Parole: Journal of Linguistics and Education, [15] (1), [2025], [27-37]

Available online at: http://ejournal.undip.ac.id/index.php/parole

A Multimodal and Critical Discourse Analysis of Gender Representation in an Indonesian Grade 4 Science Textbook

Barli Kifli[a1*], Isli Iriani Indiah Pane[b], Muhammad Aswin Rangkuti[c]

[abc] *Universitas Negeri Medan, Medan, Indonesia*

A B S T R A C T

Textbooks play a central role in shaping learners' perceptions of social roles, including those related to gender in science education. This study investigates how gender is visually and discursively represented in the *Ilmu Pengetahuan Alam dan Sosial* (IPAS) Grade 4 textbook issued by the Indonesian Ministry of Education. Using a qualitative content analysis approach, the research integrates Multimodal Discourse Analysis (MDA) and Critical Discourse Analysis (CDA) to examine 44 illustrations from the natural science chapters. The analysis focuses on how agency, authority, and scientific roles are distributed across male and female characters in both visual (e.g., posture, salience) and verbal (e.g., speech functions, cognitive authority) modes. The findings indicate that male characters are more frequently depicted and are often positioned in dominant scientific roles, while female characters appear less frequently and are generally portrayed as passive, supportive, or non-expert. Although a few scenes offer inclusive representations, these are limited and do not significantly alter the prevailing gender asymmetry. The study concludes that despite policy emphasis on equity, the textbook continues to reflect traditional gender norms, particularly in STEM-related contexts. It highlights the need for intentional alignment between visual and verbal elements to support inclusive and equitable science education.

A R T I C L E I N F O

Paper type:
Research Article

Article history:
Received: 27/08/2025
Revised: 05/10/2025
Accepted: 02/11/2025

Keywords:
- Gender Representation
- STEM Education
- Multimodal Discourse Analysis
- Critical Discourse Analysis
- Science Textbook
- Primary Education

1. Introduction

Textbooks play a central role in shaping how children perceive the world, social roles, and their own identities as learners. In many educational systems, textbooks are not only instructional tools but also ideological instruments that reproduce social norms and cultural expectations (Apple, 2004; Sleeter & Grant, 2007). This is particularly evident in how textbooks represent gender, especially in early education when children are beginning to internalize ideas about who they are and who they can become (Cahyono & Widiati, 2022; UNESCO, 2020).

The ways in which male and female characters are portrayed—visually and textually—can have far-reaching consequences. Studies show that consistent exposure to male-dominated images and narratives contributes to children's perception of men as more capable, scientific, and authoritative, while women are perceived as passive, emotional, or supportive figures (Blumberg, 2008; Koca, 2020; Lee & Collins, 2008). When these patterns appear in science or STEM-related content, they can deter girls from developing interest or confidence in scientific fields (Archer et al., 2012; Chiu et al., 2021).

Recent large-scale analyses of primary education materials across Asia, Africa, and Latin

[1] *barlikifli@unimed.ac.id (Kifli)*

America reveal that gender bias remains prevalent in visual and textual content, particularly in science, technology, and mathematics lessons (Kizilcec & Saltarelli, 2019; UNESCO, 2021; Zulfikar et al., 2022). A study by Rusznyak and Moodley (2024) emphasized that even in textbooks developed under equity-oriented curricula, such as South Africa's CAPS or Indonesia's Kurikulum Merdeka, subtle gender asymmetries persist through placement, size, speaking roles, and task distribution. These findings underscore the importance of multimodal analysis, which can detect biases that are not always evident in written text alone.

In Indonesia, recent curricular reforms have emphasized gender mainstreaming and inclusive education, particularly within the *Kurikulum Merdeka* framework (Kementerian Pendidikan Kebudayaan Riset dan Teknologi, 2022). However, empirical analysis of how these goals translate into everyday learning materials—especially science textbooks—remains limited. While some studies have explored gender bias in English language or civics textbooks, research on STEM materials, particularly through visual-discursive frameworks, is still emerging.

This study seeks to address this gap by analyzing gender representation in the nationally endorsed Grade 4 Ilmu Pengetahuan Alam dan Sosial (IPAS) textbook, published by the Indonesian Ministry of Education. The Grade 4 level was chosen because it marks a critical stage in students' cognitive and social development, when they begin to form disciplinary identities in science. Moreover, this textbook is part of the Kurikulum Merdeka reform, making it both representative and policy-relevant for understanding how gender equity is realized in official STEM learning materials.

This combined lens enables a more nuanced understanding of how gendered identities are constructed through both image and text, especially in relation to scientific authority, agency, and participation.

Despite increased awareness and policy emphasis on gender equality in education, numerous studies have demonstrated that school textbooks continue to reflect traditional gender roles, especially in the domain of science education ((Brugeilles & Cromer, 2009; Chikunda & Makonye, 2021; Sadker & Zittleman, 2016)). These patterns are evident not only in what is written but in how characters are depicted, what actions they perform, and who holds discursive or cognitive authority. This is particularly problematic in early science education, where children's exposure to learning materials significantly shapes their academic self-concept and interest in STEM fields (Makarova et al., 2019; Master et al., 2021).

In STEM textbooks globally, boys are often overrepresented in experimental roles, shown manipulating tools, leading discussions, or achieving results. Girls, by contrast, are more likely to be observers, assistants, or subjects of care (González-Pérez et al., 2020; UNESCO, 2021). These imbalances can result in what Archer et al. (2012) call the "science identity gap," whereby girls internalize the belief that science is "not for them." In visual and discursive content alike, representation becomes a form of gatekeeping (Kizilcec & Saltarelli, 2019; Sunderland, 2006).

In the Indonesian context, few studies have investigated gender bias in textbooks beyond English and social studies (Saputra, 2022). There is even less empirical research that analyzes STEM-focused textbooks using methods that account for the multimodal nature of these texts—combining visual design, character interaction, and embedded dialogue. Given that Indonesia's *Kurikulum Merdeka* positions inclusivity and equity as core values, it is crucial to examine whether these principles are reflected in state-issued instructional materials.

While several studies have examined gender bias in textbooks generally, few have focused specifically on visual-discursive representations within early science education. There have been limited studies concerned with the integration of Multimodal and Critical Discourse Analysis to uncover implicit gender asymmetries in Indonesian STEM textbooks. Therefore, this research intends to critically investigate the representation of gender in the *Ilmu Pengetahuan Alam dan Sosial* (IPAS) Grade 4 textbook. By using a combined Multimodal Discourse Analysis (MDA) and Critical Discourse Analysis (CDA) framework, this study investigates:

1. How visual representations (e.g., positioning, posture, salience) assign agency to male and female characters,
2. How dialogic structures (e.g., speech bubbles, cognitive acts, explanations) distribute scientific authority across genders,

3. How the two modes (visual and verbal) align or contradict each other in constructing gendered roles.

The following research questions guide this investigation:

1. How are male and female characters visually represented in science-related textbook illustrations in terms of action, salience, and agency?
2. How are discursive roles and scientific authority distributed between genders in embedded dialogue and character interaction?
3. To what extent do visual and verbal modes align or diverge in constructing gendered scientific identities?

These questions reflect the need to move beyond text-based counts or frequency analyses and toward a more nuanced understanding of how meaning is constructed multimodally, especially in learning contexts that shape long-term academic and professional aspirations.

This study is both timely and necessary, situated at the intersection of STEM education, gender equity, and curriculum design. By focusing on a nationally endorsed textbook under *Kurikulum Merdeka*, the research not only evaluates educational materials but also indirectly assesses how well curriculum reforms promote inclusivity in practice. As several scholars have emphasized, textbooks are not neutral; they act as ideological tools that transmit, reinforce, or challenge dominant cultural narratives (Apple, 2004; Curdt-Christiansen & Weninger, 2015).

In STEM fields, these narratives have historically privileged male voices and visibility—both in global and regional contexts (Chikunda & Makonye, 2021; UNESCO, 2021). In Indonesia, where structural gender disparities remain evident in both school science achievement and career pathways, addressing textbook bias is a foundational step toward dismantling long-term inequality.

By employing an analytical lens that includes both Multimodal Discourse Analysis and Critical Discourse Analysis, this study offers an innovative contribution to textbook research. It goes beyond content counting to interrogate how meaning is made across modes—how gaze, position, speech, and interaction create implicit lessons about who can be a scientist, who leads, and who follows. The integration of visual and linguistic perspectives reflects recent shifts in critical education research that prioritize semiotic complexity over simplistic binaries (Jewitt, 2009; Kress, 2010).

The findings from this study hold significance for multiple stakeholders:

1. For textbook authors and illustrators, it provides a framework for designing more gender-balanced visual and discursive content.
2. For curriculum developers and policymakers, it offers evidence-based insights into how curricular ideals (e.g., inclusion, equality) translate into actual classroom resources.
3. For teachers and education researchers, it contributes to the broader discourse on equitable pedagogy, representation, and learner identity formation.

In an era where early exposure to STEM role models and inclusive educational narratives is increasingly linked to long-term equity outcomes (Makarova et al., 2019; Master et al., 2021), this study underscores the need for textbooks to reflect and support these goals. Representation matters—not only for accuracy, but for justice.

2. Methods

2.1. Research Design

This study employed a qualitative content analysis approach, combining Multimodal Discourse Analysis (MDA) and Critical Discourse Analysis (CDA) to examine gender representation in the *Ilmu Pengetahuan Alam dan Sosial* (IPAS) Grade 4 textbook. The aim was to explore how visual and discursive modes construct gendered meanings within science-related contexts, particularly those relevant to early STEM education. Qualitative methods were selected to allow for in-depth

interpretation of meaning, context, and power relations embedded in both visual and textual elements (Given, 2008).

The analysis process involved several steps. First, all illustrations (N=44) were systematically coded according to multimodal categories (salience, posture, gaze, activity type) following Kress & van Leeuwen (2006). Second, images containing dialogue were transcribed and analysed through CDA, focusing on speech functions, cognitive authority, and lexical choices (Fairclough, 1995). Coding was conducted iteratively, with constant comparison to ensure consistency across data. Finally, results were thematically grouped into patterns of frequency, role distribution, discursive asymmetry, and intermodal alignment, which informed the discussion of gender representation in the textbook.

The integration of MDA and CDA enabled a holistic reading of multimodal texts, acknowledging that meaning is not produced by linguistic elements alone, but by the interplay between words, images, layout, and design (Jewitt, 2009; Kress & van Leeuwen, 2006). CDA contributed to uncovering ideologies and power relations encoded in speech acts and character roles, particularly in relation to gender, as formulated as formulated by Fairclough (1995) and Sunderland (2006)

2.2. Data Source

The book analyzed is IPAS Grade 4 textbook published by the Indonesian Ministry of Education, Culture, Research, and Technology. The selection of the Grade 4 textbook is based on its strategic relevance to students' developmental stage and the structure of the national curriculum. By Grade 4 (typically ages 9–10), students are transitioning from learning to read toward reading to learn, a shift that significantly impacts how they engage with scientific concepts and form disciplinary identities (Chambers et al., 2018). This stage also coincides with increasing cognitive and social awareness, during which children begin to internalize implicit messages about competence, authority, and gender roles—particularly in STEM-related content (Master et al., 2021). Research has shown that perceptions of science identity and interest begin to diverge along gender lines during the upper-primary years (Makarova et al., 2019), making this a critical point for analyzing how textbooks may reinforce or challenge such patterns. Moreover, Grade 4 often marks the first substantial curricular focus on experimental science in the Indonesian national curriculum, providing an appropriate and meaningful corpus for examining multimodal gender representations in STEM learning contexts (Kementerian Pendidikan Kebudayaan Riset dan Teknologi, 2022).

The data comprised 44 illustrations extracted from the first four chapters of the IPAS Grade 4 textbook published by the Indonesian Ministry of Education, Culture, Research, and Technology. These chapters were selected based on their focus on natural science content, including topics such as plant systems, force and motion, matter, and energy. The remaining chapters, which center on social studies topics, were excluded as they fall outside the scope of this study's STEM-oriented analysis.

Only illustrations featuring human figures were included. Each image was labeled sequentially (Data 1 to Data 44) and subjected to systematic coding. Images containing speech bubbles or embedded dialogues were analyzed using CDA techniques, while all illustrations were examined through MDA frameworks.

2.3 Analytical Framework

2.3.1 Multimodal Discourse Analysis (MDA)

MDA was applied following the framework developed by Kress and van Leeuwen (2006), focusing on representational, interactive, and compositional meanings. Specific attention was paid to:

1. Salience (placement, size, gaze),
2. Narrative agency (who is acting versus observing),
3. Activity type (e.g., experimental, expressive, domestic),
4. Gaze and posture (e.g., frontal vs. oblique presentation).

This allowed for interpretation of how boys and girls were visually portrayed in terms of agency, scientific engagement, and interaction with peers or tools.

2.3.2 Critical Discourse Analysis (CDA)

CDA was used to analyze the linguistic elements within the illustrations, particularly speech bubbles and embedded dialogues. Drawing on Fairclough (1995) the analysis focused on:

1. Who speaks and who remains silent,
2. Speech functions (e.g., questioning, explaining, responding),
3. Lexical choices and tone (e.g., authoritative vs. emotive),
4. Distribution of cognitive or explanatory authority.

This enabled the study to identify patterns of discursive dominance and subordination based on gender, and to reflect on the implications of such patterns for the social construction of science identity.

3. Results and Discussion

The analysis of 44 illustrations from the IPAS Grade 4 science chapters revealed consistent patterns of gender asymmetry. Male characters were more frequently depicted and commonly positioned in active, central roles within scientific contexts, while female characters appeared less often and were typically shown in supportive or observational positions. These imbalances were evident both visually—through salience, posture, and activity type—and discursively, with boys more often occupying explanatory or authoritative speech roles.

The following sections present the findings thematically:

1. Gender frequency and visibility;
2. Role distribution and scientific activity;
3. Discursive asymmetry and speech roles;
4. Intermodal alignment and contradictions;
5. Positive examples of inclusive representation;
6. Broader implications for gender equity in STEM learning.

3.1. Gender Frequency and Visibility

One of the most prominent findings from the visual analysis of the IPAS Grade 4 textbook is the unequal frequency and distribution of gender representation across the illustrations. While both male and female characters are present throughout the natural science chapters, male characters appear more frequently and are more often positioned in prominent visual roles, particularly in science-related activities. Table 1 summarizes the frequency and visibility of male and female characters across the textbook illustrations.

Table 1. Gender Frequency and Visibility in Illustrations

Representation Type	Number of Images	Typical Contexts	Examples (Data codes)
Male-only	21	Experiments, mechanical tasks, physical activity	Data 13, 14, 23, 26, 27, 33, 34, 44
Female-only	6	Domestic safety, health, expressive activities	Data 24, 25, 37, 39
Mixed-gender	17	Group observations, classroom visits, environmental tasks	Data 17, 21, 30, 35

Out of the 44 images analyzed:

1. 21 images depict only male characters, often engaging in experimentation, physical activity, or mechanical tasks (e.g., Data 13, 14, 23, 26, 27, 33, 34, 44).
2. 6 images include only female characters, mostly in contexts related to domestic safety, health, or social care (e.g., Data 24, 25, 37, 39).
3. 17 images present mixed-gender groups, but even in these scenes, male characters frequently occupy the central frame or perform the most active and visible roles (e.g., Data 17, 21, 30, 35).

These figures reflect a disproportion in how gender is visually represented, with boys appearing not only more often but also in more diverse and active contexts. In contrast, girls are underrepresented in both frequency and diversity of scientific scenarios. This aligns with what Kress & van Leeuwen (2006) describe as salience—the degree to which a character is visually emphasized through placement, size, and posture. In many images, boys are positioned at the center or in action, while girls are shown to the side, behind, or engaged in passive roles. This trend aligns with findings by Lee & Collins (2008) and Koca (2020), who documented that male characters tend to dominate textbook illustrations across STEM topics, particularly in science and math textbooks across various countries.

Moreover, entire conceptual domains such as force, motion, elasticity, and mechanical energy are depicted through male-only participation. For instance, in Data 27 and 28, boys perform experiments related to elastic force and weight measurement. In Data 33 and 34, a series of illustrations show only boys pushing, pulling, and using tools to perform tasks associated with energy and motion. These patterns contribute to the gendering of scientific space, visually framing science as a male-dominated domain.

While mixed-gender images do appear, they are often structured in ways that emphasize male action and female observation. For example, in Data 22, a boy performs a motion activity while a girl and another boy observe from a distance. In Data 35, although both boys and girls are present during a visit to a hydroelectric power plant, the visual and narrative authority is given to male figures (the teacher and the engineer), and the girls remain silent.

This visual asymmetry may appear subtle, but its repeated occurrence across textbook content may influence how young learners internalize ideas about who science is "for." As previous studies have shown (e.g., (Blumberg, 2008; Lee & Collins, 2008), representation frequency correlates with perceived legitimacy. If boys appear more often and more actively in science scenes, they are more likely to be perceived as natural science learners or future scientists.

3..2 Role Distribution and Scientific Activity

In addition to numerical visibility, the analysis also reveals clear patterns in the types of roles and activities assigned to boys and girls in science-related contexts. These differences are especially evident when examining how scientific agency is depicted through bodily engagement, task complexity, and the distribution of technical actions. As shown in Table 2, male characters dominate experimentation and mechanical processes, while female characters are limited to domestic, observational, or supportive roles.

Table 2. Distribution of Scientific Roles and Activities by Gender

Gender	Typical Scientific Activities	Representation Pattern	Examples
Male characters	Experimentation, physical manipulation, mechanical processes, energy-related tasks	Central, active, initiating action	Data 13, 14, 27, 28, 33, 34
Female characters	Domestic/health tasks, observation, expressive activities, supporting roles	Peripheral, supportive, less varied	Data 24, 25, 37, 39, 8, 12, 30

Across the dataset, male characters are consistently shown performing scientific tasks that involve experimentation, physical manipulation, mechanical processes, or environmental exploration. For instance:

1. In Data 13 and 14, boys independently perform experiments using balloons to test properties of air and gas.
2. In Data 27 and 28, boys conduct elasticity and force demonstrations, including weighing objects with a spring scale.
3. In Data 33 and 34, a series of task-based panels show boys engaging in manual labor, pushing carts, cycling, and using tools—activities commonly associated with applied physics and mechanical energy.

These scenes not only depict boys as physically active participants in science but also suggest that science learning is something boys do with their bodies, aligning with traditionally masculine-

coded physical domains. Such depictions contribute to the normalization of boys as the default agents of STEM engagement.

In contrast, female characters are assigned less varied and less active roles. When girls are shown in science-related contexts, their activities are often limited to:

1. Domestic or health-oriented tasks (e.g., cleaning up needles in Data 24, talking about food and energy in Data 39),
2. Expressive or observational roles (e.g., playing instruments to illustrate sound in Data 25, 38, 43),
3. Social interaction rather than experimentation (e.g., discussing plant parts in Data 8 or noticing changes in their environment in Data 37).

Even when girls are included in scenes that involve experimentation, they tend to participate in a supporting or shared capacity, rather than as the primary initiators of action. For example:

1. In Data 12, a girl is part of a group pouring liquids in a science task, but the scene lacks a clear central figure, and the action is shared.
2. In Data 30, boys and girls observe falling leaves and fruits, but the boys' statements guide the conceptual direction of the discussion.

This uneven distribution of activity types reflects what Kress & van Leeuwen (2006) describe as narrative agency—the capacity of a visual subject to perform action and shape the meaning of an event. In this textbook, narrative agency is repeatedly granted to boys in contexts that emphasize experimentation, measurement, or physical application of scientific concepts, while girls are more commonly aligned with observation, emotion, and reflection. This supports findings from UNESCO (2020) and Blumberg (2008), which highlight that girls are often portrayed as passive or caring figures, even in ostensibly neutral educational materials, thereby limiting their perceived fit in STEM fields.

These patterns echo broader critiques of STEM learning environments that continue to gender-code scientific tasks—a phenomenon that has long-term implications for girls' engagement, confidence, and identification with science Archer et al. (2012). By repeatedly assigning boys the roles of actor, builder, or experimenter, and girls the roles of helper, observer, or emotional supporter, the textbook reinforces binary distinctions in how science is imagined and enacted.

3.3 Discursive Asymmetry and Speech Roles

Beyond visual representation, the IPAS textbook also constructs gendered meaning through the use of dialogue embedded in illustrations. Speech bubbles and narrative exchanges are used throughout the book to model scientific reasoning, social interaction, and reflective thinking. Analyzing who speaks, what they say, and how speech roles are distributed reveals a pattern of discursive asymmetry, where male characters are more frequently positioned as explainers and authorities, while female characters appear more often in supportive, emotive, or questioning roles. Table 3 presents the distribution of discursive roles by gender, illustrating how boys are more often positioned as explainers, while girls take on questioning or supportive functions.

Table 3. Discursive Roles in Dialogue by Gender

Discursive Role	Male Characters	Female Characters	Examples
Explainers / Authorities	Frequently hold explanatory or summarizing roles, often giving "correct" reasoning	Occasionally, but less frequent	Data 5, 21 (male explainers)
Questioners / Prompters	Sometimes initiate questions but usually also answer	More often ask questions or prompt explanations	Data 21 (female questioner)
Affective / Supportive	Rare – mostly factual contributions	More frequent – emotional responses, validation, observations	Data 10, 15 (female reactions)
Expert figures	Teachers, engineers, authority figures usually male	No female scientist/engineer represented	Data 35

This pattern can be seen in multiple examples. In Data 21, a girl raises a scientific question related to surface area and force, but the explanatory response is given by a boy, who provides the "correct" reasoning. Similarly, in Data 5, the girl contributes a personal observation ("I like everything

that comes from plants"), while the boy makes a summary statement that aligns more clearly with scientific synthesis.

Such discursive arrangements reinforce a subtle but persistent hierarchy: boys are constructed as those who know and explain, and girls as those who prompt, listen, or validate. This mirrors Sunderland (2006) concept of "the male-as-knower discourse", where male characters occupy positions of epistemic authority even when female characters are present and engaged. Similar discursive imbalances have been observed in CDA-based analyses of language textbooks in Indonesia and East Asia, where male characters dominate factual, explanatory discourse (Sussex & Tsui, 2022)

In Data 10 and 15, boys deliver punchlines or conclusions related to phenomena (e.g., melting ice cream), while girls express frustration or confusion. These exchanges, while seemingly light-hearted, continue to reflect gendered participation in scientific reasoning: boys resolve, girls react.

This dynamic is further amplified by the absence of female expert figures. In Data 35, the students are accompanied by a male teacher on a visit to a hydroelectric power plant, where a male engineer serves as the expert. Although the group includes both boys and girls, all knowledge is mediated through male voices. Throughout the textbook, no female scientist, engineer, or technical authority is represented in visual or discursive form.

There are, however, moments of more balanced participation. In Data 25, two girls engage in a peer-to-peer exchange about magnets, with one expressing curiosity and the other offering to share information. In Data 39, a girl explains why she feels weak due to skipping breakfast—linking personal experience to scientific reasoning about energy intake. And in Data 42, children of mixed genders collaborate in a hands-on activity without hierarchical dialogue roles.

Still, these moments remain exceptions within a broader pattern where discursive leadership in science is largely gendered male. The implications are significant: if authority in speech is repeatedly modeled through boys, young readers may come to associate scientific thinking and confidence in explanation with masculine norms.

By analyzing not only who is shown speaking but also what types of statements each gender is allowed to make (e.g., factual, emotive, supportive, interrogative), it becomes clear that gender roles are not only visual but also linguistically encoded. These findings affirm the value of CDA in uncovering power structures embedded in everyday educational discourse.

3.4 Intermodal Alignment and Contradictions

A key strength of a multimodal analytical approach is its ability to uncover how different modes—visual and verbal—work together or conflict in shaping meaning. In the IPAS Grade 4 textbook, several images reveal an interesting interplay between what is shown (MDA) and what is said (CDA). In many illustrations, male characters are both visually dominant and discursively authoritative, thereby reinforcing traditional gender hierarchies through both modes. For instance, in Data 13, 14, and 27, boys are shown conducting experiments independently, and though these scenes contain no dialogue, the visual salience and exclusive male presence suggest autonomy in scientific learning. Similarly, in Data 5 and 21, boys are not only shown in active, central positions but also given the explanatory speech roles, while girls appear more visually peripheral or reactively engaged. These examples present cohesive multimodal messages—boys are both the actors and the knowers. Such alignment across modes strengthens the textbook's implicit message that scientific activity and reasoning are naturally associated with male students.

However, there are also notable instances where visual and verbal elements diverge, creating ambiguity in gender positioning. In Data 3, the male student is visually central and physically active (watering plants), while the female student appears more passive. Yet, in the dialogue, it is the girl who provides the correct scientific explanation about plant roots, while the boy offers an observational comment. Here, discursive authority belongs to the girl, even though the image does not visually position her as central. Likewise, in Data 30, boys and girls appear equally placed, and all contribute dialogue related to plant observations. This suggests an intentional attempt at intermodal balance, where agency is shared across gender lines both visually and verbally.

These contradictions are significant because they may challenge visual stereotypes by allowing girls to express cognitive leadership despite passive or secondary visual framing. Alternatively, they may dilute strong female agency when visual cues fail to support it. For instance, a girl who delivers a

key explanation might still be visually placed at the margin of the frame or depicted in a more static pose, reducing the emphasis on her discursive contribution. What emerges from this dual-mode analysis is that neither visual nor verbal content alone provides a complete picture of how gender is constructed in educational materials. In some cases, visual equity masks discursive imbalance—as in mixed-gender scenes where boys do most of the explaining. In other cases, discursive equality is undercut by visual marginalization, with girls speaking but not being shown in active or empowered postures. As Kress and van Leeuwen (2006) remind us, multimodal texts are never neutral: they reflect and reproduce social ideologies.

3.5 Intermodal Alignment and Contradictions

The inconsistencies identified above are not trivial. When girls are shown speaking knowledgeably but not doing science, or when they do science but are visually backgrounded, their authority becomes ambiguous. As a CDA researcher, my interpretation is that these contradictions reveal how male authority is still visually privileged, even when girls are discursively empowered. In other words, the surface appearance of balance does not dismantle the deeper visual asymmetry embedded in the textbook's design.

These dynamics highlight the need for intentional alignment in textbook production. Achieving visual and verbal parity is essential not only for ensuring gender inclusion but also for modeling equal cognitive and practical participation in science. Without such alignment, gender stereotypes persist in subtle but powerful ways: boys are seen as the doers and explainers of science, while girls remain framed as passive or secondary contributors. The broader implication is that multimodal inconsistencies can undermine policy efforts to promote gender equity in STEM education. To counter this, future textbook design should adopt strategies that consistently foreground girls both visually and discursively in scientific contexts, thereby normalizing their presence as active agents and authoritative voices in the learning process.

4. Conclusion

This study critically examined the representation of gender in the IPAS Grade 4 science textbook through a combined lens of Multimodal Discourse Analysis (MDA) and Critical Discourse Analysis (CDA). With 44 illustrations analyzed, the findings provide important insights into how visual and discursive modes work together to construct gender identities in STEM-related learning.

First, regarding visual representation, male characters were found to dominate in terms of frequency, salience, and central positioning. They were consistently placed in active roles—experimenting, manipulating objects, or leading tasks—while female characters appeared less often and were frequently confined to passive, supportive, or domestic roles. Even when included in scientific contexts, girls were rarely framed as central knowledge authorities.

Second, on discursive roles, the distribution of scientific authority in dialogue reinforced similar imbalances. Boys more often occupied the role of explainer, instructor, or knowledge-giver, while girls were positioned as questioners, respondents, or affective participants. Although several instances highlighted girls offering correct scientific explanations, these were exceptions rather than the norm, suggesting that discursive practices still largely privilege male authority.

Third, in terms of intermodal alignment, the study revealed frequent mismatches between visual and verbal modes. In some cases, girls provided scientific knowledge in dialogue but were visually marginalized, placed at the periphery of illustrations or shown in static postures. In other cases, seemingly balanced visuals masked discursive inequities, with boys speaking more authoritatively. These contradictions highlight how multimodal texts can superficially suggest equity while still reproducing asymmetrical power relations.

In synthesis, the findings underscore that textbooks are not neutral pedagogical tools but ideological instruments that shape learners' identities and aspirations. For policymakers and curriculum developers, this research demonstrates the need for intentional design that ensures both visual and discursive equity. For textbook authors and illustrators, the results provide a framework to correct gender imbalance by foregrounding girls in active, authoritative roles. Future studies could extend this

analysis to other subjects, grade levels, and cultural contexts, offering broader insights into how multimodal representation can foster or hinder inclusivity in STEM education.

References

Apple, M. W. (2004). *Ideology and curriculum* (3rd ed.). Routledge.

Archer, L., DeWitt, J., Osborne, J., Dillon, J., Willis, B., & Wong, B. (2012). Science aspirations, capital, and family habitus: How families shape children's engagement and identification with science. *American Educational Research Journal*, *49*(5), 881–908. https://doi.org/10.3102/0002831211433290

Blumberg, R. L. (2008). The invisible obstacle to educational equality: Gender bias in textbooks. *Prospects*, *38*(3), 345–361. https://doi.org/10.1007/s11125-009-9086-1

Brugeilles, C., & Cromer, S. (2009). *Promoting gender equality through textbooks: A methodological guide*. UNESCO Publishing. https://unesdoc.unesco.org/ark:/48223/pf0000158897

Cahyono, B. Y., & Widiati, U. (2022). Gender representations in Indonesian ELT textbooks: A critical review. *Studies in English Language and Education*, *9*(2), 752–770. https://doi.org/10.24815/siele.v9i2.22737

Chambers, S., Kashefpakdel, E., Rehill, J., & Percy, C. (2018). *Drawing the future: Exploring the career aspirations of primary school children from around the world*. Education and Employers. https://www.educationandemployers.org/drawing-the-future/

Chikunda, C., & Makonye, P. (2021). Gender representation in secondary school science textbooks in Southern Africa. *International Journal of Science Education*, *43*(7), 1037–1059. https://doi.org/10.1080/09500693.2021.1882105

Chiu, M. M., Price, J., & Almeida, P. (2021). Students' science identity: Evidence from international large-scale assessments. *International Journal of Science Education*, *43*(10), 1580–1602. https://doi.org/10.1080/09500693.2021.1933357

Curdt-Christiansen, X. L., & Weninger, C. (2015). *Language, ideology and education: The politics of textbooks in language education*. Routledge.

Fairclough, N. (1995). *Critical Discourse Analysis: The Critical Study of Language*. Longman.

Given, L. M. (Ed.). (2008). *The SAGE Encyclopedia of Qualitative Research Methods*. SAGE Publications.

González-Pérez, R., de Cabo, R., & Sáinz, M. (2020). Girls in STEM: Is it a female role-model thing? *Frontiers in Psychology*, *11*, 2204. https://doi.org/10.3389/fpsyg.2020.02204

Jewitt, C. (Ed.). (2009). *The Routledge handbook of multimodal analysis*. Routledge.

Kementerian Pendidikan Kebudayaan Riset dan Teknologi. (2022). *Kurikulum Merdeka dan perencanaan pembelajaran*. Kemendikbudristek.

Kizilcec, R. F., & Saltarelli, A. J. (2019). Psychologically inclusive design: Cues impact women's participation in STEM education. *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*, 1–12. https://doi.org/10.1145/3290605.3300704

Koca, S. A. (2020). Gender representation in science textbooks: A global analysis. *International Journal of Science Education*, *42*(8), 1335–1356. https://doi.org/10.1080/09500693.2020.1755794

Kress, G. (2010). *Multimodality: A social semiotic approach to contemporary communication*. Routledge.

Kress, G., & van Leeuwen, T. (2006). *Reading images: The grammar of visual design* (2nd ed.). Routledge.

Lee, J. F. K., & Collins, P. (2008). Gender representation in Hong Kong English language textbooks. *Sex Roles*, *59*(1), 127–137. https://doi.org/10.1007/s11199-008-9484-z

Makarova, E., Aeschlimann, B., & Herzog, W. (2019). The gender gap in STEM fields: The impact of the gender stereotype of math and science on secondary students' career aspirations. *Frontiers in Education*, *4*, 60. https://doi.org/10.3389/feduc.2019.00060

Master, A., Meltzoff, A. N., & Cheryan, S. (2021). Gender stereotypes about interests start early and cause gender disparities in computer science and engineering. *Proceedings of the National Academy of Sciences*, *118*(48), e2100030118. https://doi.org/10.1073/pnas.2100030118

Rusznyak, L., & Moodley, P. (2024). Textbook representations of power and participation in South African classrooms. *Journal of Curriculum Studies*, *56*(2), 256–274. https://doi.org/10.1080/00220272.2023.2294479

Sadker, D., & Zittleman, K. (2016). *Still failing at fairness: How gender bias cheats girls and boys in school and what we can do about it* (2nd ed.). Scribner.

Saputra, B. E. (2022). Gender representation in Indonesian elementary school textbooks: A content analysis. *Indonesian Journal of Applied Linguistics*, *12*(1), 10–22. https://doi.org/10.17509/ijal.v12i1.36713

Sleeter, C. E., & Grant, C. A. (2007). *Making choices for multicultural education: Five approaches to race, class, and gender* (5th ed.). Wiley.

Sunderland, J. (2006). *Language and gender: An advanced resource book*. Routledge.

Sussex, R., & Tsui, A. B. M. (2022). Gender and power in textbook dialogues: A critical discourse analysis. *Discourse: Studies in the Cultural Politics of Education*, *43*(5), 675–692. https://doi.org/10.1080/01596306.2021.1877266

UNESCO. (2020). *Global education monitoring report: Gender report—A new generation: 25 years of efforts for gender equality in education*. UNESCO Publishing.

UNESCO. (2021). *STEM education for girls and women: Breaking barriers and unleashing potential*. UNESCO Publishing.

Zulfikar, T., Andini, S., & Ningsih, Y. (2022). Visual and discursive agency in multimodal science textbooks: A gender analysis. *Journal of Educational Media and Design*, *11*(2), 91–108.