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Gender Stereotypes and Bias in School Mathematics Textbooks: A Systematic Literature Review

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ABSTRACT

Textbooks, as essential learning resources, significantly influence students' development, values, beliefs, and cultural understanding. They shape gender socialization and societal norms, imparting gender roles, identities, and biases. Creating gender-neutral textbooks necessitates comprehensive analysis, prompting numerous local and international studies on gender stereotypes and biases in educational materials. This review paper aims to examine five specific aspects of the selected research: the portrayal of gender in (i) illustrations and examples, (ii) language and terminology, (iii) sports and games, (iv) professional and activity representation, and (v) cultural and regional differences in the portrayal of gender in mathematics textbooks. A wide-ranging strategy was employed to search and identify research papers from Web of Science, Scopus, Springer Link, Google Scholar, Semantic Scholar, and ERIC. The chosen papers span the years 2003 to 2024. Out of 265 results generated, 55 publications representing 35 selected papers were chosen and themed for discussion, investigating gender stereotypes and biases in mathematics textbooks at the school level. The study's findings lay the groundwork for policy changes at the state or national level, ensuring the development and implementation of guidelines that foster gender-neutral content in educational materials. These results are also valuable for textbook development agencies, authors, and educators in creating a gender-sensitive curriculum and textbooks. Ultimately, the implications of this research will help future researchers identify areas for further study.

KEYWORDS

Gender stereotypes; gender bias; mathematics; textbook; systematic literature review.

Introduction

Textbooks are the most important, indispensable, affordable, and easily accessible educational materials. They provide essential knowledge that students follow to learn and can significantly influence students' thoughts (Zhou et al., 2021). Textbooks play a pivotal role in shaping both individual and societal behavior, as highlighted by Saleem and Zubair (2013). The content and messages conveyed in textbooks can have either positive or negative impacts on the cognitive, affective, and social development of children. This impact is achieved through the transmission of implicit or explicit images and written narratives within the educational materials (Sever, 2004). Textbooks significantly influence students' perceptions of gender concepts. They have the potential to shape learners' cultural heritage and contribute to the formation of their gender identity (Ullah, Ali, & Naz, 2014). Additionally, textbooks can impact gender stereotypes and social power dynamics (Kobia, 2009). They play a crucial role in shaping gender models for boys and girls, reinforcing gender stereotypes (Arslan Ozer, Karatas, & Ergun, 2019). School education is recognized as a crucial stage in education, strategically important for shaping learners' perspectives on humanity, molding attitudes, imparting knowledge, and developing fundamental skills (Halimatussakdiah et al., 2021). The primary-level curriculum is instrumental in cultivating the mindset of young learners, influencing their behavior, and combating gender biases (Ali & Hussain, 2019). Textbooks, integral to this process, contribute to instilling desirable attitudes in children (Sumalatha, 2004), making primary-level textbooks a focus of research across societies. Gender representation in school textbooks has been a longstanding research topic, with scholars highlighting the prevalence of masculinity and femininity stereotypes in these educational materials. Over recent decades, discussions, and studies on gender in education and textbooks have gained prominence, emphasizing the critical role of textbooks in promoting specific gender ideologies or values (Ariyanto, 2018). The relationship between gender and textbooks is reciprocal, as textbooks both reflect and construct gender norms within a culture (Aydnoglu, 2014). Consequently, the issue of gender in textbooks significantly influences students' learning experiences and attitudes (Ansary & Babaii, 2003).

This review study on gender stereotypes and bias in school education mathematics textbooks lies in its comprehensive examination of existing literature to highlight the pervasive issue of gender inequality in educational resources. By systematically identifying, analyzing, and interpreting relevant studies, this research sheds light on the extent and nature of gender biases embedded in textbooks, which can influence young learners' perceptions and attitudes toward gender roles. The findings of this study can inform educators, policymakers, and curriculum developers about the critical need to address and rectify gender disparities in educational materials, thereby promoting a more inclusive and equitable learning environment. Additionally, this research can serve as a valuable resource for future studies aimed at understanding and combating gender biases in education globally.

Objectives of the Study

- To analyze the portrayal of gender in illustrations and examples within school mathematics textbooks.
- To examine the use of language and terminology in mathematics textbooks for potential gender bias.

- To investigate the representation of sports and games in mathematics textbooks with a focus on gender inclusivity.
- To evaluate the depiction of professional roles and activities in mathematics textbooks and their alignment with gender stereotypes.
- To explore cultural and regional variations in the portrayal of gender in school mathematics textbooks.

Methodology

This study employed a systematic literature review (SLR) methodology to analyze gender stereotypes and biases in school mathematics textbooks. The SLR approach ensures a comprehensive, transparent, and reproducible analysis of existing literature, adhering to the guidelines outlined by Moher et al. (2009) and Tranfield, Denyer, and Smart (2003). To focus on previous research regarding gender stereotypes and biases in textbooks both in India and internationally, Google Scholar, ERIC, Scopus, Web of Science, Semantic Scholar, and Springer Link were chosen as the primary databases. This selection aimed to enhance the likelihood of locating pertinent literature. The search terms used were "gender stereotypes in textbooks," "gender bias in educational materials," "mathematics textbooks gender representation," and "gender equality in school textbooks." Ultimately, publications were identified that met the established criteria.

Publication Selection and Screening

The authors compiled the selected information into a spreadsheet. Initially, they manually checked the titles and abstracts of the papers before proceeding to read the full texts. This process helped determine if the papers met the criteria for the review. They ensured that the chosen papers were relevant to the main topic and selected them carefully.

Exclusion and Inclusion Criteria

The authors selected documents and data for the review by focusing on papers that formally investigated gender stereotypes and bias in school mathematics textbooks, including those based on consultations. They examined studies from organizations, institutions, Departments of School Education, and government sources. The research needed to cover themes such as gender discrimination in textbooks, bias in images, gender issues in the curriculum, and the extent of gender bias in mathematics textbook literature.

Table 1. *Inclusion and exclusion criteria*

Inclusion criteria	Exclusion criteria
⇒ Studies published between 2003 and 2024.	⇒ Studies not directly related to gender stereotypes or biases in textbooks.
⇒ Peer-reviewed journal articles, conference papers, and reports.	⇒ Non-peer-reviewed articles, editorials, and opinion pieces.
⇒ Studies focusing on gender representation in school textbooks, particularly mathematics textbooks.	⇒ Articles not available in full text.
⇒ Articles available in English.	

Data assessment and extraction

The authors collected information from all the selected papers by following a systematic plan that included examining the topic, year of publication, publisher, focus, outcomes, and keywords. They reviewed each paper's topic and outcomes separately before organizing the data. Throughout the review process, the authors continuously checked all the papers to ensure accuracy and consistency.

Delimitation of the Study

- The timeline for the review includes publications from 2003 to 2024, with duplicate publications being eliminated to maintain accuracy.
- The primary focus of the reviewed works is on gender stereotypes and bias in mathematics textbooks.

Data Presentation, Analysis and Result

The Figure 1 indicates the PRISMA (2020) diagram illustrates that a total of 265 outputs were generated from the initial review. After eliminating 75 duplicates, 190 abstracts, and titles were chosen for further examination. Out of these, 55 publications, representing 65 distinct papers, were deemed eligible for a comprehensive review, and considered suitable for the study. Additionally, 210 papers were found to lack sufficient information relevant to the topic and themes under review.

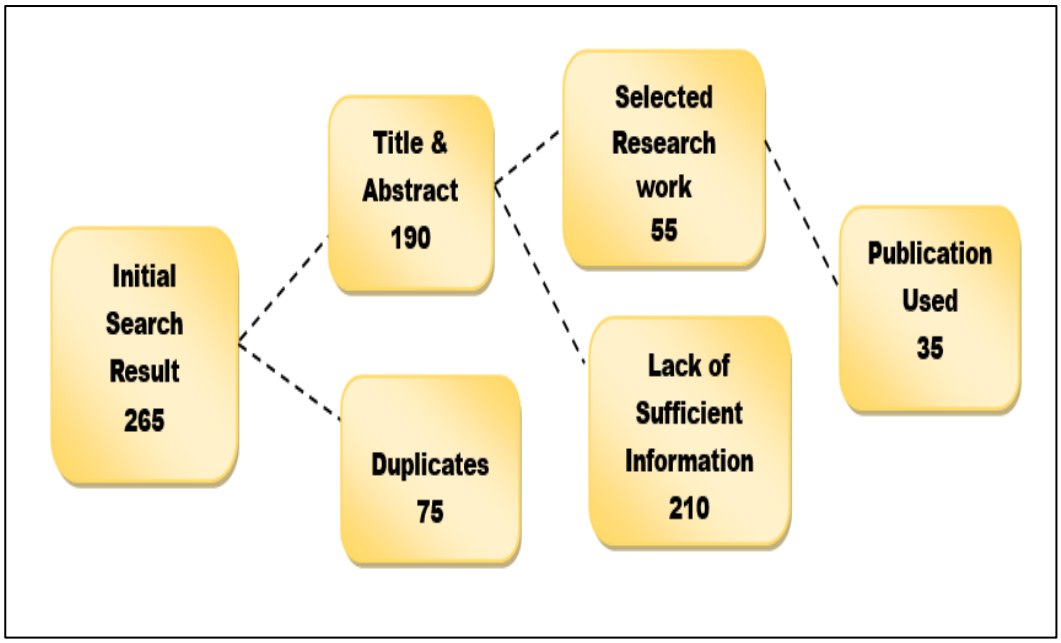

Figure 1. *PRISMA diagram*

Year-wise presentation of different types of published research work and databases where the studies were collected

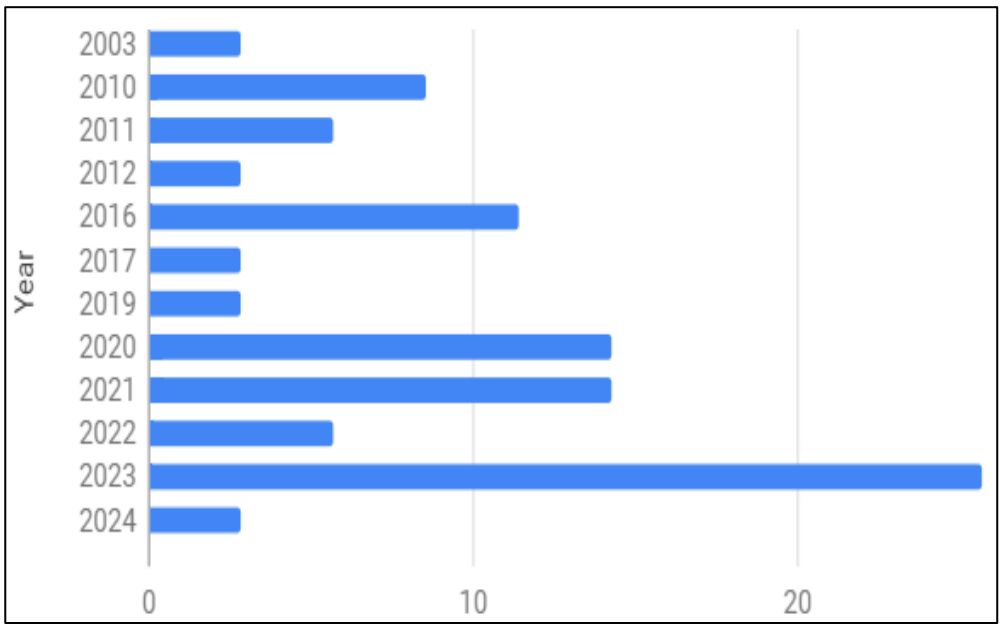

Figure 2. *Year-wise publication of selected papers*

The above Figure 2 shows that of the 35 selected papers, most were published in the year 2023 (9 or 25.7%), followed by 2020 and 2021 (5 or 14.2% each). The next highest number of publications was in 2016 (4 or 11.4%), followed by 2010 (3 or 8.5%). The years 2011 and 2022 each had 2 publications (5.7%). The years 2003, 2012, 2017, 2019, and 2024 each had 1 publication (2.8%).

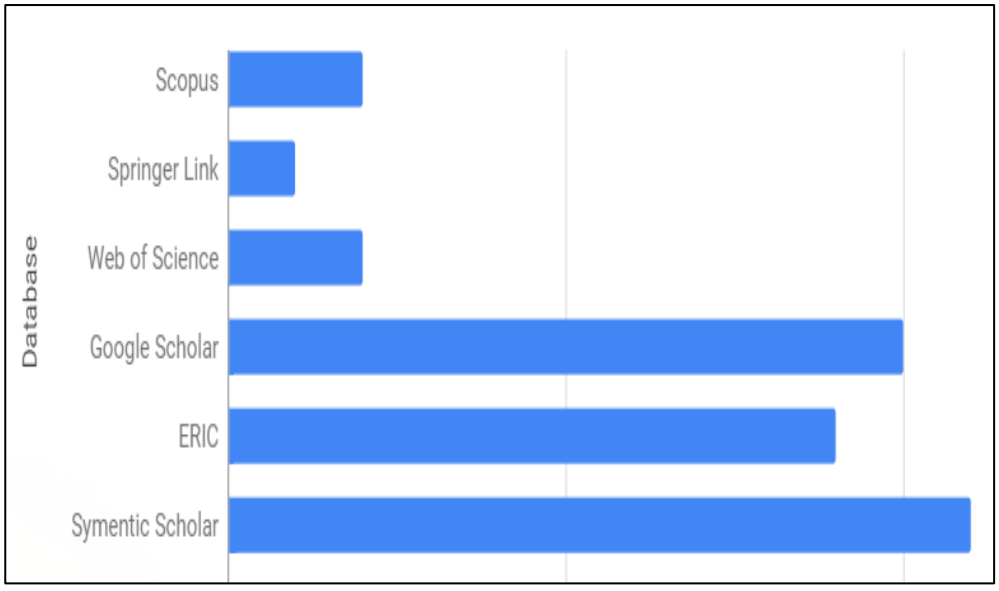

Figure 3. *Selected papers were collated from different databases*

The above Figure 3 shows the distribution of selected publications across different sources. The total number of publications is 35. Most came from Symantec Scholar (11 or 31.4%), followed by Google Scholar (10 or 28.5%) and ERIC (9 or 25.7%). Scopus and Web of Science each contributed 2 publications (5.7%), while Springer Link had the fewest with 1 publication (2.8%).

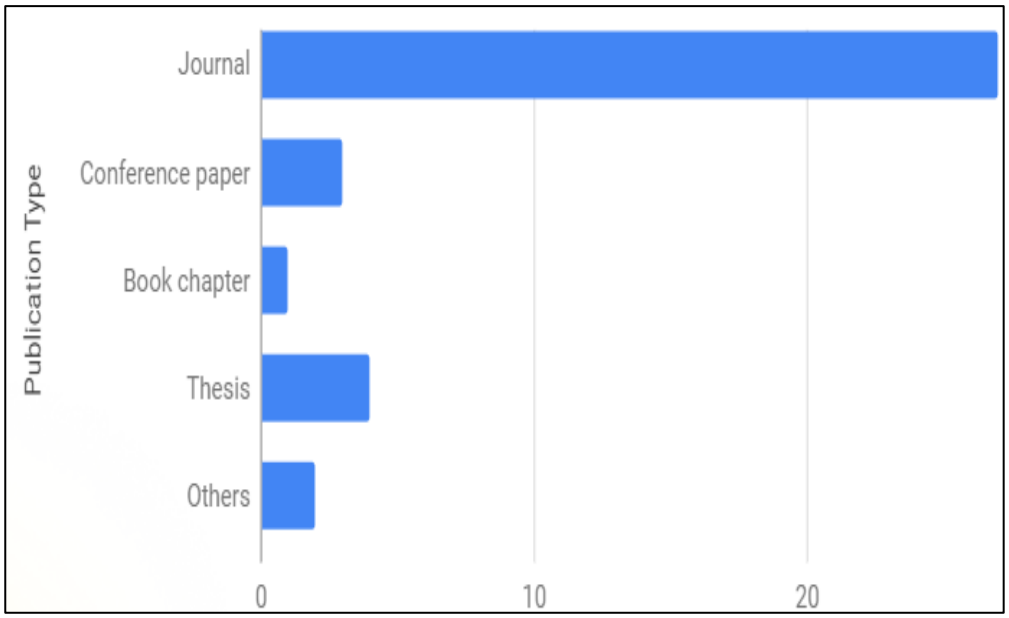

Figure 4. *Types of publication of selected papers*

The above Figure 4 shows that of the 35 selected publications, most are journal articles (25 or 71.4%), followed by theses (8 or 22.8%). Conference papers account for (3 or 8.57%), while book chapters represent (1 or 2.8%). Other types of publications constitute (2 or 5.7%). This distribution highlights a strong emphasis on journal articles, followed by theses and conference papers, with book chapters and other forms being less prevalent.

Country of publication as well as the methodology applied in those papers

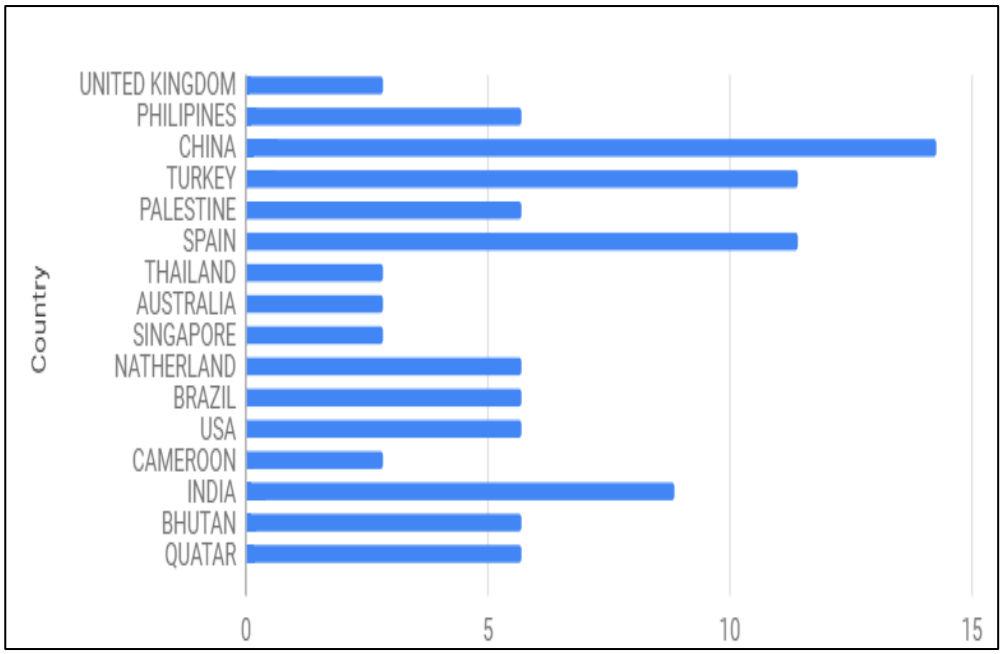

Figure 5. *Countries of the selected publication*

The above Figure 5 shows the distribution of selected publications across different countries. China has the highest number of publications (5 or 14.28%), followed by Turkey and Spain, each with 4 publications (11.42%). India contributed 3 publications (8.87%). The Philippines, Palestine, Netherlands, Brazil, USA, Bhutan, and Qatar each contributed 2 publications (5.71%). The United Kingdom, Thailand, Australia, Singapore, and Cameroon each contributed 1 publication (2.85%).

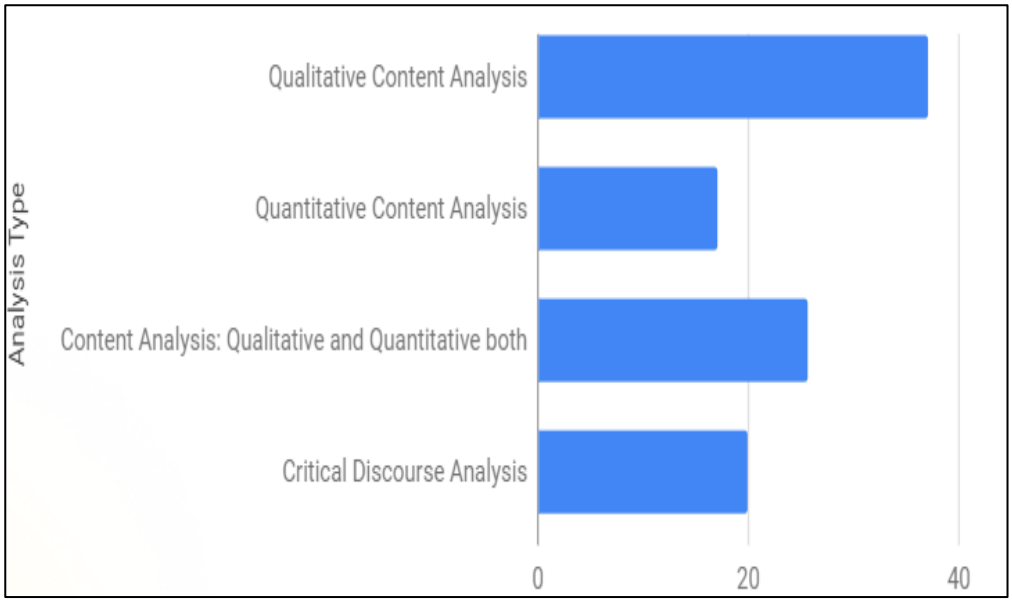

Figure 6. *The methodology used by the selected publications*

The above Figure 6 highlights most used method for analyzing gender stereotypes and bias in school mathematics textbooks is Qualitative Content Analysis, utilized in (13 or 37.14%) of the studies. This is followed by Content Analysis which combines both qualitative and quantitative approaches, used in (9 or 25.71%) of the studies. Critical Discourse Analysis accounts for (7 or 20%) of the studies, while Quantitative Content Analysis is the least used method, appearing in (6 or 17.14%) of the studies.

The below table 2 shows that out of the 35 publications, 22 (62.85%) discussed gender stereotypes and bias in textbooks through illustrations and examples. 17 (48.57%) of the published research focused on language and terminology, while 14 (40%) addressed the portrayal of gender in sports and games. Additionally, 18 (51.42%) of the publications examined gender stereotypes and bias through the visualization of profession and activity representation. Finally, 6 (17.14%) of the research works discussed regional differences in gender stereotypes and bias in textbooks.

Table 2. *Summary of themes and selected research work for review*

Category of theme	Journal Articles	Conference paper	Book Chapter	Thesis	Others
Portrayal of Gender in Illustrations and Examples	E27, E4, E21, E32, E34, E14, E29, E31, E35, E33, E34, E22, E25, E28, E32, E24		E15	E3, E13, E30, E12, E24	
Portrayal of Gender in Language and Terminology	E8, E11, E1, E6 E18, E19, E23, E33, E34, E22, E34, E16, E19	E26, E9			E33, E14
Portrayal of Gender in sports and game	E10, E22, E32, E34, E21, E27, E4, E21, E3, E13,		E20, E2		E33, E14
Portrayal of Gender in Profession and Activity Representation	E17, E18, E33, E34, E22, E34, E30, E12, E14, E6 E18, E19	E5	E15, E7	E30, E12, E24	E14
Cultural and Regional Differences in Portrayal of Gender in Textbook	E29, E31, E35, E23,			E30, E12,	

Note: "E" is a code used to categorize each of the research work included in the review.

Summary of the result

The result shows that most of the selected papers are from the year 2003 to 2024, also journal articles (71.4 %), as well as literature reviews (28.6 %), on gender stereotypes and bias in mathematics textbooks were the most reviewed in the study. This indicates that the review was thoroughly conducted with current and relevant publications. However, most of the countries represented gender stereotypes and biases presented in mathematics textbooks.

Discussion

Portrayal of Gender in Illustrations and Examples

Gender stereotypes and biases in educational materials, especially illustrations and examples, perpetuate traditional gender roles and influence students' perceptions of abilities and identities. Studies on mathematics textbooks from various countries highlight these biases and their impacts. Nurlu (2021) found significant gender imbalances in Turkish primary school textbooks, with males depicted in active roles and females in passive ones, reinforcing stereotypes that discourage girls from pursuing mathematics. Karama (2020) noted a consistent underrepresentation of females in Palestinian textbooks, portraying them in traditional roles and males as leaders, which limits girls' aspirations. San (2023) observed similar biases in Chinese textbooks, where boys were central figures in mathematical reasoning, suggesting male dominance in the field. Ullah et al. (2017) reported that in Azad Jammu & Kashmir, males were shown in professional settings while females were in domestic roles, promoting the idea that mathematical careers are for men. Guichot-Reina and De la Torre-Sierra (2023) highlighted persistent stereotypes in Spanish textbooks, depicting males as more capable, undermining girls' confidence. Tang, Chen, and Zhang (2010) found that Chinese textbooks showed boys as adventurous and girls as passive, shaping young students' career interests. Java and Parcon (2016) saw similar male dominance in Philippine textbooks, affecting girls' self-perception. Tsai (2020) noted in Thai textbooks that males were depicted as more successful, impacting girls' self-efficacy. Kandilli (2020) called for gender-neutral representations in Turkish textbooks, finding traditional roles still prevalent. Neto and Pinheiro (2021) compared Brazilian and US textbooks, revealing gender biases in both, advocating for balanced representations to promote gender equality in education. These studies consistently show that gender stereotypes and biases are prevalent in mathematics textbooks across various countries.

Portrayal of Gender in Language and Terminology

The discourse on language and terminology in mathematics textbooks reveals the perpetuation of gender biases and stereotypes within educational materials. Nurlu (2021) found significant gender disparities in Turkish textbooks, with male characters depicted in active roles and females in passive contexts, reinforcing traditional gender roles. Karama (2020) observed similar biases in Palestinian textbooks, where boys were more frequently shown in diverse roles and girls in stereotypical activities. San (2023) noted that Jiangsu textbooks predominantly featured male characters, with female characters often in supportive roles. Guichot-Reina and De la Torre-Sierra (2023) found persistent gender biases in Spanish textbooks, favoring male representations. Neto and Pinheiro (2021) highlighted that textbook from Brazil and the USA depicted boys more frequently and in diverse roles, reinforcing traditional gender roles. Yuden, Chuki, and Dorji (2021) found that Bhutanese textbooks favored male characters and masculine language. These studies consistently

show that gender biases in language and imagery can influence students' perceptions of gender roles and engagement with mathematics, underscoring the need for educational materials that promote gender equality and challenge stereotypes.

Portrayal of Gender in sports and game

The portrayal of gender in educational materials, especially in mathematics textbooks, significantly influences gender perceptions among students. Studies across various regions highlight a consistent bias favoring male representation in sports and games. Nurlu (2021) found that Turkish primary school textbooks predominantly depict boys in active sports roles, while girls are shown in passive roles. Karama (2020) observed similar trends in Palestinian textbooks, with boys frequently engaged in physical activities and girls underrepresented. San (2023) reported that Chinese elementary textbooks show boys participating in competitive games, suggesting an underlying bias that could discourage girls from engaging in sports. Ullah et al. (2017) identified a significant bias in Azad Jammu & Kashmir textbooks, reinforcing gendered notions of physical activity. Guichot-Reina & De la Torre-Sierra (2023) found persistent gender stereotypes in Spanish textbooks, with boys more often shown in sports roles. Tang, Chen, & Zhang (2010) confirmed a global trend of male dominance in sports depiction in Chinese textbooks. Java & Parcon (2016) noted that Philippine textbooks often portray boys in athletic roles and girls in traditional activities, affecting girls' interests in sports. Tsai (2020) highlighted that Thai textbooks reinforce sports as a male domain. These findings underscore the need to address gender imbalances in educational content to promote gender equality and encourage all students to engage in diverse activities.

Portrayal of Gender in Profession and Activity Representation

The representation of gender in educational materials, particularly in mathematics textbooks, is critical in shaping students' perceptions and attitudes toward gender roles and professions. Various studies have highlighted both overt and subtle forms of gender bias. Nurlu (2021) found significant gender disparities in Turkish primary school mathematics textbooks, with males depicted in active, problem-solving roles and females in passive roles, reinforcing traditional gender stereotypes. Karama (2020) revealed similar trends in Palestinian textbooks, where males were shown in professional settings and females in domestic contexts, influencing career perceptions based on gender. San (2023) observed that Chinese textbooks often depicted males in leadership and scientific roles, while females were shown in caregiving roles, limiting female students' career aspirations. Ullah et al. (2017) found that in Azad Jammu & Kashmir, males were frequently portrayed in sports and technology, whereas females were depicted in indoor activities, influencing perceptions of gender-appropriate activities. Guichot-Reina and De la Torre-Sierra (2023) noted persistent stereotypes in Spanish textbooks, with males shown as intellectually competent and adventurous, and females as nurturing. Incikabi and Ulusoy (2024) compared textbooks from Australia, Singapore, and Turkey, finding varying degrees of gender bias, with Australia showing the least. Java and Parcon (2016) found gendered illustrations in Philippine textbooks, with males in active roles and females in supportive roles. These studies consistently highlight pervasive gender bias in mathematics textbooks, reinforcing traditional gender roles and impacting students' career aspirations. Addressing these biases through balanced and inclusive representations is crucial for promoting gender equality and empowering students to pursue diverse interests and careers.

Cultural and Regional Differences in the Portrayal of Gender in Textbooks

The portrayal of gender in textbooks varies widely across cultural and regional contexts, as demonstrated by studies on mathematics textbooks globally. Cultural norms and values significantly influence gender representation in textbooks. For example, Turkish and Palestinian textbooks exhibit gender biases that reflect traditional stereotypes and societal attitudes (Nurlu, 2021; Karama, 2020). In contrast, Jiangsu, China shows a more nuanced portrayal due to a blend of traditional values and modern reforms, although some traditional roles persist (San, 2023). Regional differences also impact gender portrayal. Spanish textbooks are criticized for reinforcing stereotypes despite gender equality efforts (Guichot-Reina & De la Torre-Sierra, 2023), while textbooks from Australia, Singapore, and Turkey display unique gender biases reflecting their diverse cultural contexts (Incikabi & Ulusoy, 2024). In Azad Jammu & Kashmir, textbooks reflect local cultural norms, showing mixed progress in gender equality (Ullah et al., 2017). Globally, gendered illustrations are common in the Philippines and India, indicating a lag behind societal progress (Java & Parcon, 2016; Singha, 2022). In contrast, the Netherlands and Qatar face different challenges: the former balances ethnic and gender representation, while the latter deals with linguistic sexism (van Veen et al., 2023; Mohd Yasin et al., 2012). These findings highlight the need for culturally sensitive approaches to textbook development that address gender biases while respecting local contexts. Future research should focus on redesigning textbooks to enhance gender equality and inclusivity in diverse educational settings.

Conclusion

A systematic literature review on gender stereotypes and bias in school maths textbooks uncovers a callous state of affairs concerning continued under-representation throughout different educational settings. The study provides evidence of persistent gender imbalance in figures and examples that further female stereotype work, thus reinforcing traditional gender roles among the new generation; these findings are convincing as all data show more or less similar trends. Gendered language and imagery in textbooks are both powerful ways that students learn to predict the repeated associations between men's, and women's mathematics topics gender roles gender-skewed occupations (review), which impact how they engage with these issues. The widespread nature of the problem further underscores to necessity for educational resources that work to actively counteract biased gender norms. To counteract these biases, textbooks should be rewritten to provide a balanced and comprehensive representation. Any new efforts should instead help people escape traditional "gender binds," specifically by creating content that more equitably reflects male and female choices in real life, allowing all students to explore an expanded universe of interests/careers. Moreover, the universally consistent underrepresentation of girls in sport and physical activity across several studies suggest that there are indeed educational reforms necessary. Textbooks need to work towards featuring a balance of the genders in multiple activities as a way to break down gender stereotyping and offer children more access to interest areas, related to those depicted within the textbooks.

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