MATHEMATICS TEXTBOOK ATTRIBUTES AS PREDICTOR OF STUDENTS' ATTITUDE TO MATHEMATICS

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Abstract

The textbook is a pivotal learning material the students cannot do without and it serves as an instructional guide for the teachers. The features of the textbook can affect the interest of the learners positively or negatively and consequently, his attitude. This study is a descriptive survey which considered the correlation of four textbook features (independent variables) with the attitude of students to mathematics (dependent variable). Two validated instruments (Students' Attitude to Mathematics, r = .72 and Mathematics Textbook Rating Scale, r = .76) were used to collect data from 2,490 students and 117 mathematics teachers respectively. Multistage sampling was used to collect data from the respondents. The findings revealed that there is a positive multiple correlation of the textbook features and students' attitude to mathematics. The textbook features accounted for 2.8% of variation of students' attitude to mathematics. The variables do not have composite or any relative significant contributions to students' attitude to mathematics. The relationship between features of mathematics textbooks and students' attitude to mathematics is indicative of the need for stakeholders in mathematics textbooks to rethink the type of textbook that can impact positive attitude of students to mathematics.

Keywords: Textbook Psychological Attributes, Gender balance, Attitude, Predictor, Correlation

Introduction

Attitude is a non-cognitive factor that influences learning. Attitude is considered as a silent predisposition of people to concepts, ideas and beliefs (Mukherjee, 1980; Falaye, 2006). Attitude as a construct can either be positive or negative. Many researchers posited that positive attitude to learning correlates positively with achievement (Adesoji, 2000; Alausa, 2000) and that the more positive the attitude, the more likely the students perform in any subject (Falaye, 2006).

A number of factors that can inform the attitude a learner would have been identified by Halladyna and Shanghnessy (1982), Falaye (2006) to be any of the following; teaching method, parents influence, gender, students' cognitive styles, career interests, societal view, teachers attitude, subject matter (Afolabi, 2010), peer influence.

Attitude therefore can be summarized as the disposition towards a course, which may be a favorable or unfavorable disposition it may be good or poor (commonly referred to as negative or positive). It is an expression of the level of like or dislike, interest or disinterest. When there is 'like' or 'interest' which is caused due to intrinsic or extrinsic value or due to cause and effect, then there may tend to be good attitude towards a certain course. On the other hand, if there is 'dislike' or 'disinterest' this tends to engender a poor attitude. The 'like' or otherwise' the 'interest or otherwise', themselves could be as a result of individual makeup, innate characteristics or experience.

The classroom and home environment of the learners are full of objects, events, situations, activities which may affect the 'like or dislike', 'interest or disinterest' which may then manifest in the type of attitude the learner may have. Those factors which may affect the learning outcomes (achievement on and attitude to mathematics have been identified by many researchers and educators like Adeniran (2003), Afolabi (2001), Georgewill (1990), Ilori (2003). Such factors have been categorized into four by Afolabi (2010).

(1) Teachers factors which include the attitude, experience, knowledge of teaching methods, instructional strategies.

(2) Environmental factors- such as instructional materials, physical structures, infrastructures textbooks, the societal perception, parental attitude, peer influence and class size.

(3) Subject matter factors- nature of the subject, scope/coverage of the subject.

(4) Student related factors which include age, emotional maturity, intellectual capacity, learners' need and interest.

Essentially, the students cannot do without textbook. Kajander (2007) considered textbook as a primary source of documents for the students' personal studies and homework (Kajander and Lovric, 2009). Li (2000) asserted that textbook is considered as a very important and major instructional material worldwide.

Psychological Attributes of a Textbook

There are many attributes of a textbook that can affect the attitude and achievement of a learner. The structure, the organization, the presentation format which includes the color, the font type, the font size, the illustrations, the content, the examples, the task range and order etc.. These are the attributes that can contribute to like or dislike, interest or disinterest, attraction or repulsion and ultimately increases positive or negative attitude of learners and users.

Afolabi (2010) cited the ideals and suggestions made on textbook by Kochhar (1985) and Aggarwal (2001). Kochhar (1985) made a comprehensive list of attributes a textbook should possess if it should be used for school work. He opined that:

(1) the textbook should be interesting to keep the learners interested in learning it, well written and beautifully compiled so that it might win and retain users' goodwill by virtue of more solid qualities.

(2) It should be well illustrated with attractive colors, inspiring drawings and photographs, it should be attractive, inviting, a pleasure to look at and read, with well-chosen illustrations, well-connected and carrying through a sequence;

(3) The textbook should be up-to-date in content, frequently revised and reprinted when necessary;

(4) The textbook must be complete with its table of contents, illustrations, charts or other references.

(5) The textbook must be well-graded i.e. suitable for the capability of the children for which it is intended;

(6) The facts must be simple, clear and logically set outfit into child-centered education (Kochhar, 1985; 101).

All these attributes are not precisely the contents of the subject matter rather they are psychological attributes that can arouse interest and consequently the attitude of the learners.

Aggarwal (2001) also emphasized the psychological attributes of textbook which may tend to affect the attitude of the learner. He suggested that (1) it must possess a motivating presentation, creative and interesting content. (2) It must possess visual illustration, that should be; (i) suitable for the mental level of students, (ii) easily portable and up to date, (iii)

motivate learners, (iv) relevant and purposeful (v) accurate (vi) simple and cheap (vii) large enough for sight.

Gender representation and presentation in favor of males which is common with most textbooks often boost the morale and favors positive attitude among boys (Halai, 2010; Akalonu, 2006). Douville and Pugalee (2003) admitted that reading textbook is associated with difficulties and it becomes a more complex task when computing a successful solution. Pepin and Haggarty (2001) also emphasized that studies on mathematics texts include that which examine the sociological contexts of the textbooks and the cultural traditions represented in the textbooks (Afolabi, 2010; Johansson, 2003).

All these concerns on presentation have to do with what can enhance or elicit a positive attitude on the part of the learners.

This study is concerned with an examination of these attributes found in the literatures and research report as earlier discussed, to see their degree (level) of availability, their relevance, suitability and adequacy when compared with requirements of senior secondary school mathematics curriculum. This is similar to the study of Chandler and Brosnan (1995) which compared the correspondence that exists between frequently used mathematics textbooks series in some school districts of Ohio with 'Ohio 9^{th} Proficiency Test'.

This study also considered the correlation of these variables to establish the degree of relationship among them and with the dependent variable (i.e. attitude of students towards mathematics) in order to determine the variable that can predict students' attitude towards mathematics.

Theoretical Framework

Two theories of learning have been found germane to this study. Brunner (1966) theory of presentation of knowledge and Ausubel's (1968) theory of organization of knowledge.

Bruner (1966) says virtually any topic can be organized in certain structural ways to suit learners at various levels of education. He identified 3 modes of structural presentation of knowledge-the enactive, iconic and symbolic. He believes that learner goes through these 3 successive cognitive developmental stages. The inactive concept is explained as learner doing an activity repeatedly will enhance the learning of the concept. In his iconic structural presentation of knowledge, he explained that learners acquire knowledge through seeing an image or picture of it and symbolic is one in which learner acquire knowledge through the use of language. Mathematics has its own language and symbols. Symbols should be well annotated and adequate. Authors and publishers should present their information in most

appropriate and fascinating way to enhance learning. There should be well structured exercises which are sequentially ordered that can enhance repeated practice for all levels of achievers.

Ausubel (1968) theory of organization of knowledge: Ausubel regarded organization of knowledge as organized verbal learning. He considered knowledge to be what learners know or should know. Such knowledge should be systematically arranged in hierarchical order from simple to complex (Afolabi 2010). His concept of knowledge refers to super ordinate concepts which serve as the main building block of ideas while the subordinate ideas are those that are closely linked around the subordinate ideas. Where knowledge is properly arranged and linked, learning becomes easier. Mathematics as one of the most hierarchical structured disciplines an unorganized presented in a textbook can lead students to frustration and loss of interest and consequently a bad attitude to mathematics.

Textbook is a supplementary instructional source, which stays longer with the learner than the teacher could do, if properly presented can motivate the learner and promote a positive attitude. Textbook is no doubt a useful learning material, yet it has been understudied in most part of the world (Morgan, 1998: Pugalee, 2001; Johansson, 2003), Nigeria inclusive. There should be a concern about how it motivates or de-motivates students in their studies. These have necessitated the need for this study. This study thus examined some attributes or features of mathematics textbooks in school use as suggested by research literatures and authors. The mathematics curriculum of senior secondary school in Nigeria has provided some attributes which can be gleaned from the content presentation of the curriculum document. It is with the expectations of the mathematics curriculum that the teachers rated or measured the availability, relevance, suitability and adequacy of these attributes. The availability, relevance, suitability and the adequacy of these attributes were intercorrelated and jointly correlated to determine their contributions to students' attitude to mathematics.

Research Questions

1. What is the joint contribution of the textbook attributes (variables) to student attitudes toward mathematics?
2. What are the relative contributions of the independent variables-
   i. availability of the textbook features,
   ii. relevance of the textbook features,
   iii Suitability of textbook features,
   iv adequacy of textbook features towards students attitude to mathematics ?

3. Which of the textual material variables will predict students' attitude to mathematics?

Methodology

Sample and procedure

The population (N) consisted of all teachers, students and their recommended mathematics textbooks. Two (2) schools were randomly selected from each of the 3 senatorial districts in south-west Nigeria (Oyo, Ondo, Ogun, Osun, Ekiti and Lagos states). 117 mathematics teachers were purposively selected from the schools while a total of 2,490 students were randomly selected in the same schools. The mathematics teachers were those who have been using the textbooks for at least three (3) years so that they can be effective assessors of the books.

Instrumentations

Students' Attitude Towards Mathematics (SATM) comprised 12 items on a 4- point Likert rating scale of strongly agreed (SA), agreed (A), disagreed (D), strongly disagreed (SD). There were 6 positively worded items and 6 negatively worded items. SATM was designed for students. The Mathematics Textbook Rating Scale (MATBOOKRS) has textbook features aggregated into 4 variables- availability of textbook features relevance of the textbook features suitability of the textbook features and adequacy of textbook features. The same attributes/features (topical objectives, content, learners' activities, evaluation, presentation format, language, progressive hierarchy of tasks and that of examples, exercises, worked examples, solutions/keys to exercises, teachers' guide, and the student workbook) were differently structured and worded as appropriate under these 4 variables. These attributes also have different numbers of items under each variable as appropriate.

The attributes are said to be relevant if there exists a proper correspondence of these features /attributes with the senior secondary mathematics curriculum. It is suitable if the standard is appropriate to the target audience – not below or above the standard. An attribute is adequate if it appropriately covers the scope stipulated by the curriculum.

MATBOOKRS was validated and the availability section gave a reliability index of 0.79 while the remaining 3 parts on relevance, suitability and adequacy was found to be 0.76.

Findings and Discussions.

Table 1: Correlation Matrix among the Variables.

	Avail.	**Relev.**	**Suitab.**	**Adeq.**	**Att.**
Avail.	1				
Relev.	.400**	1			
Suitab.	.070	.605**	1		
Adeq.	.212*	.580**	.699**	1	
Att.	-.074	.152	.213*	.176	1

* Correlation is sig. at 0.05 level (2_tailed) ** Correlation is sig. at 0.01 level (2_tailed)

Table 1 shows the correlation matrix among the variables. The table revealed the correlation between each pair of variables. It also revealed the strength of correlation (correlation coefficient, r) between each pair. Those pairs of variables that are significant at 0.01 (2-tailed) are indicated (**) and those that are further significant at 0.05 (2-tailed) are indicated (*). However the concern of this study is limited to those that are significant at 0.05 levels. All the pairs of independent variables are positively intercorrelated, suitability and adequacy of the features being the highest (r = 0.699), followed by the suitability and relevance of the textbook features (r = 0.605), However, both of them are not significant.

There is significant correlation between adequacy of textbook features and availability of textbook features, r = 0.212. There is significant correlation between suitability of textbook features and attitude, r = 0.213. This implies that there is significant relationship between suitability of textbook features and student attitude to mathematics.

Research Question One

What is the joint contribution of the textbook attributes (variables) to students' attitudes toward mathematics?

Table 2: Summary of Composite Contributions of Textual Material Variables on Students' Attitude to Mathematics

Multiple R	R square	Adjusted R square	Std. Error
.248	.062	.028	1.8240

Table 2 is a result of multiple regression with coefficient R= 0.248, which indicates a positive linear correlation between the textbook features and students' attitude to Mathematics. The R square is 0.062 while the adjusted R square is 0.028. This shows that the four textual material variables accounted for a 2.8% contribution to the total variance in students' attitude to Mathematics.

Table 3: Regression ANOVA of Textual Material Variables on Students' Attitude to Mathematics

Source of variation	Sum of square	Df	Mean	F	Sig. F
Regression	24.422	4	6.105	1.835	.127
Residual	372.622	112	3.327		
Total	397.044	116			

Table 3 reveals further investigation on the linear relationship between textual material variables and students' attitude to Mathematics. From the table, $F(4,116) = 1.835$ ($p>0.05$). This means that there is no significant composite contribution of textual material variables on students' attitude to Mathematics.

Research Question Two

What are the relative contributions of the independent variables-

i availability of the textbook features,

ii relevance of the textbook features,

iii Suitability of textbook features,

iv adequacy of textbook features towards students attitude to mathematics ?

Table 4: Relative Contributions of each of the Textual Material Variables on Students' Attitude to Mathematics

Independent variables (Predictors)	**Unstandardized coefficients**		**Standardized coefficients**	**Rank**	**T**	**Sig. t**
	B	Std Error	Beta			
(Constant)	34.011	.952			35.734	.000
Availability of textbook features	-. 065	.050	- .135	1st	-1.300	.196
Relevance of textbook features	.022	.031	.095	3rd	.726	.469
Suitability of textbook features	.027	.032	.119	2nd	.842	.401
Adequacy of textbook features	.010	.021	.066	4th	.493	.623

The Beta weights in table 4 indicate the relative contributions of each of the textual material variables on students' attitude to Mathematics. The order of contribution of these variables to the criterion variable is availability, suitability, relevance and adequacy of textbook features with β values -.135, .119, .095, .066 respectively. None of these four variables have significant contribution on students' attitude to Mathematics.

Research Question Three

Which of the textual material variables will predict students' attitude to mathematics?

None of the four textbook features made a significant contribution to students' attitude to mathematics. The variables impacted positively but none of them have significant contribution. Therefore none of them could predict students' attitude to mathematics.

Discussion

The four textbook variables have a positive correlation with students' attitude to Mathematics explained to the tune of 2.8%. These variables do not have significant composite or relative contributions to students' attitude to Mathematics. The implications of these findings is that the students' attitude to Mathematics may tend to appear indifferent irrespective of the effort made to make their textbooks available in full and wide coverage of the curriculum or not, with or without activities, colors, diagrams, comprehensive exercise or not. It therefore implies further that more effort is needed to come up with a type of textbook that can arouse positive attitude on the part of the students. In extension, this type of attitude may have the tendency to make the four variables impact no significant relative contribution to Mathematics achievement.

A textbook with appropriate standard examples and exercises have the tendency to impact positive attitude on learners. To possess an appropriate standard, a textbook must have task for every learner. Three types of achievement categories have been a common construct in research. These are high achievers, medium or moderate achievers and the low achievers. The moderate achievers refer to the average learners. All these categories should have appropriate tasks and activities. Using a textbook, no group should be left out. By the law of cause and effect the low level or medium level achievers can move to the next higher level of achievement once he is motivated by the level of exercises and tasks he is doing. If the standard is inappropriate or if the task is not set in the appropriate hierarchy of task, the morale of the learner may be dappled. In this case, a lukewarm attitude may develop.

Gender presentations and illustrations in favour of males have been reported in textbooks by Akalonu (2006), Halai (2010). The already existing gap between male and female learners in mathematics and the physical sciences should be bridged. There is a need for a textbook which will give adequate gender balance without bias in illustrations and representations. Learning with such textbooks, female learners can see learning mathematics to be a course in the female domain. A negative attitude to mathematics can be traced to be higher on the part of female than male learners and their mathematics achievement is positively correlated with their attitude. Therefore, efforts must be made in these areas to use textbook to improve the attitude of all. All the four variables are germane to the consideration of students' attitude to mathematics and all the textbook features and attributes are essential to effective learning through mathematics textbook. To encourage positive attitude, the language of presentation should be simple and familiar. The importance and application of studying each concept or topic should be outlined at the beginning of the chapter or section. Good and attractive font type and size should be used. Attractive layout should be embedded and pervade the mathematics textbooks for school use. To enhance positive attitude, these psychological attributes of textbook should be given serious attention in writing, publishing and recommending textbooks for school use.

Conclusions and Recommendations

There is a significant relationship between the suitability of textbook features and students' attitude to mathematics. The appropriate standard of examples, illustrations and tasks should me ensured in students' textbooks. A moderate standard of exercise properly presented can elicit a positive attitude of the students. The exercises should be well graded to meet the standard of task for all levels of achievement- low medium or high achievers.

A negative linear correlation however not significant exists between the availability of textbook features and students' attitude to mathematics. This is a reflection of indifference attitude irrespective of the existence or otherwise of some features in the textbooks. If the presence of some features cannot culminate to a positive attitude, then what can? There is therefore a need for stakeholders (teachers, authors, publishers, government and parents) in school mathematics textbooks to rethink on what type of textbook can impact a positive attitude on the learners.

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