v1: 6 March 2024

Research Article

Analysis of Gender Representations in Recommended Biology Textbooks Used by Senior School Students in Nasarawa State, Nigeria

Peer-approved: 6 March 2024

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Qeios, Vol. 6 (2024)
ISSN: 2632-3834

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The controversy and inconsistent reports on gender difference in students' performance in Biology are yet to abate. As part of the contributions to address the challenge, this study was designed to analyze gender representations in recommended biology textbooks used by senior school students in Nasarawa State, Nigeria. Seven Biology textbooks were purposively selected and analyzed in the study, while four research questions were raised and answered. The instrument used for data collection was a proforma designed by the researchers and used to record the identified masculine, feminine, and gender neutral words, colours, pictures, and diagrams. Findings indicated that the selected Biology textbooks contained 39.1%, 32.5%, and 28.4% gender neutral, masculine, and feminine words, respectively. Also, findings revealed that the selected Biology textbooks contained 51.7%, 48.1%, and 0.4% gender neutral, feminine, and masculine colours, while 99.1%, 0.6%, and 0.3% gender neutral, feminine, and masculine pictures and diagrams were observed in the selected Biology textbooks. In addition, findings indicated that there was no gender balance in the textbooks considered in the study. The study concluded that all the selected Biology textbooks contained gender representation in words, colours, pictures, and diagrams that were imbalanced in representations. It was therefore recommended that Biology textbook authors should revisit their textbooks and amend the observed inequality in gender representations to avoid the promotion of gender bias and partiality among the upcoming generations.

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Introduction

Biology, the scientific study of organisms, is taught to students at the secondary and tertiary levels of education in many different nations, including Nigeria. Applications of biological knowledge have had, and still have, significant impacts on a variety of aspects of human society and the environment (Martin & Robert, 2015; Michael, 2015). Biology plays a major role in industrialization and other sectors of the economy. Martin and Robert (2015) defined Biology as the scientific study of living things and vital processes. Gorgeous (2013) defined Biology as a natural science concerned with the study of life and living organisms including their structures, while Michael (2015) opined that Biology is a unique science of life that relates to virtually all aspects of human life.

BioExplorer.net (2024) noted that the knowledge of Biology helps an individual to understand the various functions of the body parts, which enables any individual to maintain good health. According to Rashid, Muhammad, and Tsauri (2023), Biology is composed of numerous sub-disciplines which include zoology, botany, genetics, medicine, agriculture, and anatomy. In addition, Biology has been integrated into a number of fields of specialization which includes; Biochemistry, Biotechnology, Bioengineering, Cell Biology, Marine Biology, Agricultural Biology (Ramalingam, 2013). Biology constitutes the most important content in the field of food production, Medicine, Dentistry, building, textile, paper industries, nano- and biotechnology (Akanbi & Kolawole, 2014; Jadhav, Inamdar, Kamble & Ghangaonkar, 2024).

Despite the importance of Biology and its significance to human existence, the performances of Senior Secondary School students in Biology in external examinations such as the West African Senior School Certificate Examinations (WASSCE) are not encouraging. For instance, Table 1 revealed that the total number of students that sat for Biology was higher than for chemistry and physics. Furthermore, Table 1 shows an inconsistency in students' performances in biology due to the drop in percentage credit passes in 2012 and 2018, respectively, which contrasts the gradual improvement witnessed in the other years under review.

 doi.org/10.32388/J59S2U

Year	Biology				Chemistry				Physics		
	Total Sat	Credit Pass	%		Total Sat	Credit Pass	%		Total Sat	Credit Pass	%
2010	1,300,418	427,644	33.90		465,643	236,059	50.70		463,755	237,756	51.30
2011	1,505,199	579,432	38.50		565,692	280,250	49.54		563,161	360,096	63.94
2012	1,646,150	587,044	35.66		627,302	270,570	43.13		624,658	429,415	68.74
2013	1,648,363	852,717	51.73		639,296	462,517	72.34		637,023	297,988	46.77
2014	1,365,384	766,971	56.17		636,268	397,649	62.49		635,729	386,270	60.76
2015	1,390,234	798,246	57.42		680,357	412,323	60.60		684,124	410,543	60.01
2016	1,200,367	740,345	61.68		706,873	408,122	57.74		705,125	415,655	58.95
2017	580,449	394,898	68.03		377,970	320,635	84.83		377,851	205,757	54.45
2018	1,087,063	679,299	62.48		728,551	424,231	58.22		728,354	571,687	78.49
2019	1,033,304	775,103	75.01		726,132	566,156	77.96		725,853	565,746	77.94

Table 1. Students' Enrolment and Performance in May/June West African Senior School Certificate Examinations in Biology, Chemistry, and Physics in Nigeria 2010 to 2019

Note. % = percentages. Adapted from "Effects of Modelling Clay and Demonstration Kit on Senior School Students' Performance in Cell Division in Omu-Aran, Nigeria," by G. A. Adeoye, 2021, Ph.D. thesis, University of Ilorin, Nigeria and West African Examinations Council, Lagos, Nigeria

Researchers in the field of science education have identified the difficulty and abstract nature of some biology concepts (Adewumi & Adeoye, 2023; Ojo, 2024), misconceptions (Luwoye, Bello & Adeoye, 2021; Obigbor & Ajaja, 2023), students' study habits (Ebele & Olofu, 2017, Okekeokosisi, Mbaegbu, & Nchikwo, 2023), and teachers' reliance on textbooks (Adegboye, Bello, & Abimbola, 2017) among factors responsible for students' unencouraging performance in Biology. Benson-Ogbu, Abonyi, Okafor, and Chinyere (2016) specifically identified unbalanced gender representation in recommended Biology textbooks as the root cause of students' poor performances in Biology.

Textbooks are printed and unprinted materials which contain facts and ideas around a subject (Adeoye, 2022). Textbooks have overtime remained an unparalleled source of knowledge influencing the content taught in schools at all levels of education (Olorundare, 2014; Pavešić & Cankar, 2022). For instance, Devdeep (n.d.) identified the Biology textbook as a pivotal material that both teachers and students cannot do without. In consonance, Kajander and Lovric (2009) asserted that the Biology textbook is the primary document that students use for their personal studies and homework. Biology textbooks are usually in hard or soft copies and consist of discussions, explanations, illustrations, and practical-based ideas on biology topical contents related to the study of living and non-living things.

Many Biology textbook authors engage the use of gender-sensitive words, expressions, colours, diagrams, and pictures for the presentation of their thoughts (Pavešić & Cankar, 2022). This gender representation in Biology textbooks has been identified to influence students' disposition towards the reading of such books, which invariably determines their performances. Adigun, Onihunwa, Irunokhai, Sada, and Adesina (2015) and Umoh (2003) defined gender as a range of physical, biological, mental, psychological characteristics and attributes pertaining to and differentiating males from their female counterparts.

Masculinity, according to Filgona and Sababa (2017), and Barot (2012), is linked with dominance, strength, and aggression because males are seen as the kings and breadwinners, while feminine roles are usually associated with subordination, homemaking, and nurturing of characters. In addition, masculinity is often associated with colors such as brown, blue, green, and black, while the feminine gender is attracted to purple, black, red, orange, blue, green, yellow, and pink colors (Joe, 2003; Palmer, 2010). The need for gender equality and rights protection has led to the evolution of gender neutrality, which emphasizes equal representation and treatment of men, women, and transgender individuals without discriminations (Moser, 2014).

Gender and gender-related issues have over the years brought up many arguments with reference to the influence they exert on students' achievement in different fields of study. For instance, Anenye and Osuafor (2023), Nasution, Al Muhdhar, Sari, and Balqis (2023) contended that gender had no significant influence on students' Biology achievement in terms of students' creative thinking skills, while Amedu (2015) observed that the jigsaw method of teaching favors male students more than female students in Biology achievement. However, Ibrahim (2020) and Ahmed, Shittu, Yahaya, and Dada (2021) found out in their separate studies that there was no significant difference in the performance of male and female students in biology.

Lawal (2016) conducted research on gender representation in Nigerian mathematics textbooks for the upper basic level of education in Kwara State, Nigeria. The findings from the study revealed that female characters were less frequently represented in texts and pictorial illustrations in all the textbooks examined compared to male characters. Also, Brusokaitė (2013) analyzed the British textbook "Speak Out," published in 2011 by Longman, and found out that women appear to be underrepresented in the labor market. Women are depicted in a limited variety of jobs and mainly hold artistic occupations such as models, actors, and designers. Male jobs are more varied, including risky, menial occupations and occupations that require a degree.

Mustapha (2012) analyzed gender representation in five highly recommended English Language textbooks for junior secondary schools in Nigeria to assess learning materials and found that both male and female are discriminated against, but females are largely discriminated against. This is seen in forms of underrepresentation, visibility, and domination of the female gender. In another study carried out by Abimbola and Odeniya (2013), which involved gender analysis of pre-service teachers using a questionnaire to gather data on 183 male students and 267 female students of pre-service teachers in Oyo State, the results showed that the nature and content of Biology practicals is not being influenced by the gender of the pre-service teachers.

Johansson and Malmsjö (2009) conducted research on the analysis of gender representation in Swedish textbooks, including two textbook series from the 2000s, among others, and found an overrepresentation of male characters in both of them. Interestingly, in the older textbook series examined, it was men who were overrepresented. Also, research was conducted on the effectiveness of diagrams and pictures representations. Cheung (2014) conducted research on the effectiveness and problems of utilizing diagrams in senior secondary school students' learning of cell division. A convenience sampling technique was used to select 22 secondary school students from an intact Biology class in a girls' school. The results revealed that students perceived diagrams as useful for learning cell division. Furthermore, this research tends to analyze pictures that are gender-neutral and pictures that are appealing to male and female in the selected Biology textbooks.

Objectives of the Study

The main objective of this study was to analyze gender representation in senior school Biology textbooks used in Nasarawa State, Nigeria. Specifically, attempts were made in the study to:

1. Find out how frequently masculine, feminine, and gender-neutral words appeared in the selected Biology textbooks.
2. Investigate how frequently masculine, feminine, and gender-neutral colours are represented in the selected Biology textbooks.
3. Find out how frequently pictures and diagrams that are appealing to male and female are represented in the selected Biology textbooks.
4. Examine the relative abundance of each type of gender representation in the selected biology textbooks.

Research Questions

In this study, answers were sought to the following research questions.

1. How frequently did masculine, feminine, and gender-neutral words appear in the selected Biology textbooks?

doi.org/10.32388/J59S2U

2. How frequently are masculine, feminine, and gender-neutral colours represented in the selected Biology textbooks?
3. How frequently are pictures and diagrams that are appealing to males and females represented in the selected Biology textbooks?
4. What is the relative abundance of each type of gender representation in the selected biology textbooks?

Methodology

Research Design

The study is a descriptive study of the survey design. The study involved the description of content and analysis of gender representation in selected Biology textbooks recommended by the Ministries of Education Area Inspectorate Office (MEAIO), Akwanga, Nasarawa State, Nigeria.

Participants

The population consisted of all Biology textbooks used in Nigerian Senior Secondary Schools, while the target population was biology textbooks commonly used by senior school students in Nasarawa State. A purposive sampling technique was used to select seven Biology textbooks that were recommended by the Ministry of Education Area Inspectorate Office (MEAIO), Akwanga, Nasarawa State, Nigeria. The criteria for the selection of the Biology textbooks are that the Biology textbooks are recommended by the Ministry of Education Area Inspectorate Office (MEAIO), Akwanga, Nasarawa State, Nigeria, the Biology textbooks are readily available in the bookshops, the Biology textbooks are in conformity with the current Biology curriculum used in Nigeria, and the Biology textbooks are in use in schools and contain the data to be used.

The recommended textbooks selected for the study include:

- Kola, S., Akinade E.A., Ekpunobi, E. N., & Mohammed, S. A. (2013). Nelson Biology 3 for Senior Secondary Schools. Lagos: Nelson Publishers Ltd.
- Egunyomi, A., Bob, F. G., Abdullahi B. A., & Oyetola, A. O. (2011). Exam Focus Biology for WASSCE. Ibadan: University Press PLC.
- Duyilemi. A. N., & Oladele, B. D., (2010) Practical Biology for Schools and Colleges. Ibadan: Gbabeks Publishers Ltd.
- Ajayi, O. O., Nwadiaro, P. O., & Nyam, M. A. (2017). An Introduction to General Biology. Abuja: Yabyangs Publishers Ltd.
- Olusola, A. O. (2012). Science Teachers Association of Nigeria (STAN) Biology for Senior Secondary Schools. Ibandan: HERN publishers Plc.
- Michael, M. C. (2015). Essential Biology for Senior Secondary Schools. Lagos: Tonad Publishers Limited.
- Ramanligam, S.T. (2013). Modern Biology Senior Secondary Science Series. Onitsha: African First Publishers.

Instrumentation

The instrument used in this study for data gathering was a proforma adapted from Brugeilles and Cromer (2009). It was used to record the identified masculine, feminine, and gender-neutral words; feminine, masculine, and gender-neutral colours; pictures and diagrams that are appealing to males and females in the selected Biology textbooks.

Validity and Reliability of Research Instruments

The instrument was subjected to face and content validity through the assistance of three Science Education experts from the University of Ilorin, Ilorin, Nigeria, and two experienced Biology teachers from Nasarawa State, Nigeria. The validators helped to determine the appropriateness of the contents of the instrument, clarity of the items, and arrangement of the items in the instrument. The inter-rater agreement method was used to determine the reliability of the instrument, while the data collected were analyzed using Fleiss kappa statistics, which gave a reliability coefficient of 0.71.

Data Collection/Administration

The list of recommended Biology textbooks used by Senior Secondary School students in Akwanga, Nasarawa State, Nigeria, was obtained from the State Ministry of Education Area Inspectorate Office (MEAIO), Akwanga, Nasarawa State. The data in this study were extracted from the selected biology textbooks through direct observation. This was done by a careful and thorough reading of each textbook line by line, sentence by sentence, page by page from the beginning to the end, with concentration on masculine, feminine, and gender-neutral words, colours, pictures, and diagrams used in the selected textbooks. All the words, colours, pictures, and diagrams considered to represent gender were marked or labeled accordingly and photocopied in order to be read again to ascertain the genders that are represented in them.

Data Analysis Procedure

The data collected were coded and analyzed using descriptive statistics of frequency, percentage, and bar charts. All statistical analyses were done using the Statistical Package for Social Science (SPSS) window version.

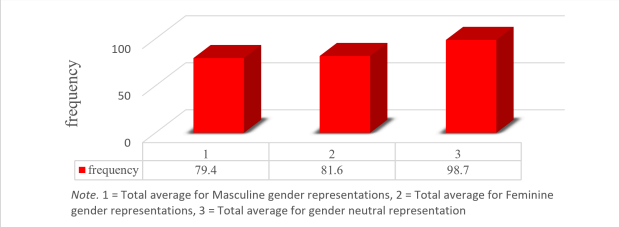
Results

- **Research Question 1**: How frequently did masculine, feminine, and gender-neutral words appear in the selected Biology textbooks?

Table 2 showed that there was gender representation of words in all the selected Biology textbooks. However, it was observed that modern Biology has the highest frequency of masculine words (29.5%) while the Practical Biology textbook has the lowest frequency of masculine words (39.4%). In terms of feminine words, the modern Biology textbook (38.7%) also has the highest frequency, while the Practical Biology textbook (15.3%) has the lowest frequency. For the gender-neutral representations of words, the STAN Biology textbook (40.9%) has the highest frequency, while General Biology (28.7%) has the lowest frequency. Figure 1 indicates that the total average for gender-neutral representations is the highest, followed by the feminine and masculine genders.

Characters	Masculine		Feminine		Gender neutral		Total	
	f	%	f	%	f	%	f	%
Nelson Biology	94	37.3	73	29.0	85	33.7	252	100.0
Exam Focus	45	31.3	28	19.4	71	49.4	144	100.0
Practical Biology	44	39.6	17	15.3	50	45.0	111	100.0
General Biology	45	31.5	57	39.9	41	28.7	143	100.0
Stan	99	22.0	167	37.1	184	40.9	450	100.0
Essential Biology	92	36.4	49	19.4	112	44.3	253	100.0
Modern Biology	137	29.5	180	38.7	148	31.8	465	100.0
Total Average	79.4	32.5	81.6	28.4	98.7	39.1	259.7	100.0

Table 2. Frequency and Percentages of Masculine, Feminine, and Gender-neutral Word Representations in the Selected Biology Textbooks



Note. 1 = Total average for Masculine gender representations, 2 = Total average for Feminine gender representations, 3 = Total average for gender neutral representation

Figure 1. Total Average Frequency and Percentages of Masculine, Feminine, and Gender-neutral Word Representations in the Selected Biology Textbooks

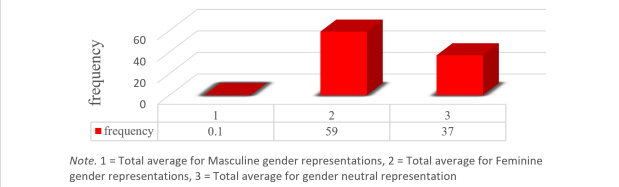
- **Research Question 2**: How frequently are masculine, feminine, and gender-neutral colours represented in the selected Biology textbooks?

Table 3 revealed that there was no gender representation of colours in most of the selected Biology textbooks, as it was observed that gender representation of colours was only found in two Biology textbooks (Essential and Modern Biology). In the Essential Biology textbook, 95.80% of the colours were feminine, while 4.20% were gender-neutral representation, and no masculine colour was found. However, the Modern Biology textbook had 0.4% of the colours as masculine, 0.4% as feminine, and 99.2% were gender-neutral colours. Figure 2 indicates that the total average for feminine colour representations is the highest, followed by the gender-neutral and masculine representations.

doi.org/10.32388/J59S2U

Characters	Masculine		Feminine		Gender neutral		Total	
	f	%	f	%	f	%	f	%
Nelson Biology	0	0.0	0	0.0	0	0.0	0	0.0
Exam Focus	0	0.0	0	0.0	0	0.0	0	0.0
Practical Biology	0	0.0	0	0.0	0	0.0	0	0.0
General Biology	0	0.0	0	0.0	0	0.0	0	0.0
Stan	0	0.0	0	0.0	0	0.0	0	0.0
Essential Biology	0	0.0	412	95.8	18	4.2	430	100.0
Modern Biology	1	0.4	1	0.4	241	99.2	243	100.0
Total Average	0.1	0.4	59	48.1	37	51.7	336.5	100.0

Table 3. Frequency and Percentages of Masculine, Feminine, and Gender-Neutral Colours Representations in the Selected Biology Textbooks



Note. 1 = Total average for Masculine gender representations, 2 = Total average for Feminine gender representations, 3 = Total average for gender neutral representation

Figure 2. Total Average Frequency and Percentages of Masculine, Feminine, and Gender-neutral Word Representations in the Selected Biology Textbooks

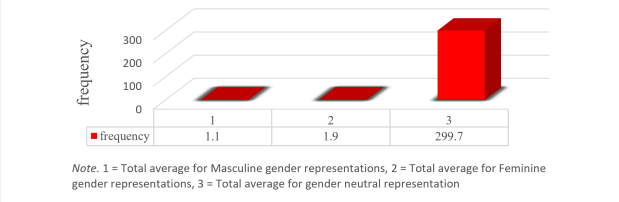
- **Research Question 3**: How frequently are pictures and diagrams that are appealing to male and female represented in the selected Biology textbooks?

Table 4 showed that there were few pictures and diagrams appealing to either male or female while most pictures and diagrams were gender neutral. This can be observed from the total average frequency of 0.3% masculine, 0.6% feminine, and 99.1% gender-neutral appealing pictures and diagrams. Figure 3 indicates that the total average for gender-neutral diagram and picture representations is the highest, followed by the feminine and masculine genders.

doi.org/10.32388/J59S2U

Characters	Masculine		Feminine		Gender neutral		Total	
	f	%	f	%	f	%	f	%
Nelson Biology	0	0.0	0	0.0	138	100.0	138	100.0
Exam Focus	0	0.0	6	2.3	252	97.7	258	100.0
Practical Biology	0	0.0	0	0.0	251	100.0	251	100.0
General Biology	0	0.0	1	0.8	129	99.2	130	100.0
Stan	3	0.6	2	0.4	478	99.0	483	100.0
Essential Biology	5	1.2	4	1.0	396	97.8	405	100.0
Modern Biology	0	0.0	0	0.0	454	100.0	454	100.0
Total Average	1.1	0.3	1.9	0.6	299.7	99.1	302.7	100.0

Table 4. Frequency and Percentages of Diagrams and Pictures Appealing to Male, Female, and Gender-Neutral in the Selected Biology Textbooks



Note. 1 = Total average for Masculine gender representations, 2 = Total average for Feminine gender representations, 3 = Total average for gender neutral representation

Figure 3. Total Average Frequency and Percentages of Masculine, Feminine, and Gender-neutral Diagrams and Pictures Representations in the Selected Biology Textbooks

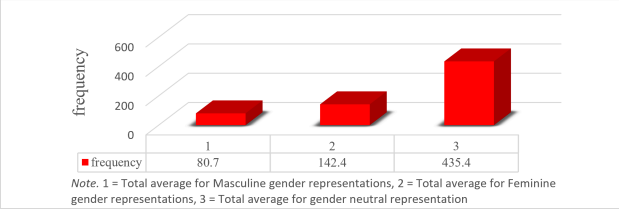
- **Research Question 4**: What is the comparative abundance of each type of gender representation in the selected biology textbooks?

Table 5 showed that there was no relative equality in gender balance in the Selected Biology textbooks for the study. It was observed that Modern Biology had the highest (f = 1162) gender representations followed by Essential Biology (f = 1088) and STAN Biology (f = 933). Others are Exam Focus, Nelson Biology, Practical Biology, and General Biology, which had frequencies of 402, 390, 362, and 273 respectively. Figure 4 revealed that the relative abundance of gender neutral representations in the selected books was the highest, followed by the Feminine and Masculine gender representations.

doi.org/10.32388/J59S2U

Characters	Masculine		Feminine		Gender neutral		Total	
	f	%	f	%	f	%	f	%
Nelson	94	16.6	73	7.3	223	7.3	390	100
Exam Focus	45	8.0	34	3.4	323	10.6	402	100
Practical Biology	44	7.8	17	1.7	301	9.9	362	100
General Biology	45	8.0	58	5.8	170	5.6	273	100
Stan	102	18.1	169	17.0	662	21.7	933	100
Essential Biology	97	17.2	465	46.6	526	17.3	1088	100
Modern Biology	138	24.4	181	18.2	843	27.7	1162	100
Total Average	80.7	14.3	142.4	14.3	435.4	14.3	658.5	100

Table 5. Frequency and Percentages of the Comparison of the Seven Selected Biology Textbooks in terms of Relatively Gender Balance



Note. 1 = Total average for Masculine gender representations, 2 = Total average for Feminine gender representations, 3 = Total average for gender neutral representation

Figure 4. Total Average Frequency and Percentages of the Comparison of the Seven Selected Biology Textbooks in terms of Relatively Gender Balance

Discussion

The focus of this study was to analyze gender representation in senior secondary school Biology textbooks used in Nasarawa State, Nigeria. Findings revealed that there was gender representation of words in all the selected Biology textbooks. Conversely, the gender-neutral characters were the most frequent in terms of gender representation of words, while the masculine characters were more frequent than feminine characters in terms of words or texts in all the selected Biology textbooks. This outcome may be as a result of the authors' negligence in considering gender issues while preparing the words/texts materials. Also, it may be as a result of authors' belief that male is associated with dominance, strength, intelligence, and kingship. Hence, some authors are gender-biased when representing gender issues in words. This outcome concurs with the findings of Lawal (2016); Tang, Chen, and Zhang (2010); Lee and Collins (2010), who observed that female characters were less frequently represented in texts of the textbooks. However, this finding is dissimilar to that of Johansson and Malmsjö (2009), who reported many female word characters in the textbooks.

The findings further showed that there was no gender representation of colours in most of the selected Biology textbooks. The few Biology textbooks that showed the gender representation of colours revealed that feminine and gender-neutral characters were the most frequent. However, only a few masculine characters were found in the selected textbooks for the study. This could be as a result of the authors' preference for using bright and attractive colours without putting gender characteristics into consideration for the readers. Also, this could be as a result of authors' unawareness of masculine, feminine, and gender-neutral colours. Conversely, this outcome was contrary to the findings of Dzulkifli and Mustafar (2012), who found that color characters in the textbooks favour both male and female.

Moreover, findings also revealed a very lower level of pictures and diagrams appealing to male or female characters, while most of the pictures and diagrams were gender-neutral. This outcome could be as a result of the fact that Biology pictures and diagrams are not about the level of beauty attractiveness to the reader but rather the quality and quantity of the labeling, the neatness, and size of the pictures and diagrams. The finding is contrary to Mohammed (2015); Lee and Collins (2010); Tang, Chen, and Zhang (2010), who reported over-representations of male pictures and diagrams in the textbooks of other subjects, and Safiah, Aziz, and Kamisah (2015), who found that the textbooks' pictures and diagrams were more appealing to both male and female.

The result of the study showed that there was no relative gender balance in the selected Biology textbooks for the study. It was observed that both the Modern Biology and Essential Biology contained the highest gender-represented characters, while other selected textbooks contained fewer gender-represented characters. Specifically, it was observed that the Modern Biology contained the highest masculine and gender-neutral characters respectively from the comparison of the relative frequency of all the selected Biology textbooks, while the Essential Biology contained the highest feminine characters respectively from the comparison of the relative frequency of all the selected Biology textbooks for the study. The result of the study could be because there is no benchmark minimum standard for authors' gender representations in the textbooks. This supports the findings of similar studies by Hall (2014); Gharbavi and Mousavi (2012), who observed gender imbalance in textbooks. However, the result was contrary to the study of Mustedanagic (2010) that found gender balance in the textbooks was more frequent.

Conclusion

The study concluded that all the selected Biology textbooks were laden with gender representations in terms of words, colours, diagrams, and pictures. Also, most authors are careful enough to use gender-neutral words, diagrams, and pictures, but the representation in terms of colours favours the feminine gender most.

Recommendations

The following recommendations are considered relevant based on the findings of this study:

1. Textbook authors should revisit their textbooks and amend the gender inequality representation in the Biology textbooks to avoid the promotion of gender bias among the upcoming generations.
2. Curriculum development bodies should try to update and enrich the benchmark minimum standard for authors' gender representations of words, colours, pictures, and diagrams in the textbooks for teaching Biology.
3. There is a need to create awareness of the existence of gender fairness in the Biology textbooks through workshops and seminars for teachers, curriculum planners, policy makers, and authors.

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Declarations

Funding: No specific funding was received for this work.
Potential competing interests: No potential competing interests to declare.