A Model of Gender Equity in Nigeria Mathematics Textbooks

Zinyahs Maris Zakka[1]*

[1] Department of Mathematics, FCT College of Education, Zuba Abuja, Nigeria

Email Address

zakkamaris@yahoo.com (Zinyahs Maris Zakka)
*Correspondence: zakkamaris@yahoo.com

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Abstract:

This study examined gender equity strategies in mathematics textbooks used in two private secondary schools in Kaduna south local government. The purpose of the study is to determine the important strategies to reduce gender bias in mathematics textbooks of two private secondary schools in Kaduna South Local government Areas. A mixed method research design was employed. Questionnaire and interview were used as the instrument in this study, and the questionnaire has a reliability of 0.85. The sample of the study consisted of 526 students which comprised of 256 (48.7%) male and 270 (51.3%) female students and five mathematics teachers. The results revealed six most important strategies which may reduce gender bias in mathematics textbooks from both quantitative and qualitative data. A model was developed and recommended for adoption and implementation at entire private secondary schools in Kaduna State, Nigeria.

Keywords:

Gender Bias, Gender Equity, Mathematics Textbooks and Strategies

1. Introduction

Mathematics textbooks and other teaching and learning materials are embedded with gender bias. [2], [10], [14], [22], and [27] found that gender bias is prevalent in mathematics textbooks. On the other hand, studies revealed that there are biased towards female students in the mathematics textbooks and other learning and teaching materials [6, 8, 16, 17, 19, and 29]. These studies were conducted in various countries such as the UK, the USA, Australian, China and Nigeria. [5] Asserts that even though boys and girls sit in the same classroom, read the same textbooks, listen to the same teacher, but they are receiving a different education. Previous studies, showed that gender bias in mathematics textbooks are not only in Nigeria but also in developed countries. These biases influence students' self-esteem, self-confidence in mathematics and negative attitude towards their mathematics teachers.

2. Materials and Methods

2.1. Materials and Methods

Gender bias is still prevalent in Nigeria classrooms in spite of the revision done in mathematics curriculum and other teaching and learning materials with the aim of eliminating gender bias in the classroom setting Federal Ministry of Education [7, 20]. The biases are dominant in mathematics classroom activities and also in teaching and learning materials [2, 19, 29]. There is no model that can reduce gender bias in mathematics in private secondary schools in Abuja Nigeria. Gender bias in the classroom has negative effect to both female and male students by limiting their interest in mathematics, and the students lack self- confidence in mathematics, as well in themselves [30]. It as well affects their aspirations in choosing of careers in mathematics and related mathematics fields [9, 18]. Therefore this research sought to develop a model that will guide against gender bias in teaching and learning mathematics at junior secondary schools in Nigeria.

3. Results and Discussion

The main goal of this study is to propose a model that may reduce gender bias in mathematics classroom settings in FCT secondary schools.

Investigate the important strategies that can reduce gender bias in mathematics textbooks of private secondary schools in Kaduna.

To find out the perception of mathematics teachers about important strategies that can reduce gender bias in mathematics textbooks of private secondary schools in Kaduna

To propose a model that can reduce gender bias in mathematics classrooms setting of private secondary schools in Kaduna.

4. Research Questions

Based on the objectives, this study sought to find answers to the following research questions;

(a) What are the important strategies that can reduce gender bias in mathematics textbooks of private secondary schools in Kaduna?

(b) What is the perception of mathematics teachers about important strategies that can reduce gender bias in mathematics textbooks of private secondary schools in Kaduna?

(c) What is the appropriate model that can reduce gender bias in mathematics textbooks of private secondary schools in Kaduna?

5. Methodology

The researcher adopted a mixed method research design in which quantitative data were collected and analysed then followed by qualitative data which were collected and analysed as well in a single study. A sample of 526 students of two private secondary schools consisted of 256 (48.7%) male and 270 (51.3%) female students respectively. Three male and two female mathematics teachers were purposively selected for interview. The reliability of the instrument was 0.85. Stepwise multiple regression analysis was used to determine the important strategies that can reduce gender bias in mathematics textbooks used at two private secondary schools in Kaduna South Local government. A mode of Miles & Huberman (1994) and Thematic Analysis was adopted for qualitative aspect in this study. Therefore, the

model has three stages such as data reduction, data display and verifying and drawing conclusion.

6. Analyses and Discussion

6.1. Research Question 1

What are the important strategies that can reduce gender bias in mathematics textbooks of private secondary schools in Kaduna?

To answer the research question (i), data were obtained from the questionnaire which was subjected to stepwise linear regression analysis, and the results are shown in Tables 1 and 2.

Table 1 presents the results of stepwise linear regression analysis. A significant regression model emerged with F3, 372 = 84.460, $p < 0.05$, R2 = .400, three variables of standardized coefficient with Beta values were; there should be realistic depiction of males and females = .290, mathematics textbooks be free of surface bias = .191, and mathematics textbooks should have names of great women mathematician (local and internationally) = .185, $p < 0.05$ are considered the important strategies that can guide against gender bias in teaching and learning mathematics at junior secondary 2 in Kaduna as shown in Table 1 below.

Table1. *Stepwise Regression Results of Important Strategies for reducing gender bias in Mathematics Textbooks.*

Important strategies that guide against gender bias in teaching and learning mathematics	S.C Beta	p < 0.05
1a) there is realistic depiction of males and females	.616	.000
2a) there is realistic depiction of males and females	.368	.000
b) mathematics textbooks be free of cosmetic bias	.284	.001
3a) there should be realistic depiction of males and females	.290	.002
b) mathematics textbooks be free of cosmetic bias	.191	.043
c) mathematics textbooks should have names of great women locally and internationally	.185	.046

Table 2 indicates the summary of stepwise linear regression analysis with the highest value Adjusted R2 =.400 which shows that the model accounts for 40.0% variance of important strategies that can reduce gender bias in mathematics textbooks used at secondary school in Kaduna south.

Table 2. *The Most Important Strategies that can reduce gender bias in Mathematics Textbooks.*

Most important strategies that can foster gender equity in teaching and learning mathematics	R2	Adjusted R2	S.E
1. there should be realistic depiction of males and females	.380	.378	4.17020
2. mathematics textbooks be free of surface bias	.399	.395	4.11079
3. mathematics textbooks should have names of great women locally and internationally	.405	.400	4.09422

The results of the stepwise multiple linear regressions in Table 2 indicates the summary model of the most important strategies that can reduce gender bias in mathematics textbooks used at private secondary schools. The important strategies are; there should be a realistic depiction of males and females, mathematics textbooks are free of surface bias, and mathematics textbooks should have names of great women locally and internationally. The strategies are in descending order according to their level of important. The most important strategies among the three are; mathematics

textbooks should have names of great women locally and internationally, with 40% contribution to the model, and there should be a realistic depiction of males and female is the last. Mathematics textbooks are presenting with tasks that combine picture which conveying vital information [25].

Many studies found that gender representation in textbooks is a reality of what is obtainable in that society. However, the males and females are depicted in a stylized manner which conforms to the widely accepted, but frequently fictitious, ideas of what her members groups are [21]. These strategies are supported by many scholars in order to break the barrier of gender bias in mathematics classroom among students [4, 12, 13, 26], but contrary to findings of [11]. Furthermore, [26] suggested that names of contemporary male and female mathematicians should be indiscriminately distributed to both male and female students to study will influence both male and female students.

Female students should know about the contributions in mathematics by female mathematicians which can merge naturally into relevant course topics. For instance in algebra, students should learn why Emmy Noether is sees today as the founder of modern abstract algebra. Secondly, students should engage in some activities that are related to some of the mathematicians' work. However, these three strategies that can reduce gender bias in mathematics textbooks used at the private secondary schools in Kaduna, Nigeria.

6.2. Research Question 2

What is the perception of mathematics teachers on the important strategies that can reduce gender bias in mathematics textbooks of secondary schools in Kaduna?

In order to answer this research question, it was further divided into two open-ended questions that are aided in collection of data related to important strategies that can reduce gender bias in mathematics textbooks of secondary schools. The following sub-questions were formed such as; (a) what is your opinion about the characters in mathematics textbooks? (b) what are the ways to address these characters with gender bias?. The data collected from the interviews were transcribed, coded and categorised into three major categories that emerged such as “equal representation of boys and girls, neutral gender character, and non-traditional occupation characters”. The three categories are presented below.

Mathematics textbooks serve as a gateway for determining student’s worldview of female and male roles in the society. The textbooks are used by students in the school which influence their attitude negatively and values towards mathematics and career which is related to mathematics fields[28]. Most of the things they read or see the inside of the textbooks of what is happening in the real life situation so they take to whatever they read and see in the textbook. The students may think that whatever is in the textbooks such as gender roles and stereotypes is a reflection of socially desirable of the people [1]. Three important strategies that can reduce gender bias in mathematics textbooks were identified as; (teachers should present male and female characters equally, teachers should use neutral gender characters in mathematics, and textbooks should use non-traditional occupation characters).

6.2.1. Teachers Should Present Male and Female Characters Equally

The representations in this context include the number of female and male characters depicted in texts and illustrations in the learning materials as well as gender

role portrayed. The under-representation of characters may affect both male and female students in mathematics. Many opinions were expressed an unequal representation of male and female characters in mathematics textbooks by T1, T3, T4, T5 and T2. But T1 lay more emphasis that;

"Hah… hah…, the teacher have to ensure that he/she balance the characters of both male and female while teaching by not following the textbooks on the characters where it is underrepresented by making substituting the other character in order to balance by using either male or female name as the case may…"(T1).

T1 does not follow what is in the textbooks where some characters are being short changed and is gender sensitive and an advocate of gender equity.

Other different opinions from T2 and T4 of the unequal gender characters representation in mathematics textbooks are unnoticed by some teachers. T5 said that.

"Wait… sir let me take a look at the mathematics textbook on what you are talking about where …is…is the mathematics textbook I just kept here? asking her students Hmm…really I have never take note of this before all my 10 years of teaching until only now that I notice what you are saying sir…I think there is the need for the textbook to have fairly same characters" (T5).

T5 lacks the knowledge of gender despite the number of years of working experience. This also shows that teachers have not received training on gender issues in their school. In another development, there are views of the authors of mathematics textbooks on gender characters, in which the participants attribute the gender bias through the authors of the mathematics textbooks that they are not aware or do lack the knowledge of gender issues, but T4 put more impression stated;

"I think…. The writers and authors are to be blamed on this issue of not balancing male and female characters…..they made a great mistake from the beginning, and as a teacher I follow what is in the textbook" (T4).

T4 does not have the information of gender issues and, therefore, does not care. In sum, it is observed from the data analysis that gender bias exists in the textbooks and some teachers are striving to improvise to complement the characters that are underrepresented as in the case of T1. Some participants are unaware of the gender bias in mathematics textbooks they are using. However, teachers should present male and female characters equally is an important strategy emanating from the six interviewees on strategies that can foster gender equity in mathematics classrooms at junior secondary levels in Kaduna.

6.2.2. Teachers Should Use Neutral Gender Characters in Mathematics

Gender characters use in the textbook has positive influence to both male and female students in mathematics [6]. Authors should ensure they use the neutral character in the textbooks. This is because students spend most of their lives in school using mathematics textbooks. They learn basic skills and also formulate attitudes and behaviour from what they have read in the textbooks. They internalized what they read and see as suitable for the textbooks as being masculine and feminine [3]. Many opinions about the use of neutral gender character emanated from the ten interviewees such as (T1, T3, T4) are sharing the same views, thus T5 have stressed more that;

"Hmm… yah… the characters in the textbooks I think should contribute to diverse roles of the society to reflect the contribution of women and men from the diverse roles" (T5).

Other opinions emerged from T2, T4 and T3 that characters in the textbooks when they neutral have positive impact on both male and female students in terms of their self-esteem and self-confidence nevertheless T2 further expressed her views that;

"Am …suggesting that textbooks should use characters that contribute to the self-worth of all the students and the materials should also contribute to a feeling of self-worth in all the students….that is my opinion sir" (T2, T3, and T5).

Different opinions from the previous voiced out that characters in the textbooks should be mixed from T1, and T4. Thus, T4 reiterated that

In my opinion, male and female characters should not be differential but rather they should be mixed with one single character can serves male and female …I think is better" (T4).

The results revealed that the bias is in favour of the certain character in the textbooks and therefore, there is a need for neutral characters to be used in the textbooks. Neutral gender characters emerged from ten participants as a strategy that can foster gender equity in mathematics classroom based on the mathematics textbooks.

6.2.3. Textbooks Should Use Non-Traditional and Traditional Occupation Characters

Gender role stereotypes are perceived by learner's minds through textbooks. The gender role stereotyping is an issue of concern in mathematics and a thing of worry because of its potential negative effects on learners towards mathematics. In addition, [1] found that some children may think that whatever they see in their textbooks such as gender roles and stereotypes is the reflection of socially acceptable. This means that children stand the chance of believing what they are reading or seeing in the textbooks. Moreover, most of the things they read or see the textbooks are what is happening in the real life situation because they internalize whatever they read and see on the textbooks. There are many views on the gender roles in the textbook used by teachers T1, T2, T3, T4, and T5 have similar opinions which mean that such characters have influence on both the male and female students in mathematics but T1 emphasizes that;

"Yes … you see textbooks are supposed to show the character of male and female doing the same type of work In my point of view, other of the textbooks show discrimination in some occupations, for instance, engineering mostly is men whereas bankers are mostly women etc"…. (T1).

The other views of T2, T4 and T5 are similar but, T3 stated that;

"am of the view….. that textbooks should show all kinds of occupation in male and female characters by…. Attaching the characters in the same occupation" (T3).

From the analysis of the data, the results findings indicate that gender inequity exists on the gender roles in which males and females are placed in the traditional occupation which is sometimes restricted to male or female. But, non- traditional occupation gender characters are a strategy that can reduce gender bias in mathematics textbooks.

6.3. Research Question 3

What is the appropriate model that can guide against gender bias in teaching and learning mathematics at the junior secondary school in Kaduna state Nigeria based on mathematics textbooks?

The results of the stepwise multiple linear regression in Table 2 indicates the summary model of the most important strategies on mathematics textbooks. The important strategies are; there should be a realistic depiction of males and females, mathematics textbooks are free of surface bias, and mathematics textbooks should have names of great women locally and internationally. The strategies are in descending order according to their level of important. The most important strategies among the three are; mathematics textbooks should have names of great women locally and internationally, with 40% contribution to the model, and there should be a realistic depiction of males and female is the last. Mathematics textbooks are presenting with tasks that combine picture which conveying vital information [25].

Many studies found that gender representation in textbooks is a reality of what is obtainable in that society. However, the males and females are depicted in a stylized manner which conforms to the widely accepted, but frequently fictitious, ideas of what her members groups are [21]. These strategies are supported by many scholars in order to break the barrier of gender inequity in mathematics classroom among students [4, 12, 13, 26], but contrary to findings of [11]. Furthermore, [26] suggested that names of contemporary male and female mathematicians should be indiscriminately distributed to both male and female students to study will influence both male and female students.

Female students should know about the contributions in mathematics by female mathematicians which can merge naturally into relevant course topics. For instance in algebra, students should learn why Emmy Noether sees today as the founder of modern abstract algebra, and first Nigerian female mathematician Grace Alele Secondly, students engage in some activities that are related to some of the mathematicians' work. However, these three strategies on mathematics textbooks can be employed to foster gender equity in teaching and learning of mathematics at all levels of junior secondary schools in Nigeria.

The qualitative findings revealed that ‘teachers should present male and female characters equally, use neutral gender characters in mathematics, and textbooks should use non-traditional and traditional occupation characters’ which are the important strategies that can foster gender equity in teaching and learning mathematics at junior secondary school in Abuja. Teachers should endeavour to balance characters of male and female used in texts and illustration [19], [24], and [6], while teaching and textbooks should have traditional and non-traditional occupations for both male and female and as well as gender neutral as suggested by [23], and [14].

The findings of qualitative are supporting the quantitative results. Based on these findings, Figure 1 is a model of mathematics textbooks that can guide against gender bias in mathematics classroom settings. The quantitative findings are arranged according to their level of importance but the qualitative findings are not as shown in Figure1. The findings of the quantitative and qualitative were triangulated to found a model that can guide against gender bias in mathematics classrooms at junior secondary school levels in Kaduna-Nigeria as shown in Figure 1.

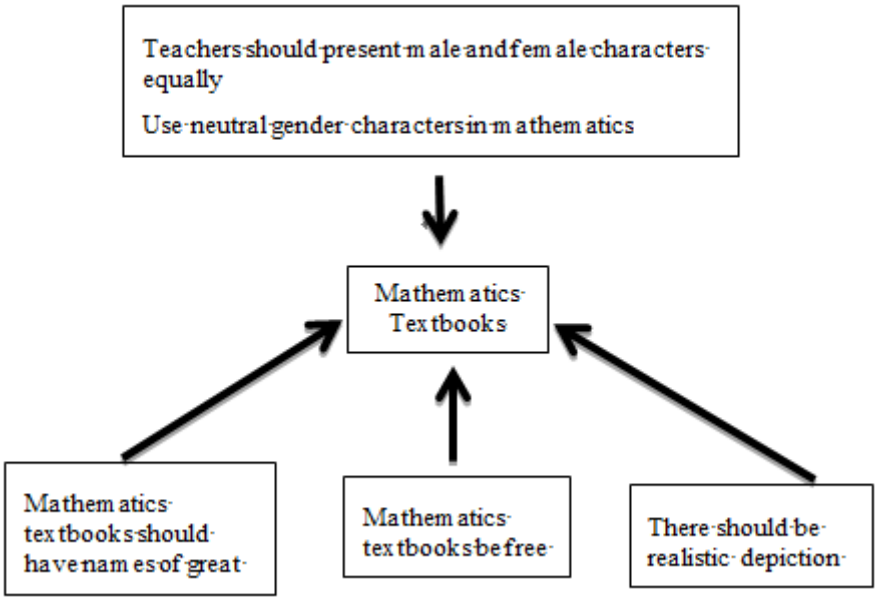

Figure 1. *A mode that can reduce gender bias in Mathematics textbooks.*

7. Conclusion and Recommendation

The findings of the research study have resulted in developed a model that guide against gender bias in teaching and learning mathematics at junior secondary school levels in Kaduna State. Nigeria. The model comprised of the most important strategies of mathematics textbooks that can guide against gender bias in mathematics classroom settings. The model was formed from the findings of both quantitative and qualitative data. In the light of this, the researcher concludes that the model that can guide against gender bias in mathematics classroom settings was established to serve as an authentic instrument for promoting and steering the implementation of eliminating of gender bias in mathematics textbooks at junior secondary school in Kaduna State Nigeria. Therefore, the implementation of the model can effectively eliminate gender bias and make both the male and female students to be self-esteem, and self –confidence in mathematics and they will be able to reach their full potential.

In this study, the following recommendations were directed towards the stakeholders of junior secondary education in Kaduna, Nigeria in order to guide against gender bias in mathematics classrooms.

(1) The model can be used by the NERDC and NMC to reduce gender bias in mathematics curriculum and textbooks

(2) Guidance and counselling teachers can use this model in interacting with the students.

(3) The model can be used by Mathematics teachers to reduce gender bias in mathematics textbooks.

(4) The model can be used by researchers as a reference document

Conflicts of Interest

There is no conflict of interest regarding the publication of this article.

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