. *Sociology, 46*(6), 1003–1019. https://doi.org/10.1177/0038038511435063

Jehle, A. M. C., Groeneveld, M. G., van de Rozenberg, T. M., & Mesman, J. (2024). The hidden lessons in textbooks: Gender representation and stereotypes in European mathematics and language books. *European Journal of Education*, *59*(4), Article e12716. https://doi.org/10.1111/ejed.12716

Jochim, V. (2014). *„Weil Mädchen anders lernen": Die Konstruktion von Geschlecht in Grundschulbüchern und ihre heteronormative Wirkmächtigkeit* [The construction of gender in elementary school textbooks and its heteronormative impact] (Eckert. Working Paper No. 9). http://www.edumeres.net/urn/urn:nbn:de:0220-2014-00270

Karsten, G. (1976). *Mariechens Weg ins Glück? Die Diskriminierung von Mädchen in Grundschullesebüchern* [Mariechen's path to happiness? Discrimination against girls in elementary school reading books] (2nd ed.). Frauenselbstverlag.

Kerkhoven, A. H., Russo, P., Land-Zandstra, A. M., Saxena, A., & Rodenburg, F. J. (2016). Gender stereotypes in science education resources: A visual content analysis. *PloS One*, *11*(11), Article e0165037. https://doi.org/10.1371/journal.pone.0165037

Kiesendahl, J., & Ott, C. (Eds.). (2015). *Eckert. Die Schriftreihe. Studien des Georg-Eckert-Instituts zur internationalen Bildungsmedienforschung: Vol. 137. Linguistik und Schulbuchforschung: Gegenstände - Methoden - Perspektiven* [Linguistics and textbook research. Objects - methods - perspectives]. V&R. https://doi.org/10.14220/9783737005159

Klaczynski, P. A., Felmban, W. S., & Kole, J. (2020). Gender intensification and gender generalization biases in pre-adolescents, adolescents, and emerging adults. *The British Journal of Developmental Psychology, 38*(3), 415–433. https://doi.org/10.1111/bjdp.12326

Klinger, C. (2012). Leibdienst - Liebesdienst - Dienstleistung [Serfdom - (Lost) Love's Labor - Service Industries: Services From Feudal Times to Late Capitalism]. In K. Dörre, D. Sauer, & V. Wittke (Eds.), *Kapitalismustheorie und Arbeit: Neue Ansätze soziologischer Kritik* (pp. 258–273). Campus Verlag.

Klinger, C., & Knapp, G.-A. (Eds.). (2008). *Überkreuzungen, Fremdheit, Ungleichheit, Differenz* [Intersections, foreignness, inequality, difference]. Westfälisches Dampfboot.

KMK. (1986). *Beschluss zur Darstellung von Mann und Frau in Schulbüchern* [Resolution on the representation of men and women in textbooks]. Kulturministerkonferenz. https://www.kmk.org/fileadmin/Dateien/veroeffentlichungen_beschluesse/1986/1986_11_21-Darstellung_Mann_Frau_Schulbuecher.pdf

Knudsen, S. V. (2005). Dancing with and without gender - Reflections on gender, textbooks and textbook research. In M. Hornsley, S. V. Knudsen, & S. Selander (Eds.), *Stockholm Libary of Curriculum Studies: Vol. 15. Has past passed? Textbooks and educational media for the 21st century. The 7st IARTEM Volume* (pp. 70–87). HLS Förlag.

Knudsen, S. V. (2006). Intersectionality - A theoretical inspiration in the analysis of minority cultures and identities in textbooks. In É. Bruillard, B. Aamotsbakken, S. V. Knudsen, & M. Horslex (Eds.), *Caught in the web or lost in the textbook? 8th international conference on learning and educational media* (pp. 61–76).

Koenig, A. M. (2018). Comparing prescriptive and descriptive gender stereotypes about children, adults, and the elderly. *Frontiers in Psychology*, *9*, Article 1086. https://doi.org/10.3389/fpsyg.2018.01086

Kollmayer, M., Schober, B., & Spiel, C. (2017). Gender stereotypes in education: Development, consequences, and interventions. *European Journal of Developmental Psychology, 3*, 1–17. https://doi.org/10.1080/17405629.2016.1193483

Kollmayer, M., Pfaffel, A., Schober, B., & Brandt, L. (2018). Breaking away from the male stereotype of a specialist: Gendered language affects performance in a thinking task. *Frontiers in Psychology, 9*(985), 1–10. https://doi.org/10.3389/fpsyg.2018.00985

Korlat, S., Foerst, N. M., Schultes, M.-T., Schober, B., Spiel, C., & Kollmayer, M. (2022). Gender role identity and gender intensification: Agency and communion in adolescents' spontaneous self-descriptions. *European Journal of Developmental Psychology, 19*(1), 64–88. https://doi.org/10.1080/17405629.2020.1865143

Koster, D., Ott, C., & Sunderland, J. (2025). Gender and sexual diversity in language education: Global approaches to educational media. *Gender and Language, 19*(3), 259–274. https://doi.org/10.3138/gl-2025-0018

Koster, D., Nuriah, Z., Pot, A., Sas, C., & Zegers, T. (2023). More than migrants? Representations of wo/men of colour in Dutch language textbooks. *Language Teaching Research*. Advance online publication. https://doi.org/10.1177/13621688231198420

Lässig, S. (2010). Wer definiert relevantes Wissen? Schulbücher und ihr gesellschaftlicher Kontext [Who defines relevant knowledge? Textbooks and their social context]. In E. Fuchs, J. Kahlert, & U. Sandfuchs (Eds.), *Schulbuch konkret: Kontexte - Produktion - Unterricht* (pp. 199–215). Julius Klinkhardt.

Lenth, R. V. (2025). *emmeans: Estimated marginal means, aka least-squares means*. R package version 1.11.1-00001. https://rvlenth.github.io/emmeans/.

Levanon, A., & Grusky, D. B. (2016). The persistence of extreme gender segregation in the twenty-first century. *American Journal of Sociology, 122*(2), 573–619. https://doi.org/10.1086/688628

Liben, L. S., Bigler, R. S., & Krogh, H. R. (2001). Pink and blue collar jobs: Children's judgments of job status and job aspirations in relation to sex of worker. *Journal of Experimental Child Psychology, 79*(4), 346–363. https://doi.org/10.1006/jecp.2000.2611

Liben, L. S., Bigler, R. S., & Krogh, H. R. (2002). Language at work: Children's gendered interpretations of occupational titles. *Child Development, 73*(3), 810–828. https://doi.org/10.1111/1467-8624.00440

Lindner, V., & Lukesch, H. (1994). *Geschlechtsrollenstereotype im deutschen Schulbuch: Eine inhaltsanalytische Untersuchung von Schulbüchern für Grund-, Haupt- und Realschulen der Fächer Deutsch, Mathematik, Heimat- und Sachkunde sowie Religionslehre in Bayern, Nordrhein-Westfalen und der ehemaligen DDR zugelassen im Zeitraum von 1970 bis 1992* [Gender role stereotypes in German textbooks]. Roderer.

Lindner, J., & Makarova, E. (2024). Challenging gender stereotypes: Young women's views on female role models in secondary school science textbooks. *International Journal of Educational Research Open*, *7*, Article 100376. https://doi.org/10.1016/j.ijedro.2024.100376

Lippa, R. A., Preston, K., & Penner, J. (2014). Women's representation in 60 occupations from 1972 to 2010: More women in high-status jobs, few women in things-oriented jobs. *PloS One*, *9*(5), Article e95960. https://doi.org/10.1371/journal.pone.0095960

Lüdecke, D., Ben-Shachar, M., Patil, I., Waggoner, P., & Makowski, D. (2021). performance: An R package for assessment, comparison and testing of statistical models. *Journal of Open Source Software*, *6*(60), Article 3139. https://doi.org/10.21105/joss.03139

Lüdecke, D. (2018). ggeffects: Tidy data frames of marginal effects from regression models. *Journal of Open Source Software*, *3*(26), Article 772. https://doi.org/10.21105/joss.00772

Markom, C., & Weinhäupl, H. (2007). *Die Anderen im Schulbuch: Rassismen, Exotismen, Sexismen und Antisemitismus in österreichischen Schulbüchern* [The others in the textbook. Racisms, exoticisms, sexisms and antisemitism in Austrian textbooks]. Braumüller.

Martin, C. L. (2000). Cognitive theories of gender development. In T. Eckes & H. M. Trautner (Eds.), *The developmental social psychology of gender* (pp. 91–121). Erlbaum.

Matthes, E., Ott, C., Schütze, S., & Wrobel, D. (Eds.). (2024). *Kontinuität und Wandel von Wissen in Bildungsmedien [Continuity and change of knowledge in educational media]*. Verlag Julius Klinkhardt.

Matthes, E., & Schütze, S. (Eds.). (2016). *Beiträge zur historischen und systematischen Schulbuchforschung*. Textbooks under Scrutiny. Julius Klinkhardt.

McCall, L. (2005). The complexity of intersectionality. *Signs: Journal of Women in Culture and Society*, *30*(3), 1771–1800. https://doi.org/10.1086/426800

Mills, S., & Mustapha, A. S. (Eds.). (2015). *Gender representation in learning materials: International perspectives*. Routledge. https://doi.org/10.4324/9781315764092

Moser, F., Hannover, B., & Becker, J. (2013). Subtile und direkte Mechanismen der sozialen Konstruktion von Geschlecht in Schulbüchern: Vorstellung eines Kategoriensystems zur Analyse der Geschlechter(un)gerechtigkeit von Texten und Bildern [Subtle and direct mechanisms of the social construction of gender in school textbooks: Presentation of a category system for analyzing gender (in)equality in texts and images]. *Gender: Zeitschrift Für Geschlecht, Kultur Und Gesellschaft*(3), 77–93.

Moser, F., & Hannover, B. (2014). How gender fair are German schoolbooks in the twenty-first century? An analysis of language and illustrations in schoolbooks for mathematics and German. *European Journal of Psychology of Education, 29*(3), 387–407. https://doi.org/10.1007/s10212-013-0204-3

Moser, F. (2016). Schulbuchanalysen unter Geschlechtergesichtspunkten [Textbook analyses from a gender perspective]. In H. Faulstich-Wieland (Ed.), *Enzyklopädie Erziehungswissenschaften Online* (pp. 1–24). Beltz Juventa. https://doi.org/10.3262/EEO17160359

Moss-Racusin, C. A., Dovidio, J. F., Brescoll, V. L., Graham, M. J., & Handelsman, J. (2012). Science faculty's subtle gender biases favor male students. *Proceedings of the National Academy of Sciences of the United States of America, 109*(41), 16474–16479. https://doi.org/10.1073/pnas.1211286109

National Science Board, & National Science Foundation. (2024). *The STEM labor force: Scientists, engineers, and technical workers: Science and engineering indicators 2024*. NSB-2024-5. National Science Foundation & National Center for Science and Engineering Statistics. https://ncses.nsf.gov/pubs/nsb20245

Nosek, B. A., Smyth, F. L., Sriram, N., Lindner, N. M., Devos, T., Ayala, A., Bar-Anan, Y., Bergh, R., Cai, H., Gonsalkorale, K., Kesebir, S., Maliszewski, N., Neto, F., Olli, E., Park, J., Schnabel, K., Shiomura, K., Tulbure, B. T., Wiers, R. W., & Greenwald, A. G. (2009). National differences in gender-science stereotypes predict national sex differences in science and math achievement. *Proceedings of the National Academy of Sciences of the United States of America, 106*(26), 10593–10597. https://doi.org/10.1073/pnas.0809921106

Ohlms, U. (1984). „Und drinnen waltet die züchtige Hausfrau…": Das Mädchen- und Frauenbild in Grundschulbüchern ["And inside rules the chaste housewife…" The image of girls and women in elementary school books]. In L. Brehmer & U. Enders-Dragässer (Eds.), *Die Schule lebt - Frauen bewegen die Schule: Dokumentation der 1. Fachtagung in Gießen 1982 und der 2. Fachtagung in Bielefeld 1983* (pp. 131–161). DjI Deutsches Jugendinstitut.

Olsson, M., & Martiny, S. E. (2018). Does exposure to counterstereotypical role models influence girls' and women's gender stereotypes and career choices? A review of social psychological research. *Frontiers in Psychology*, *9*, Article 2264. https://doi.org/10.3389/fpsyg.2018.02264

Ott, C. (2016). Geschlechterstereotypen auf der Spur. Ein Plädoyer für mehr Linguistik in der Bildungsforschung [Tracing gender stereotypes. A plea for more linguistics in educational research]. In C. Groppe, G. Kluchert, & E. Matthes (Eds.), *Bildung und Differenz* (pp. 161–183). Springer VS. https://doi.org/10.1007/978-3-658-10003-2_8

Ott, C. (2017a). Geschlechterforschung zu Schulbüchern gestern und heute: Forschungsparadigmen und Methodik [Gender research on textbooks yesterday and today. Research paradigms and methodology]. In B. Aamotsbakken, E. Matthes, & S. Schütze (Eds.), *Beiträge zur historischen und systematischen Schulbuch- und Bildungsmedienforschung. Heterogenität und Bildungsmedien: Heterogeneity and Educational Media* (pp. 279–290). Klinkhardt.

Ott, C. (2017b). *Sprachlich vermittelte Geschlechterkonzepte: Eine diskurslinguistische Untersuchung von Schulbüchern der Wilhelminischen Kaiserzeit bis zur Gegenwart* [Linguistically mediated gender concepts. A discursive-linguistic study of textbooks from the Wilhelminian Empire to the present time]. de Gruyter. https://doi.org/10.1515/9783110555578

Ott, C. (2021). Doing und Undoing Gender in zeitgenössischen Bildungsmedien. Eine Forschungsschau zu Schulbuchstudien von 2010 bis 2019 [Doing and undoing gender in contemporary educational media. A research showcase on textbook studies from 2010 to 2019]. In J. v. Dall'Armi & V. Schurt (Eds.), *Von der Vielheit der Geschlechter* (pp. 165–178). Springer VS. https://doi.org/10.1007/978-3-658-32251-9_13

Pietraszkiewicz, A., & Formanowicz, M. (2023). Verbs are associated with agency: Evidence from word ratings and natural language use. *Social Psychology, 54*(5), 271–282. https://doi.org/10.1027/1864-9335/a000522

Pietraszkiewicz, A., Formanowicz, M., Gustafsson Sendén, M., Boyd, R. L., Sikström, S., & Sczesny, S. (2019). The big two

dictionaries: Capturing agency and communion in natural language. *European Journal of Social Psychology, 49*(5), 871–887. https://doi.org/10.1002/ejsp.2561

Plante, I., Théorêt, M., & Favreau, O. E. (2009). Student gender stereotypes: Contrasting the perceived maleness and femaleness of mathematics and language. *Educational Psychology, 29*(4), 385–405. https://doi.org/10.1080/01443410902971500

Plante, I., O'Keefe, P. A., Aronson, J., Fréchette-Simard, C., & Goulet, M. (2019). The interest gap: How gender stereotype endorsement about abilities predicts differences in academic interests. *Social Psychology of Education, 22*(1), 227–245. https://doi.org/10.1007/s11218-018-9472-8

Preinsberger, A., & Weisskircher, E. (1997). Mathematikschulbücher - eine aktuelle Untersuchung [Mathematics textbooks - a current investigation]. In L. Lassnigg & A. Paseka (Eds.), *Schule weiblich - Schule männlich: Zum Geschlechterverhältnis im Bildungswesen* (pp. 132–143). Studien Verlag.

Prentice, D. A., & Carranza, E. (2002). What women and men should be, shouldn't be, are allowed to be, and don't have to be: The contents of prescriptive gender stereotypes. *Psychology of Women Quarterly, 26*(4), 269–281. https://doi.org/10.1111/1471-6402.t01-1-00066

Puzio, A., & Valshtein, T. (2022). Gender segregation in culturally feminized work: Theory and evidence of boys' capacity for care. *Psychology of Men & Masculinities, 23*(3), 271–284. https://doi.org/10.1037/men0000397

R Core Team. (2024). *R: A language and environment for statistical.* R Foundation for Statistical Computing. https://www.R-project.org/

Ridgeway, C. L. (2011). Framed by gender: How gender inequality persists in the modern world. *Oxford University Press*. https://doi.org/10.1093/acprof:oso/9780199755776.001.0001

Risman, B. J. (2004). Gender as a social structure. *Gender & Society, 18*(4), 429–450. https://doi.org/10.1177/0891243204265349

Rubin, G. (1975). The traffic in women: Notes on the "Political economy" of sex. In R. Reiter (Ed.), *Toward an anthropology of women* (pp. 157–210). Monthly Review Press.

Salem, S. (2018). Intersectionality and its discontents: Intersectionality as traveling theory. *European Journal of Women's Studies, 25*(4), 403–418. https://doi.org/10.1177/1350506816643999

Schmader, T., & Nater, C. (2025). Gender. In D. Gilbert, S. Fiske, E. Finkel, & W. Mendes (Eds.), *Handbook of social psychology* (6th ed.). Situational Press. https://doi.org/10.70400/AKXO6205

Schneider, D. J. (2005). *The psychology of stereotyping*. Guilford Press.

Scott, K. P. (1986). Effects of sex-fair reading materials on pupils' attitudes, comprehension, and interest. *American Educational Research Journal, 23*(1), 105–116. https://doi.org/10.3102/00028312023001105

Scott, K. P., & Feldmann-Summers, S. (1979). Children's reactions to textbook stories in which females are portrayed in traditionally male roles. *Journal of Educational Psychology*(71), 396–402. https://doi.org/10.1037/0022-0663.71.3.396

Sczesny, S., Formanowicz, M., & Moser, F. (2016). Can gender-fair language reduce gender stereotyping and discrimination? *Frontiers in Psychology*, *7*, Article 25. https://doi.org/10.3389/fpsyg.2016.00025

Silbermann, A., & Krüger, U. M. (1971). *Abseits der Wirklichkeit: Das Frauenbild in deutschen Lesebüchern*. Eine soziologische Untersuchung [Beyond reality. The image of women in German reading books. A sociological study]. Verlag Wissenschaft und Politik.

Smith, D. E. (1987). *The everyday world as problematic: A feminist sociology*. *Northeastern series in feminist theory*. Northeastern University Press.

Sollwedel, I. (1968). Das Mädchen- und Frauenbild in den Lesebüchern der Volksschule: Ergebnisse einer Untersuchung in Baden-Württemberg [The image of girls and women in elementary school reading books]. *Informationen Für Die Frau, 3*, 12–14.

Sollwedel, I. (1971). Patriarchat oder kritische Frauenbilder - Zum Leitbild westdeutscher Lesebücher [Patriarchy or critical images of women – On the model of West German reading books]. In O. Gmelin & I. Sollwedel (Eds.), *Basis-Arbeitsergebnisse. Bankrott der Männerherrschaft: Material zu Problemen der Frauenemanzipation* (pp. 92–111). Europäische Verl.anst.

Stahlberg, D., Braun, F., Irmen, L., & Sczesny, S. (2007). Representation of the sexes in language. In K. Fiedler (Ed.), *Social communication* (pp. 163–187). Psychology Press.

Stará, J., Chvál, M., & Starý, K. (2017). The role of textbooks in primary education. *E-Pedagogium, 17*(4), 60–69. https://doi.org/10.5507/epd.2017.053

Starr, C. R., & Zurbriggen, E. L. (2017). Sandra Bem's gender schema theory after 34 years: A review of its reach and impact. *Sex Roles, 76*(9–10), 566–578. https://doi.org/10.1007/s11199-016-0591-4

Stein, G. (1977). *Schulbuchwissen, Politik und Pädagogik: Untersuchungen zu einer praxisbezogenen und theoriegeleiteten Schulbuchforschung* [Textbook knowledge, politics, and pedagogy. Investigations into practical and theory-based textbook research]. Gesamthochschule Duisburg, Kastellaun.

Stewart-Williams, S., & Halsey, L. G. (2021). Men, women and STEM: Why the differences and what should be done? *European Journal of Personality, 35*(1), 3–39. https://doi.org/10.1177/0890207020962326

Su, R., Rounds, J., & Armstrong, P. I. (2009). Men and things, women and people: A meta-analysis of sex differences in interests. *Psychological Bulletin, 135*(6), 859–884. https://doi.org/10.1037/a0017364

Tagliamonte, S. A., & Baayen, R. H. (2012). Models, forests, and trees of York English: Was/were variation as a case study for statistical practice. *Language Variation and Change, 24*(2), 135–178. https://doi.org/10.1017/S0954394512000129

Tellhed, U., Bäckström, M., & Björklund, F. (2017). Will I fit in and do well? The importance of social belongingness and self-efficacy for explaining gender differences in interest in STEM and HEED majors. *Sex Roles, 77*(1), 86–96. https://doi.org/10.1007/s11199-016-0694-y

Trepanier-Street, M. L., & Romatowski, J. A. (1999). The influence of children's literature on gender roles perceptions: a reexamination. *Early Childhood Educational Journal*(26), 155–159. https://doi.org/10.1023/A:1022977317864

U.S. Bureau of Labor Statistics. (2023). *Women in the labor force: a databook* (BLS Reports No. 1103). https://www.bls.gov/opub/reports/womens-databook/2022/home.htm

van de Rozenberg, T. M., Groeneveld, M. G., van Veen, D. P., van der Pol, L. D., & Mesman, J. (2023). Hidden in plain sight: Gender bias and heteronormativity in Dutch textbooks. *Educational Studies, 59*(3), 299–317. https://doi.org/10.1080/00131946.2023.2194536

van de Rozenberg, T. M., van der Pol, L. D., van Esveld, S., Groeneveld, M. G., Kroes, A. D. A., & Mesman, J. (2024). The role of parents in predicting gender-stereotypic attitudes towards HEED occupations and gender-stereotypic interest in these careers. *European Journal of Social Psychology, 54*(2), 478–494. https://doi.org/10.1002/ejsp.3029

van der Vleuten, M., Jaspers, E., Maas, I., & van der Lippe, T. (2016). Boys' and girls' educational choices in secondary education: The role of gender ideology. *Educational Studies, 42*(2), 181–200. https://doi.org/10.1080/03055698.2016.1160821

Vervecken, D., & Hannover, B. (2015). Yes I can! Effects of gender fair job descriptions on children's perceptions of job status, job difficulty and vocational self-efficacy. *Social Psychology, 46*(2), 76–92. https://doi.org/10.1027/1864-9335/a000229

Vervecken, D., Hannover, B., & Wolter, I. (2013). Changing (S)expectations: How gender fair job descriptions impact children's perceptions and interest regarding traditionally male occupations. *Journal of Vocational Behavior, 82*(3), 208–220. https://doi.org/10.1016/j.jvb.2013.01.008

Vervecken, D., Gygax, P. M., Gabriel, U., Guillod, M., & Hannover, B. (2015). Warm-hearted businessmen, competitive housewives? Effects of gender-fair language on adolescents' perceptions of occupations. *Frontiers in Psychology, 6*(1437), 1–10. https://doi.org/10.3389/fpsyg.2015.01437

Watt, H. M. G., & Eccles, J. S. (Eds.). (2008). *Gender and occupational outcomes: Longitudinal assessments of individual, social, and cultural influences*. American Psychological Association. https://doi.org/10.1037/11706-000

Watt, H. M. G. (2010). Gender and occupational choice. In J. C. Chrisler & D. R. McCreary (Eds.), *Handbook of gender research in psychology* (pp. 379–400). Springer Science + Business Media. https://doi.org/10.1007/978-1-4419-1467-5_16

Weber, L. (2019). Arbeit - Leben: wechselseitiges Verflechtungsverhältnis aus Sicht der Geschlechterforschung [Work - life: interdependence from the perspective of gender studies]. In B. Kortendiek, B. Riegraf, & K. Sabisch (Eds.), *Handbuch Interdisziplinäre Geschlechterforschung* (pp. 87–94). Springer VS. https://doi.org/10.1007/978-3-658-12496-0_68

Weisgram, E. S., Dinella, L. M., & Fulcher, M. (2011). The role of masculinity/femininity, values, and occupational value affordances in shaping young men's and women's occupational choices. *Sex Roles, 65*(3–4), 243–258. https://doi.org/10.1007/s11199-011-9998-0

Weitzman, L. J., Eifler, D., Hokada, E., & Ross, C. (1972). Sex-role socialization in picture books for preschool children. *American Journal of Sociology, 77*(6), 1125–1150. https://doi.org/10.1086/225261

West, C., & Zimmermann, D. H. (1987). Doing gender. *Gender & Society, 1*(2), 125–151. https://doi.org/10.1177/0891243287001002002

Wicht, A., Miyamoto, A., & Lechner, C. M. (2022). Are girls more ambitious than boys? Vocational interests partly explain gender differences in occupational aspirations. *Journal of Career Development, 49*(3), 551–568. https://doi.org/10.1177/0894845321991665

Wickham, H. (2016). ggplot2: Elegant graphics for data analysis. *Springer International Publishing*. https://doi.org/10.1007/978-3-319-24277-4

Wilke, C. O. (2015). *cowplot: Streamlined plot theme and plot annotations for 'ggplot2': R package version 1.1.3.* https://doi.org/10.32614/CRAN.package.cowplot

Witt, S. D. (1997). Boys will be boys, and girls will be…Hard to find: Gender representation in third grade basal readers. *Education and Society, 15*(1), 47–57. https://doi.org/10.7459/es/15.1.05

Witt, S. D. (2001). The influence of school texts on children's gender role socialization. *Curriculum and Teaching, 16*(1), 25–43. https://doi.org/10.7459/ct/16.1.03

Wolter, I., Braun, E., & Hannover, B. (2015). Reading is for girls!? The negative impact of preschool teachers' traditional gender role attitudes on boys' reading related motivation and skills. *Frontiers in Psychology, 6*, Article 1267. https://doi.org/10.3389/fpsyg.2015.01267

Wong, Y. L. A., & Charles, M. (2020). Gender and occupational segregation. In N. A. Naples (Ed.), *Companion to women's and gender studies* (pp. 303–325). Wiley. https://doi.org/10.1002/9781119315063.ch16

World Economic Forum. (2023). *Global gender gap report 2023: Insight report*. https://www.weforum.org/publications/global-gender-gap-report-2023/

World Health Organization. (2024). *Fair share for health and care: gender and the undervaluation of health and care work.* https://www.who.int/publications/i/item/9789240082854

Young, M., & Muller, J. (2016). *Curriculum and the specialization of knowledge: Studies in the sociology of education*. Routledge Taylor & Francis Group.

Yuval-Davis, N. (2006). Intersectionality and feminist politics. *European Journal of Women's Studies, 13*(3), 193–209. https://doi.org/10.1177/1350506806065752

Zala-Mezö, E., Totter, A., & Häbig, J. (2021). Schulbuch - Entstehung, Rolle und Bedeutung für Unterricht und Schule [Textbook - Development, role and significance for teaching and school]. In V. Manitius & T. Webs (Eds.), *Beiträge zur Schulentwicklung. Unterstützungssysteme für Schulen: Konzepte, Befunde und Perspektiven* (1st ed., pp. 105–122). wbv Publikation.

Ziegler, A., & Stoeger, H. (2008). Effects of role models from films on short-term ratings of intent, interest, and self-assessment of ability by high school youth: A study of gender-stereotyped academic subjects. *Psychological Reports, 102*(2), 509–531. https://doi.org/10.2466/pr0.102.2.509-531

Zuur, A. F., Ieno, E. N., Walker, N., Saveliev, A. A., & Smith, G. M. (2009). *Mixed effects models and extensions in ecology with R*. Springer Science + Business Media. https://doi.org/10.1007/978-0-387-87458-6