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The hidden lessons in textbooks: Gender representation and stereotypes in European mathematics and language books

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Abstract

This cross-national European comparison examined gender representation and stereotypes in mathematics and language textbooks from Germany, Italy, Lithuania, the Netherlands and Romania. The results showed that female characters were numerically underrepresented. Female characters were also less often a main character or individually portrayed compared to male characters, but not proportionally to the overall lower number of female characters. Characters in occupational roles were less often female than male, whereas among characters with gender non-conform characteristics, these were more often female than male in some textbooks. There was no sexual diversity among characters. The differences in gender representation are found within each country, but gender differences were smaller in more gender-egalitarian countries. If textbooks are to offer the same learning benefits to both boys and girls, students should be equally represented in a diversity of roles and occupations.

KEYWORDS
European school textbooks, gender non-conformity, gender representation, gender stereotypes, sexual diversity

1 | INTRODUCTION

While textbooks are primarily intended to convey knowledge (Gray 2013), they also convey social norms (Sovič & Hus, 2015). In textbooks, social norms about gender emerge in the form of representation and stereotypes (UNESCO, 2020). Studies have found that it matters whether people feel represented when learning, because this may influence their behaviour such as course selection (Bettinger & Long, 2005), school performance (Egalite et al., 2015) and the gender gap in education (Davis & Reynolds, 2018). In the current study, we aim to uncover the status of gender representation and stereotypes in European school textbooks.

1.1 | Gender representation: Numbers and roles

Gender representation refers to the numerical visibility of gender in textbooks, such as the absolute number of male and female characters. In addition, it is important to investigate the quality of representation, such as which roles male and female characters play and whether these are in line with stereotypes (Mills & Mustapha, 2015). According to social role theory (Eagly, 2013), gender stereotypes are consensual beliefs about gendered attributes (e.g. boys wear their hair short) and are the result of cognitive categorization about what a person or a group is like (e.g. boys like to experiment with building objects).

1.2 | Child development and gender equality in education

Young people's educational and career development is influenced by gender representation and stereotypes. When students do not feel represented, they may experience reduced feelings of belonging and self-esteem (Cheryan et al., 2017; Stout et al., 2011), as well as a decreased effort for studying (Good et al., 2010; Kim et al., 2018; Stout et al., 2011). This may lead to students being discouraged from pursuing education in fields that do not align with their perceived abilities. For example, women are less likely to study computer sciences (Cheryan et al., 2017; Stout et al., 2011). Such stereotypical career choices are problematic, because more gender balance in education and in occupational choices is likely to be beneficial to women's financial independence (McCaughey, 2023; McGrew, 2016), men's job security (Eurofound & European Commission Joint Research Centre, 2021) and overall a better match between people's abilities and ambitions (Zarrett & Lerner, 2008). More gender balance in education and in occupational choices will also benefit later generations. Children's cognitive abilities are found to improve when their mothers have a career (Brilli, 2022) and their fathers are involved in their upbringing (Rollè et al., 2019). In general, it seems that when young people are supported in realizing their full potential, society as a whole will benefit.

1.3 | Gender equality in Europe

The present study compares school textbooks from European countries regarding the representation of gender. Reports on gender equality show that in European countries attain high scores on gender equality compared to countries in other regions, but there is still room for improvement (Equal Measures 2030, 2022; UNDP (United Nations Development Programme), 2019). It is expected that there will be variations in the traditionality of gender representation and stereotypes in textbooks between European countries, depending on economic factors and social values. For this reason, textbooks from five countries were included: The Netherlands, Germany, Italy, Lithuania and Romania. Based on the 2022 SDG Gender Index, the Netherlands

(10th) ranks as the most egalitarian country in the sample, followed by Germany (33rd), Italy (54th), Lithuania (57th) and Romania (69th) as the most traditional country (see data on factors related to gender equality for each country in Table S4 in Appendix S1). Although there are several national studies on gender representation in textbooks, the results are difficult to compare because of variations in the sample characteristics and research methodologies between studies. To our knowledge, there have been no comparative studies on gender representation and stereotyping in textbooks in Europe. However, such studies are of interest, because studying variations between countries might uncover the most problematic topics concerning educational equality or even reveal best practices.

1.4 | Gender representation and stereotypes in textbooks

Researchers have found that learning materials such as textbooks contain an unequal gender representation, but the extent of this underrepresentation varies between countries. Studies on Dutch textbooks showed that female characters were not underrepresented in pictures in language books, but they are underrepresented when taking characters in pictures and text together (Koster, 2020; van de Rozenberg et al., 2023). Studies on German, Italian, Lithuanian and Romanian textbooks found an underrepresentation of 30%–40% female characters (Biemmi, 2015; Finsterwald & Ziegler, 2008; Grünberg, 1996; Ligių Galimybių Kontrolieriaus Tarnyba, 2019; Miroiu, 2004; Moser & Hannover, 2014). A more subtle way of underrepresentation can manifest in the number of times a specific character is mentioned (Lee & Collins, 2010). This is important to look into, because even if there are an equal number of female and male characters in textbooks, if male characters are mentioned more often, there is still an inequality in representation.

Besides inequality in numeral representation, characters can also be represented according to traditional gender stereotypes. There are several ways in which gender stereotypes can be present in textbooks. For example, previous research has demonstrated that female characters are underrepresented as main characters (Biemmi, 2015; Miroiu, 2004). It has also been shown that a minority of female characters in German textbook are portrayed as individuals rather than in relation to a husband or children (Finsterwald & Ziegler, 2008). And when it comes to occupational roles, textbooks predominantly show women in domestic roles and men in occupations (Blumberg, 2008), while actually, about 70% of European women (and 80% of European men) participate in the workforce (Eurostat, 2024). Additionally, women are currently found to work in a variety of jobs, but female characters in European textbooks have a more limited range of occupations compared to male characters (Biemmi, 2015; Cocorada, 2018; Finsterwald & Ziegler, 2008; Miroiu, 2004; Moser & Hannover, 2014).

1.5 | Non-conforming characters in textbooks

Because of the multitude of traditional stereotypes in textbooks, it is worthwhile to look into non-traditional gender roles as well (Biemmi, 2015; Niehaus, 2018). Gender non-conforming characters convey non-traditional messages about gender and can serve as role models. There are a few examples in European textbooks of 'brave' girls, and of women who work until late in the evening, but there are many more stereotype-confirming examples (Biemmi, 2015; Miroiu, 2004). Furthermore, studies of diversity in textbooks in recent decades have included LGBT characters (see Macgillivray & Jennings, 2008). This is an interesting development, not only because it provides an opportunity for representation for LGBT students but also because these types of characters challenge heteronormative ideas (Gray, 2013; Moore, 2020). These studies show that in US and European textbooks, there are very few mentions of sexual diversity (Gray, 2013; LUSK Autonomes Queerreferat der Universität zu Köln, 2011; Macgillivray & Jennings, 2008).

1.6 | The current study

In sum, this paper examines gender representation and gender stereotypes in mathematics and language textbooks in Germany, Italy, Lithuania, the Netherlands and Romania. Based on previous literature, in the current study the following hypotheses are tested for characters in European textbooks for languages and mathematics: (H1) There are fewer female than male characters; (H2) Female characters are mentioned less often than male characters; (H3) Main characters are less likely to be female; (H4) Female characters are less often portrayed as individuals as opposed to male characters; (H5a) Characters in occupational roles are less likely to be female than male; (H5b) Types of occupations are less diverse for female than for male characters; (H6) No or only very few characters will be described as sexually diverse; and Gender non-conform characteristics in male and female characters are explored.

2 | METHOD

2.1 | Materials

2.1.1 | Textbooks

For each country, Germany, Italy, Lithuania and the Netherlands, a mathematics textbook and a language textbook in the official language of the country were analysed. In the case of Romania, the analysis was limited to a mathematics textbook. This resulted in a sample of five mathematics textbooks and four language textbooks. These two subjects represent two domains that are stereotypically male (science) or female (language, see Steffens & Jelenec, 2011). All textbooks were coded from cover to cover. For every country, the selected textbooks were the ones used most often in the age group 12–13 years old. If there was a division of academic levels for this age group within schools, the middle level was chosen (e.g. the German Realschule). See Appendix S2 for a description of textbook selection for each country. The Dutch textbooks were coded as part of a larger national study (masked for review). Because general patterns of gender representation were studied, it is not in the interest of the study to identify the publishers of the selected books, and therefore, neither names of publishers nor the titles of the books are reported.

2.1.2 | Characters

All characters in texts and pictures for whom their gender was discernible were coded. Furthermore, if the number of members of the group was unknown (e.g. 'girls playing basketball'), this group of characters was excluded from the analyses, so that the analyses were only run with separately identifiable characters to allow for counting and comparing the number of characters. There was a joint probability of agreement of 70%–89% among coders on whether to include a character, this topic was continually discussed during the intervision sessions.

2.1.3 | Gender of characters

In the case of pictures, gender was assumed by the appearance of the characters (e.g. long hair or skirts for women). In the case of text, the gender of the character was assumed by their name, the pronouns referring to them or a gender-specific term. The probability of agreement among coders was 83%–96%.

We are aware that in our study, we are using binary gender categories, which is not in line with insights on the non-binary nature of gender (Morgenroth et al., 2021). Additionally, by categorizing characters through stereotypical indicators such as classifying characters by appearance, characters that are not stereotypically presented are ignored and thus run the risk of missing more subtle gender cues, such as when categorizing a female character with short hair as male. But research has shown that even children with flexible gender expressions still categorize gender in the same manner as gender-conforming children would (Glazier et al., 2020). Therefore, the categorization was conducted in a similar manner to children's gender perception: By only following clear cues consistent with gendered expectations (Maccoby, 2000). This could mean that, for example, a character with short hair was characterized as female if there were other clear gender indicators such as their pronouns.

2.1.4 | Taking up space

The extent to which characters took up space in the textbooks was measured by counting how often they were mentioned by name and the number of times they were referred to (e.g. as 'she' or 'her', 'their grandmother'). In pictures, the coders counted the number of times the same character was depicted throughout the book, and the intraclass correlation for interrater reliability ranged from .95 to .97.

2.1.5 | Main characters

In stories with one character, this character was always coded as the main character. When stories had multiple characters, the character from whose perspective the story was being told or the character that was central to the story was coded as the main character. When multiple characters contributed to the story equally, they were all coded as main characters. In pictures, characters were coded as the main character when they were by themselves or the centre of attention in comparison with the other people around them. There was a joint probability of agreement of 70%–96% among coders.

2.1.6 | Individual characters

Characters were coded as individuals when they were depicted by themselves. In text, they were coded when they had characteristics or showed behaviour that is not in relation to someone else (e.g. Maya won the race). The probability of agreement among coders was 90–96%.

2.1.7 | Occupational roles

The first author coded whether a character did or did not have a professional, paid occupation (e.g. journalist, engineer, baker). Voluntary work (e.g. referee local soccer club) and unpaid work (e.g. housework) do not fall under this definition, neither do mythical vocations such as Santa Claus. Additionally, the description of the occupation that was given in the textbook was listed and categorized according to the sub-major groups' classification of the International Standard Classification of Occupations 2008 (International Labor Organisation, 2012). Not all descriptions were classifiable (e.g. 'employee') and subsequently not included in the analyses.

2.1.8 | Sexual diversity

Sexual diversity was coded when a character was described in terms of a romantic relationship (e.g. 'his girlfriend called him', description of marital status) or when one person had romantic thoughts or feelings about another person (e.g. 'I met Luigi's sister and her new boyfriend'). Sexual diversity was also coded for famous people (e.g. Brad Pitt) whose sexual orientation is presented through the relationships and preferences they publicly express. There was a 90%–100% probability of agreement among coders.

2.1.9 | Gender non-conform characteristics

Coders assessed whether a character's behavior or description exhibited non-conforming characteristics. It was considered as such when the trait or action described is usually associated with the other gender than the character's gender, for example a man who is baking a pie or a woman playing rugby. The variable was extensively discussed during the training sessions to reach agreement. The probability of agreement among coders was 75%–96%.

2.2 | Procedure

An extensive coding system was developed to code gender messages in textbooks. This coding guide was written by the authors of this study. There was one coder per country, resulting in five coders in total. These coders were native speakers of the official language in their respective countries, except for the Romanian book, which was coded by a non-native, proficient speaker. There were three female and two male coders. The coders were intensively trained in several training sessions, to get familiar with the coding guide and the data. At the end of the training sessions, all coders completed a reliability set in English, consisting of approximately 40 pages of a mathematics and a language book in the English language.

2.3 | Data analysis

Three analyses were conducted for each hypothesis: the proportion of (1) male and female characters; (2) male and female characters per school subject; mathematics or language; and (3) gender per school subject within and between countries. All analyses were performed in SPSS (IBM Corp, 2020) unless otherwise mentioned. In line with other studies in this field (Gadassi & Gati, 2009; Good et al., 2010; Lee & Collins, 2010), all results were tested against a significance level of .05.

To analyse whether female characters are underrepresented, binomial tests were used. These tests allow for a comparison of the proportion of one level of a binary variable (e.g. gender: female) to a probability. To determine whether the proportions of female and male characters were equal, a binomial test estimated whether the proportion of female characters was 50%. Cohen's *g* (Cohen, 1988) was used to estimate the effect size, because Cohen's g reveals the difference between the sample proportion and 50%. Furthermore, binomial tests were used to determine whether there was a difference between the proportion of female characters that are main characters, individual characters or among those with an occupation and the overall proportion of female characters in textbooks. Cohen's h (Cohen, 1988) was used to estimate the effect size, as Cohen's h measures the difference between two proportions.

Next, male and female characters were compared for each subject, mathematics or language. To assess the association between the categorical variables of gender and school subject, a Fisher's exact test was employed, and

the effect size was estimated with Cramer's *V* (Cohen, 1988). Subsequently, the difference in underrepresentation of female characters between countries was estimated. The country proportions were compared using a chi-squared independence test. This test can be used to compare more than two countries. Pairwise *z*-tests indicated which countries differed from others in the underrepresentation of female characters.

Robust or non-parametric tests were chosen to compare the number of times a character was mentioned. Following the guidelines of the Tukey Method (Tukey, 1977), we found that the data for this hypothesis contained many outliers. Additionally, we found that the residuals were not normally distributed and there was heterogeneity of variance. This makes sense for the sample the current study: in some mathematics exercises, for example, when calculating interest on savings, the one who saves the money might be mentioned only once. However, in a short story for practising text comprehension, the main character will occur often. To calculate the gender comparison, the non-parametric Mann–Whitney test was conducted. To compare the number of characters between subjects and countries, robust ANOVAs were ran in jamovi (The Jamovi Project, 2022) with the walrus package (Love & Mair, 2022).

3 | RESULTS

3.1 | Gender representation

Our sample consisted of 9 textbooks containing 3017 characters and included characters from both text and pictures (see Tables S5 and S6 in Appendix S3). Of the 3017 characters, 1107 were female (37%) and 1910 were male. Binomial analyses showed that across countries, there were less female than male characters (see Table 1): The proportion of female characters for both subjects significantly differs from 50% in each of the five countries. For the mathematics books, a chi-square independence test with pairwise *z*-tests indicated a difference between countries, $\chi^2(4) = 12.99$, $p = .01$, $V = .12$. The proportion of female characters in the Romanian mathematics textbook was smaller than in the mathematics textbooks from the Netherlands. For language books, there was a difference between countries as well, $\chi^2(3) = 22.94$, $p < .001$, $V = .11$. The proportion of female characters in the Dutch language textbook was higher than in the Italian and Lithuanian textbooks.

3.2 | Gender differences in taking up space

Most characters (73%) were mentioned or depicted only once or twice, but some characters were mentioned much more often, up until 137 times. For all characters, a Mann–Whitney test showed no significant difference between the median number of times a female character (Mdn = 2.00, Range = 115) and a male character (Mdn = 1.00, Range = 136) were mentioned: $U = 1{,}037{,}135.50$, $z = -.940$, $p = .35$.

When differentiating between the subjects, there are similar results. There was no statistical difference between the median number of times a female character and a male character were mentioned in mathematics books (female $n = 376$, Mdn = 2.00, Range = 47; male $n = 538$, Mdn = 2.00, Range = 47; $U = 110{,}661.50$, $z = .26$, $p = .79$), nor in language books (female $n = 731$, Mdn = 1.00, Range = 115; male $n = 1.327$, Mdn = 1.00, Range = 136; $U = 476{,}594.50$, $z = -.74$, $p = .46$). A robust two-way ANOVA revealed no interaction effect for subject and gender ($Q = .17$, $p = .68$). Between countries, a similar pattern emerged. Robust two-way ANOVAs revealed no interaction effect for gender and country for mathematics books ($Q = 4.43$, $p = .37$), nor for language books ($Q = 1.93$, $p = .59$). See Table S7 in Appendix S4 for the statistics per country.

TABLE 1 The number and percentage of female characters per book and per country listed per hypothesis, as well as the effect size of the proportional difference with all female characters.

	Mathematics					Language			
Variables	**Germany**	**The Netherlands**	**Italy**	**Lithuania**	**Romania**	**Germany**	**The Netherlands**	**Italy**	**Lithuania**
% Female characters (*N*)	39%* [a,b] (113)	44%* [b] (139)	39%* [a,b] (51)	40%* [a,b] (52)	23%* [a] (21)	35%* [a,b,c] (62)	42%* [b] (294)	30%* [c] (149)	33%* [a,c] (226)
% Female main characters (*N*), Cohen's *h*	41% (90) .04	45% (124) .02	40% (45) .02	40% (48) .02	35%* (19) .27	38% (25) .06	43% (227) .02	34% (91) 0	35% (205) .04
% Individual female characters (*N*), Cohen's *h*	35% (80) .08	44% (139) 0	38% (48) .02	40% (52) 0	21% (10) .04	34% (57) .02	42% (294) 0	30% (139) 0	33% (221) 0
% Female in occupational role (*N*), Cohen's *h*	6%* (3) .85	21%* (10) .50	31% (5) .17	9%* (1) .73	0%* (0) 1.50	28% (19) .15	35%* (57) .14	10%* (11) .52	22%* (15) .25
% Female gender non-conform (*N*), Cohen's *h*	89%* (24) 1.12	83% (5) .88	86%* (6) 1.03	70% (7) .63	44% (4) .45	63%* (19) .57	73%* (8) .64	40% (8) .21	49%* (28) .33

Note: There is no data for a Romanian language textbook as we did not include this book in our corpus. [a,b,c]Significant difference at $p < .05$ per row by subject between the proportion of female characters. Percentages sharing the same superscripts do not differ significantly.

*Significant difference between the proportion of male and female characters at $p < .05$. For the first row of data, the asterisk indicates a significant deviation from .50, and for the other rows, the asterisk indicates a significant deviation from the proportion of overall female characters in this book and country.

3.3 | Gender representation among main characters and individuals

In all textbooks, there were 2233 main characters. Of these main characters, 874 characters were female (39%). There were fewer female than male main characters, but the proportion of female main characters was larger than the overall proportion of female characters in textbooks (37%). Furthermore, in all textbooks, there were 2849 individual characters (depicted in an individual role as opposed to a group member). Of these, 1040 characters were female (37%). There were fewer female than male individual characters, but the proportion of female individual characters did not differ from the overall proportion of female characters (37%). There were similar results for main and individual characters per subject and across countries (see Appendix S5 and Table 1 for statistics).

3.4 | Gender representation in occupations

Out of all characters, 18% ($n = 545$) were described as having an occupation. Of these, 22% ($n = 121$) were female. A binomial analysis shows that the proportion of female characters with an occupation significantly differed from the overall proportion of female characters (37%) (95% CI: 19%–26%, $p < .001$, Cohen's $h = .15$).

When looking into the separate subjects, a similar pattern of underrepresentation of female characters emerged. It became evident in both mathematics books (14% female characters; 95% CI: 0.9%–21%; differs from 39% overall; $p < .001$, Cohen's $h = .24$) and language books (25% female characters; 95% CI: 21%–30%; differs from 36% overall; $p < .001$; Cohen's $h = .11$). There was a significant association between gender and subject when looking into occupational status as assessed by Fisher's exact test, $p = .01$, Cramer's $V = .12$. The proportion of female characters with a job was smaller in mathematics books than in language books, and the limited occupational representation for female characters indicates a more traditional gender representation in mathematics books.

When looking into the gender representation of occupational status across the two subjects per country, there were similar results (see Table 1). Among characters with an occupation, there were less female than male characters, even when taking the overall proportion of female characters in textbooks into account. This difference was not significant for all countries, possibly due to a small sample size. When comparing the differences in proportions between countries, the values for Cohen's h show that the difference between male and female characters was largest in the Romanian and German mathematics books, medium-to-small in the Lithuanian and Dutch mathematics books and negligible in the Italian mathematics book. For the language books, the difference was biggest in the Italian language book, followed by the Lithuanian language book. The difference was small for the German and Dutch language books.

3.5 | Gender representation and occupational diversity

Out of the 545 characters portrayed within an occupational context, 513 occupations could be classified according to the ISCO-08 (International Labor Organisation, 2012). There was a clear difference among characters with an occupation: Female characters were represented in fewer occupational categories ($n = 20$) than male characters ($n = 35$). In mathematics books, the number of categories that female and male characters are represented in is respectively 10 and 28, and in language books 16 and 31. Within the countries, there is a similar pattern of how male characters have a wider variety of occupations than female characters (see Table 2).

Table 3 shows a ranking of the most mentioned job descriptions. When looking into gender representation in occupational descriptions, some similarities could be observed: Among characters with an occupation, both female and male characters were authors, teachers and athletes (see Table 3). Scientist is an occupation that was mentioned mostly for male characters; only four female scientists were specified in all nine textbooks taken together.

TABLE 2 Ratio of Job categories for female (f) and male (m) characters per country and subject.

Country	Mathematics	Language
Germany (f: m)	6: 16	7: 14
Netherlands (f: m)	7: 17	10: 17
Italy (f: m)	2: 5	8: 21
Lithuania (f: m)	0: 7	7: 16
Romania (f: m)	0: 6	–

TABLE 3 Top five most mentioned job descriptions by gender and the number of characters that were described in this occupation.

Rank	Female characters	Male characters
1	Author (28)	Author (51)
2	Teacher/instructor/trainer (17)	Scientist (41)
3	Athlete (12)	Teacher/instructor/trainer (26)
4	Actress/singer (6)	Athlete (12)
5	Announcer/interviewer/presenter (5)	Artist/glassmaker/sculpturer (10)

When looking into the different subjects, in mathematics books, female characters were mostly teachers, while male characters had a wider variety of occupations, similar to those in Table 3. In language books, there were similar job descriptions as in Table 3 (yet fewer scientists), but a distinction in occupations for female characters where appearance matters (e.g. actress, host) and occupations in the crafts (e.g. sculpturer) for male characters becomes evident.

When comparing within countries, job descriptions remained similar compared to the descriptions above. Because the sample size per gender per subject per country was small, it is not possible to describe patterns between countries.

3.6 | Sexual diversity in textbooks

Of all 3017 characters, only 81 characters (3%, of which 48 female) were described in terms of romantic relations or romantic interests. Upon examination of the written descriptions, it was noted that all of the characters were depicted in heterosexual relationships. There were no sexually diverse characters.

3.7 | Gender non-conformity in textbooks

Lastly, gender representation was examined among characters portrayed with gender non-conform characteristics. Out of the 3016 characters (gender non-conform information about one character was missing), 175 (6%) were described with gender non-conform characteristics. Of these characters, 109 (62%) were female. Binomial analyses show that this proportion significantly differed from 37% (95% CI: 55%–70%, $p = .001$, Cohen's $h = .51$). There were more female than male characters portrayed with gender non-conform characteristics.

In mathematics books ($n = 59$), the proportion of female characters (78%) significantly differed from 39% (95% CI: 65%–88%, $p < .001$, Cohen's $h = .82$). In language books ($n = 116$), the same pattern was found (54% female characters, which differs from 36%; 95% CI: 49%–64%; $p < .001$; Cohen's $h = .36$). When comparing between the subjects, there was a significant association between gender and subject as assessed by Fisher's exact test,

$p = .003$, Cramer's $V = .23$. This indicates that the gender difference in characters portrayed with gender non-conform characteristics is smaller in language books than in mathematics books, pointing towards a more traditional gender pattern in mathematics books.

When looking into the differences within individual countries, it was found that more female than male characters are portrayed with gender non-conform characteristics (see Table 1). But because of small sample sizes, these results should be interpreted with caution. The effect sizes of the between-countries comparisons indicate that the differences are largest in the German, Dutch and Italian mathematics books, followed by Lithuanian and Romanian mathematics books. There was a similar pattern in language books; the difference is largest in the German and Dutch language books, followed by the Lithuanian and Italian language books.

4 | DISCUSSION

Our results showed an underrepresentation of female characters in European school textbooks. There was no gender difference in number of mentions of the same character. There were fewer main and individual female than male characters, but they were not underrepresented above and beyond the overall levels of underrepresentation of female characters. Characters in occupational roles were less often female, and female characters were represented in less occupational categories than male characters. But within characters showing gender non-conform characteristics, females were overrepresented. There were no representations of sexual diversity in textbooks. These differences were found in both language and mathematics books but for occupations and gender non-conformity, gender differences seem to be smaller in language books. Differences in gender representation and stereotypes were present within each country in the current study, although not universally: Within-countries differences seem smaller in more egalitarian countries (especially the Dutch textbooks), as compared to the more traditional countries (i.e. Italy, Lithuania and Romania).

4.1 | Female characters are underrepresented

As expected, there was an underrepresentation of female characters in European textbooks, for both subjects and in all countries. This finding is in line with previous studies (Biemmi, 2015; Blumberg, 2008; Cocorada, 2018). There was no difference in gender representation between mathematics and language books, but as expected, the gender differences are smaller in more egalitarian countries such as the Netherlands and Germany as compared to more traditional countries (i.e. Italy, Lithuania and Romania). It remains noteworthy that even in the more egalitarian countries, there was still an underrepresentation of female characters. Because gender representation influences pupil's attitudes on gender roles (Kneeskern & Reeder, 2022) and educational gender representation is associated with higher educational performance (Davis & Reynolds, 2018; Good et al., 2010), the finding of an underrepresentation of female characters might indicate a larger benefit of education for boys than girls, even in more gender egalitarian countries such as in Europe. This inference is supported by statistics showing that in all countries in the current study, women are underrepresented in positions with decision-making authority (EU 2019 report equality men women). Additionally, statistics have shown that on average, men in Europe, and men in most of the individual countries in the current study, had more years of schooling than women (UNDP, 2024).

4.2 | No gender differences in taking up space

Contrary to our expectations, there was no gender difference in the number of times specific male and female characters were referred to in textbooks. This means that a female character, such as Florence Nightingale, is not mentioned

less often in textbooks than a male character, such as Shakespeare. This finding applied to all characters taken together, within mathematics and language textbooks, between these subjects, and between and within countries. These findings are in contrast with earlier studies revealing that female characters were mentioned less frequently than male characters (Biemmi, 2015; Lee & Collins, 2010). Since there were no differences, this may signal a development where textbook authors are increasingly selecting a female main character to compensate for the gender imbalance in textbooks, as recommended by national and international policies on educational equality (Biemmi, 2015; UNESCO, 2017). To find out if there is indeed a shift towards equal gender representation in textbooks, we suggest conducting a study on changes in the gender of main characters over time. However, the finding that female characters were not mentioned less often did not alter the gender imbalance in textbooks. The current research revealed that there were approximately 1.5 male characters for every female character. Therefore, even if male and female characters are mentioned equally often, pupils are still more likely to encounter male names than female names in their textbooks.

4.3 | Underrepresentation of female main characters

There is a similar gender imbalance when looking into main characters. Even though there was an underrepresentation of female main characters, it was not as large as expected: There were more female main characters compared to the overall proportion of female characters, but this finding had a very small effect size. Consequently, it is not surprising that there were no gender differences when analysing main characters between mathematics and language books, nor within or between countries. In the Romanian mathematics book only, there were more female main characters than expected, yet fewer than male main characters. While this is a significant finding, it is notable that both the proportion of female characters and the proportion of female main characters in the Romanian mathematics book are the lowest in the country comparison. There are no studies about changes over time on the gender of main characters, but the current findings could signal a development where textbook authors increasingly choose a female main character to even out the gender imbalance in textbooks, as requested in national and international policies on educational equality (Biemmi, 2015; UNESCO, 2017).

4.4 | Underrepresentation of female individual characters

As expected, there was an underrepresentation of female individual characters in textbooks (characters that are portrayed as being alone or independent), but this underrepresentation of female individual characters is comparable to the already smaller proportion of female characters in the textbooks. There was no gender difference in individual characters between mathematics and language books, nor between countries. The findings show a substantial proportion of female characters that are portrayed as individuals. Our numbers are slightly higher than in another research (Finsterwald & Ziegler, 2008). This could indicate that it is becoming more commonplace to portray female characters as individuals and not in connection to someone (e.g. as a mother). This inference is in line with research findings that in the last decades, women place more importance on their career and financial independence (Goldin, 2006; Ponthieux & Meurs, 2015).

4.5 | Underrepresentation of female characters among characters with an occupation

For other messages in textbooks, gender differences are still evident. As expected, there was a strong underrepresentation of female as compared to male characters among those with an occupation. This is in line with previous studies (Biemmi, 2015; Blumberg, 2008; Cocorada, 2018; Finsterwald & Ziegler, 2008; Miroiu, 2004; Moser

& Hannover, 2014) and conveys the message that having a paid job is more for men than for women. There are also gendered messages about the type of occupations: Occupations of male characters were more diverse than those of female characters. Moreover, male characters were more often described as scientists, and in mathematics books, female characters were almost exclusively teachers. This image of gendered occupations is in line with previous studies (Biemmi, 2015; Cocorada, 2018; Finsterwald & Ziegler, 2008) and conveys the message that some occupations are more suitable for women than others. Evidence suggests that messages about gendered occupations may influence adolescents' educational and career choices: For instance, traditional gender stereotypes have been linked to a decreased likelihood that girls will choose a STEM major (Makarova et al., 2019). Furthermore, they can reduce women's interest in traditionally masculine occupations (Rudman & Phelan, 2010). For instance, traditional gender stereotypes are related to girls' decreased interest in a political career (Bos et al., 2022). There were divergent patterns when looking into occupational differences between the countries: In language books, gender stereotypes are, as expected, more traditional in the culturally more traditional countries. But in mathematics books, effect sizes show substantial differences for both egalitarian and traditional countries. This latter finding is in line with research on gender differences in science, technology, engineering and mathematics (STEM): While girls in economically developed and egalitarian countries might have more access to a STEM education, they seem to be less inclined to choose accordingly (e.g. because of lower perceived self-efficacy for STEM). But girls from less economically developed and egalitarian countries will have less access, yet might be more likely to choose STEM education (e.g. because if they can enter the labor market, this field would offer economic stability) (Stoet & Geary, 2018). This shows that several variables might influence the gender gap in STEM education and might explain why this gap exists in some but not all egalitarian and traditional countries.

4.6 | No sexual diversity in textbooks

There were no examples of diversity in characters' sexuality in European textbooks. Because previous literature points to very few cases of sexual diversity among textbook characters, for example in German history books (LUSK Autonomes Queerreferat der Universität zu Köln, 2011), we did not expect to find none. Simply dismissing this result as a sampling issue does not seem to do it justice, as other comprehensive national studies also report no sexual diversity among textbook characters (Ligių Galimybių Kontrolieriaus Tarnyba, 2019; masked for review). The attitude towards sexual diversity is more negative in countries where same-sex marriage is not legal (Abou-Chadi & Finnigan, 2019), which might explain the absence of such characters in Italian, Lithuanian and Romanian textbooks. But in countries that are more tolerant towards sexual diversity, such as the Netherlands, religious groups seem to influence the curriculum (Maussen & Vermeulen, 2014). Omitting sexual diversity from textbooks should be discouraged since this deprives pupils of a learning opportunity about the diversity of relationships and family types and it might reinforce negative stereotypes (Koster, 2020; Macgillivray & Jennings, 2008; UNESCO, 2017). One way to address the inclusion of sexually diverse characters in textbooks is to add exercises that implicitly mention such characters but are consistent with the subject matter. For instance, a mathematics exercise could involve two men buying their first house together, and students would need to calculate the interest rate of the mortgage. With this approach, the exercise remains relevant to all students, and sexually diverse characters are integrated into the book instead of being portrayed as an exception.

4.7 | Overrepresentation of female characters with gender non-conform characteristics

Exploratively, gender non-conform characteristics were considered. A strong overrepresentation of female characters was revealed in such situations overall, across subjects and countries. This conveys the image that it

is more acceptable for women to display gender non-conform behaviour than for men, which is in line with the notion that there are stricter prescriptive stereotypes (i.e. how people should behave) for men than for women (Koenig, 2018). However, it is important to have gender non-conforming role models, as they can demonstrate the potential for diversity and progress (UNESCO, 2017). For future research, we suggest looking into the type of gender non-conform activities that male and female characters engage in. More insight into this topic may provide more information about the effect of counter-stereotypical characters and about role models in textbooks. An example of integrating gender non-conform characteristics in a language book could be to include a story about a father that takes care of his children while the mother is at work.

Furthermore, there was a difference between countries: There were more female than male characters with non-conforming characteristics in the more egalitarian countries compared to the traditional countries. While in textbooks in egalitarian countries, women were described as, for example, earning a high salary, men in these countries were not described as, for example, spending time with their children. This aligns with research indicating that in egalitarian societies, perceptions of typical female characteristics shift, while perceptions of typical male characteristics remain constant (Gustafsson Sendén et al., 2019; Wilde & Diekman, 2005). Moreover, studies have shown that in traditional countries, people perceive an increase in feminine characteristics in men (Lopez-Zafra & Garcia-Retamero, 2011).

4.8 | Mathematics textbooks display more traditional gender stereotypes than language textbooks

The current data indicate that mathematics books are more traditional than language books when looking into gender stereotypes such as occupations. This is in line with previous research (Moser & Hannover, 2014) and might be explained by the differences in space for elaborations on characters. The Elaboration Likelihood Model (Petty & Cacioppo, 1986) describes how for quick decisions people may rely on stereotypes (e.g. matching a character name with an activity description in a mathematics book), but less so when they have to think about characters more extensively (e.g. when writing a page-long story for a language book). But as a possible consequence, currently, girls might benefit more from their representation in language, than in mathematics books, yet the objective is that all students benefit equally. The finding that mathematics books seem to convey more traditional messages than language books might contribute to explanations of gender differences in educational choices, such as the underrepresentation of female students in STEM.

4.9 | Traditional countries show larger gender differences than egalitarian countries

As expected, a greater underrepresentation of female characters was identified in more traditional countries. This aligns with research arguing that social ideologies are reflected in school textbooks (Issitt, 2004). A greater female underrepresentation may convey the image that women are less visible in more traditional countries than in more egalitarian countries. Consequently, girls from traditional countries, who have fewer opportunities to identify with a character in their textbooks, may benefit less from education than girls from more egalitarian countries. The current findings on gender differences in occupation further illustrate this gap: Gender differences in occupation are more pronounced in language books from more traditional countries compared to more egalitarian countries. This is consistent with previous studies that have shown higher support for traditional female roles in countries with lower female labor market participation, which are often traditional countries (André et al., 2013; Guetto et al., 2015). The lower number of examples of women with an occupation in textbooks in traditional countries may discourage girls from more traditional countries from pursuing a career to a greater extent than girls from more egalitarian countries.

4.10 | Limitations and recommendations

Our corpus consisted of only one book per subject per country, and there was only one textbook from Romania. A larger corpus might have improved the validity of the current data. Also, difficulties determining the most widely used textbook for each country or subject (see Appendix S2) might have affected the generalizability of the findings from Germany, Lithuania and Romania. The current results may not fully reflect gender representation and stereotypes in all textbooks in each respective country. As a result, the country comparison may provide a different perspective on the difference between egalitarian countries as compared to traditional countries. Nevertheless, recent national studies on textbooks from the respective countries show similar results to ours (Biemmi, 2015; Cocorada, 2018; Koster, 2020; Miroiu, 2004; Moser & Hannover, 2014), which suggests that the current study presents an adequate reflection of gender representation in textbooks. Another limitation is that each textbook was rated by one coder. The reliability of the current data might have been stronger if the books were rated by multiple coders, but our approach has the advantage that coders rated books in their native tongue thus leaving less room for errors when coding. Because coders received a collective intensive training, showed good coding reliability and received intervision during the coding, reliability was ensured.

While the current study included a diverse selection of countries, it might have been beneficial to add data from a country where textbooks offer an egalitarian image of men and women. There are only very few such examples. Swedish textbooks seem to come close; they depict an egalitarian representation and sparsely contain traditional gender stereotypes (Blumberg, 2008). Such data could offer insights into the interaction of national culture and gender representation and might offer examples of best practices.

To learn more about impact of gender messages on pupils' learning process in different national contexts, we propose a follow-up study to examine gender messages in textbooks over time. A study examining gender representation and stereotypes in textbooks across different countries over the past 50 years could provide insights into whether gender representation has become more equal, role diversity in characters has progressed, and how gender differences in numerical representation and occupational roles in traditional and egalitarian countries have developed.

5 | CONCLUSION

To our knowledge, this is the first cross-national study on gender representation and stereotyping in European school textbooks. The current results show that female characters are still underrepresented, and both male and female characters are traditionally presented in European textbooks, especially where social roles such as occupational status are concerned. This is the case even in more egalitarian countries. This means that textbooks reflect a society based on stereotypes rather than current gender roles in society. But even if textbooks were to reflect current roles, this would not be sufficient to provide optimal learning conditions (Good et al., 2010), because it would simply reproduce the current inequal status quo of a society where most teachers are female and engineers are male. Instead, if schools and textbook institutes want to support gender equality, they should present an equal portrayal of men and women in diverse roles. Such a balanced representation is important because books that reflect the reader and the reader's ambition will motivate them to learn and grow (Bishop, 1990). We suggest that textbook publishers take steps to ensure equal representation, for example by using a random name generator. We also encourage schools to contribute to equal representation by offering additional learning materials with counter-stereotypical role models such as world champion Sebastian Vettel who quit Formula 1 racing to spend more time with his kids, or mathematician Ada Lovelace, who wrote the first computer program. In this way, hopefully, every pupil will feel inspired when they see an equal number of men and women performing a variety of roles in their learning materials.

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CONFLICT OF INTEREST STATEMENT

All authors declare that they have no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study will be made openly available in DataverseNL at https://dataverse.nl/.

PREREGISTRATION

This study was preregistered on OSF: https://archive.org/details/osf-registrations-nkxwu-v1.

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