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TEACHERS' ATTITUDINAL VARIABLES IN THE IMPLEMENTATION OF THE FURTHER-MATHEMATICS CURRICULUM AS CORRELATES OF STUDENTS' LEARNING OUTCOMES

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ABSTRACT

The study was designed to obtain empirical evidence on the teachers' perception of the contents of the Further-Mathematics curriculum and their attitudes toward instructional and assessment practices in its implementation. The extent to which these teacher variables influence the students' perception of their Further-Mathematics lessons and their achievement in the subject was also examined.

The study adopted an ex-post facto design involving 32 teachers and 349 students selected from 32 out of 96 schools offering the subject in Ogun State, Nigeria. Each teacher responded to a questionnaire while each student responded to a questionnaire and an achievement test. Data analysis included descriptive statistics, multiple regression, and path analysis.

The study revealed that the influence of the teachers' perception of the curriculum on the student variables is positive and significant but mostly indirect via the teachers' attitudes toward instructional practices. The teachers' attitudes toward instructional practices exert both direct and indirect influence on the student variables, whereas the teachers' attitudes toward assessment practices appeared to have no significant influence either directly or indirectly on the students' learning outcomes. Of all the variables in the study, the students' perception of their lessons have the highest direct influence on the students' achievement in Further-Mathematics.

Introduction and Background

Curriculum is often understood as synonymous with the organisation of the delivery of knowledge; that is planning to teach (Ivowi, 1984; Sharpes, 1988). It is thus what is transmitted through the levels of schooling-primary, secondary, and tertiary, with additions or deletions regulated by government agencies.

Over the years, one of the most significant developments in the Nigerian education system is that of curricular reforms, which have run through the whole educational system. The reforms were undertaken by government agencies such as the Ministries of Education, nongovernmental organisations such as the United States Agency for International Development (USAID) and the Comparative Education Studies and Adaptation Centre (CESAC) of the University of Lagos, Nigeria, and the Mathematics Association of Nigeria (MAN). These efforts provided the basis for the development of curriculum in various school subjects like Integrated Science, Physics, Chemistry, Biology and Mathematics.

The most remarkable curriculum reform in the country was undertaken at the National Curriculum Conference of 1969. The main theme of this conference covered the whole of the Nigerian education system. The conference enunciated working objectives and general objectives for each level of education were proposed. The conference was unique in two respects. Firstly, it was the first time Nigerians sat down to determine their needs and expectations from the Nigerian education system without the active participation of expatriates. Secondly, the composition of the participants cut across the Nigerian populace from all walks of life. Virtually all groups, be it ethnic, work, or professional callings, were represented.

The conference has been followed up by the establishment of the then Nigerian Educational Research Council (NERC) now Nigerian Educational Research and Development Council (NERDC). Under the auspices of the NERC, workshops on the Primary School Curriculum (April, 1971) and Secondary School Curriculum (1973) have been organised. In these workshops, objectives at subject level were considered in detail and outline syllabuses produced. The council is supposed to be responsible for the co-ordination of all curriculum activities at the national level.

Apart from leading to the establishment of the then NERC, the 1969 curriculum conference also generated tremendous interest in curriculum research projects. Among these are the UNESCO/UNICEF assisted Primary Education Improvement Project for Northern State of Nigeria and the six-year primary school project conducted by the Institute of Education of the then University of Ife. It is also important to note that the conference has provided the basis for the current National Policy on Education.

Mathematics is among the most ancient of subjects of instruction and has held a high place in all educational programmes for many years. It has retained this place because it has been considered indispensable in the training of the liberally educated man (Howard, 1963). More importantly, it has retained its place because of its continued and ever increasing services to other areas of study. Mathematical techniques are constantly being developed to meet the changing requirements of Physics, Chemistry, Biology, Social and Behavioural Sciences, Engineering and Computer Science. According to Setidisho (1961), no other subject forms a strong binding force among various branches of the sciences as mathematics. This remark about mathematics is an indication of its versatility.

In Nigeria today, the common man on the street can always tell us that mathematics is an important subject, at least from what he knows of the importance placed on it by the teachers and examination bodies. The subject appears conspicuously in the curriculum of our primary and secondary schools and every student who passes through these institutions of learning is supposed to learn the subject compulsorily. It has also become *sine qua non* to securing admission to read science or social science-based courses while at least a pass is required for the other courses.

Nigeria has been teaching mathematics in one form or the other since the beginning of formal education in the country. Fakuade (1979) stated that in the pre-independence days, elementary mathematics was taught as general arithmetic, geometry and trigonometry. The 1960s witnessed the introduction of modern mathematics.

However an examination of the various documents on the developments in mathematics education in Nigeria (eg. Alli, 1977; Fakuade, 1979) revealed that for a long time in the history of Nigerian education there was never any National Mathematics Curriculum which reflected the national goals of the country. All the mathematics programmes were mostly attempts at making foreign based curricula, especially those of Europe and America , adaptable to the needs and aspirations of the country. The first attempt to have one began with the defining of national objectives for mathematics at the Benin conference of 1977. The task of developing a truly indigenous mathematics curriculum was taken up by the then NERC in 1978 and about the same time CESAC embarked on another version of the curriculum. Later the efforts of the two bodies were coordinated at a workshop tagged "The National Critique" at Onitsha. The curriculum which emerged and was finally accepted by the Federal Ministry of Education is now being implemented in Nigerian secondary schools beginning from the 1982/83 academic year.

In order to cater for the different talents and abilities of the secondary school students, two mathematics courses were designed for them. The first called General Mathematics was designed for the generality of the students and it is compulsory for all of them. The second course, called Further-Mathematics was designed for the brighter students for whom General Mathematics may not be enough. However, this course is elective and also contains all the topics in the General Mathematics. It is to be taken at the senior secondary school level. It's implementation started in 1988 with the first set of those who started the junior component of General Mathematics in 1982/83.

Teachers' Role in Curriculum Implementation

Any curriculum can be viewed from several perspectives. according to Robitaille (1980), from the administrator's point of view, there is the intended curriculum, that is the curriculum produced by the curriculum developers. From the teachers' point of view there is the implemented curriculum, that is the curriculum as it is presented to students in their classrooms. From the students' point of view, there is the attained or realised curriculum, that is the curriculum as learned or assimilated by them.

However, studies such as Connelly (1972) and Olson (1980) have shown that the three are not necessarily congruent. Furthermore, in summarising the results of their study of the open-classroom movement in the United States, Gaiqunta and Kazlow (1980) concluded that there is a general tendency for schools and school systems to distort the goals and intents of educational innovations. Among the factors which they identified as being responsible are: lack of clarity about new rules, lack of teaching skills and incompatibility with existing school practices.

Thus teachers play very significant roles in effecting curriculum reforms. Curriculum packages by themselves cannot improve teaching and learning; the most important factor is the teacher (Akintola, 1977). The teacher is expected to influence the children through the curriculum.

Empirical studies linking instructional processes and teacher characteristics to pupil achievement have been accumulating, for example Coleman et.al. (1969), Graber and Weisman (1978), Morrisay (1981), and Chacko (1981) to mention a few, have shown that pupils' learning is not a simple direct consequence of the teachers teaching them. It is influenced by them (i.e. the teachers) through their teaching methods, attitudes, knowledge, experience, length and type of training and such related factors. The teacher is the person engaged in interactive behaviours with the pupils, effecting changes in them. These changes could be cognitive, affective or psychomotor, or a combination of all these. The teacher's own characteristics such as his personality, behaviour, and the like cast important impressions on the child's mind and guide his or her mind such that the teacher cannot be dispensed with or totally replaced.

Significance of the Study

As pointed out by Beeby (1970):

> ...no change in practice, no change in the curriculum has any meaning unless the teachers understand it and accept it. If they do not understand the new curriculum or refuse to accept it other than superficially, instructions are to no avail. At the best, they will go on doing, in effect, what they have been doing...

There is therefore no gainsaying in the fact that teachers play significant roles in curriculum implementation. In the implementation of the new mathematics curriculum, there is thus the need to investigate such teacher variables that could possibly correlate with students' learning outcomes in order to guide the implementation process. This study therefore sought to obtain empirical evidence on the teachers' perception of the contents of the curriculum and their attitudes towards instructional and assessment practices in it's implementation. It went further to ascertain the extent to which these teachers' affective variables explain students' learning outcomes in the subject.

Specifically the study was aimed at answering the following questions:

1. How do the teachers perceive the contents of the curriculum ?
2. What are the attitudes of the teachers toward instructional practices in the implementation of the curriculum ?
3. What are the attitudes of the teachers toward assessment practices in the implementation of the curriculum ?
4. To what extent do the teachers' affective variables explain students' perception of their lessons ?

5. To what extent do the teachers' affective variables and students' perception of their lessons explain students' achievement in the subject ?

This study is part of a larger study involving the evaluation of the implementation process of the Further-Mathematics curriculum.

The Sample

The study adopted an ex-post facto research design involving 32 teachers and 349 students selected randomly from 32 out of 96 schools offering the subject in Ogun State, Nigeria. For the sampling exercise, the state was divided into four zones, namely Egba, Egbado, Ijebu, and Remo. These zones are the four main geographical divisions in the state. The number of schools selected from each zone was based on the proportion of the number of schools in the zone out of the 96 senior secondary schools in the state. The students were those in the final year of the senior secondary, being on the verge of completing the Further-Mathematics syllabus. Each of the schools selected had an average of 35 students taking the subject. Out of these, an average of approximately 11 students were selected along with the teachers teaching them.

The Instruments

The teachers' questionnaire was divided into three sections; A, B, and C. Section A dealt with the topics in the curriculum in terms of the teachers' involvement in the design, the scope of the topics, their appropriateness to the level of the students and response of the students to them. It was made up of ten items designed along the pattern of a four point Likert rating scale of "Strongly Agree" (SA), "Agree" (A), "Disagree" (D), and "Strongly Disagree" (SD). The respondents were to respond by choosing any of the four points as they deemed appropriate for each of the items.

Section B contained a list of the topics in the Further-Mathematics curriculum. The teachers were to state which of these topics were not appropriate to the level of the students, difficult to teach, not liked by the students, not covered by their textbooks, and which of them they were not familiar with.

The last section dealt with the attitudes of the teachers toward some instructional and assessment practices. There were 24 items, 13 on instruction and 11 on assessment practices. It was also designed like a four point Likert scale and the teachers were to respond as such.

The students' questionnaire contained 20 items on teachers' activities in the classroom during the teaching and learning process. They were to respond by using a three-point scale of "Often", "Sometimes", and "Never", choosing any of the three they thought was applicable to their Further-Mathematics class for each of the 20 items.

The instruments had been already validated and used for a similar study conducted by the researcher (Alausa, 1997).

Data Analysis Procedure

The various data gathered for the study were analysed using the SPSS computer statistical program. Descriptive statistics, multiple regression and path analysis procedures were used. The descriptive statistics included frequency counts and percentages of subjects choosing the different response categories of the respective measuring instruments, and means and standard deviations of the frequencies. These were used in describing the trends in the perceptions of the teachers and students and the teachers' attitudes toward instructional and assessment practices. This procedure was used to answer questions 1, 2 and 3.

For research questions 4 and 5 which were concerned with ascertaining and explaining the influence of the teacher variables on the students' learning outcomes, multiple regression and path analysis procedures were employed. The emphasis was on formulating and testing an exploratory model involving the five variables in the study, that is:

V_1 = *Teachers' perception of the curriculum.*

V_2 = Teachers' attitudes toward instructional practices.

V_3 = Teachers' attitudes toward assessment practices.

V_4 = Students' perception of their lessons in Further-Mathematics.

V_5 = Students' achievement in Further-Mathematics.

It is in this context that the importance of the independent variables (V_1, V_2 and V_3) in their interrelationships with the dependent variables (V_4 and V_5) are brought to bear.

The three basic assumptions for any path model in establishing causal relationships among variables are covariation, time order, and nonspuriousness (Bohrnstedt and Knoke, 1988). These assumptions are graphically displayed in the causal diagrams below :

Figure 1

Path Diagram With Coefficient Symbols for the Students' Perception Model (Question 4)

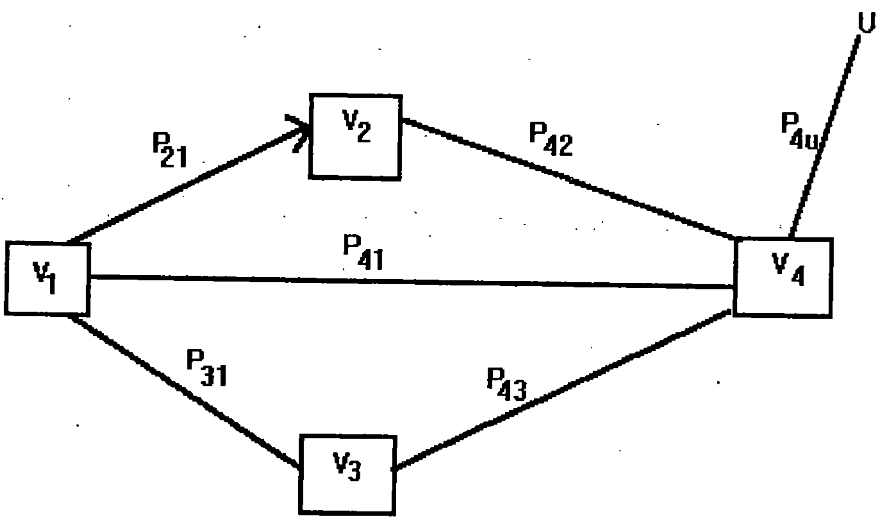
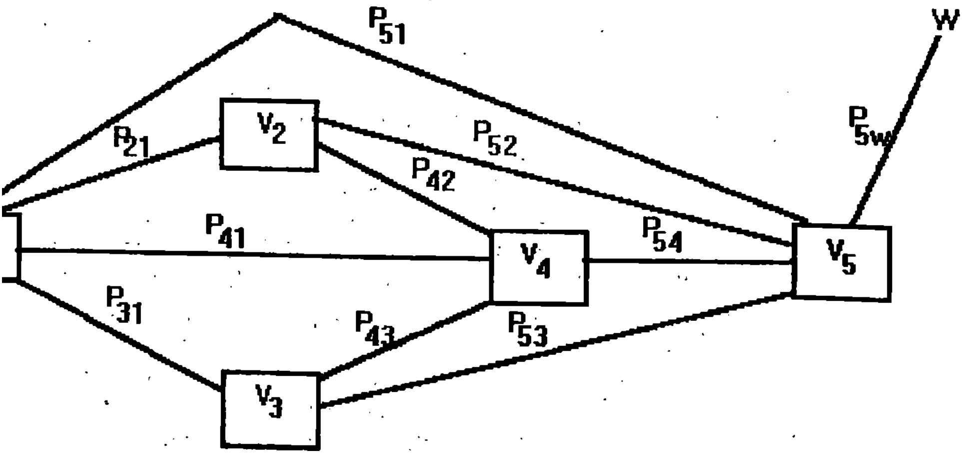


Figure 2

Path Diagram With Coefficient Symbols for the Students' Achievement Model (Question 5)



The temporal order is organised from left to right. Variables placed on the left in a diagram, are therefore considered antecedents to those located toward the right. A causal connection between two variables is represented by a single-headed arrow, with the tail emerging from the cause and the head pointed to the effect. The directions of the co-variation between the dependent and the independent variable are postulated to be positive. That is, an increase in the teacher variables (independent) should lead to an increase in the student variables (dependent). In addition, the teachers' attitudes toward instructional practices (V_2) and their attitudes toward assessment practices (V_3) are assumed to be correlated but not causally related. Therefore they are placed at the same point on the horizontal axis of the causal diagram.

The teachers' perception of the contents of the curriculum is the predetermined variable in the model. This is because it is the only variable whose cause is not specified and is outside the interest of the model. The arrows drawn from the unmeasured variables U and W to the dependent variables V_4 and V_5 respectively represent the belief that the variations in these variables are not completely explained by the specified causal factors (V_1,V_2, and V_3) hypothesised by the model. The teachers' perception of the curriculum is postulated to have both direct and indirect effects on the student variables, whereas the teachers' attitudes toward instructional and assessment practices are postulated to have only direct effects on the students' perception of their lessons and both direct and indirect effects on the students' achievement. It is expected that the manifestations of the teachers' perception of the contents of the curriculum will be brought to bear on their instructional and assessment practices. Further, since the students are directly exposed to the teachers' instructional and assessment practices, their own perception of their lessons should be directly affected by these teacher variables. In the same vein, the students' achievement in the subject should be directly affected by their own perception of their lessons as well as the teachers' instructional and assessment practices.

The structural equations below represent the structure of interrelated hypothesis in the model. These equations bear a one-to-one relationship with the causal diagrams above.

$$V_4 = P_{41}V_1 + P_{42}V_2 + P_{43}V_3 + P_{4u} \quad \text{(I)}$$

$$V_5 = P_{51}V_1 + P_{52}V_2 + P_{53}V_3 + P_{54}V_4 + P_{5w} \quad \textit{(ii)}$$

The first equation captures the hypothesised relationship between V_1, V_2, V_3 , and V_4 making the assumption that the independent variables (V_1 V_2 V_3) are linearly related to the dependent variable (V_4). In a similar manner, the second equation captures the postulated relationship between V_1, V_2, V_3, V_4 and V_5 making the same assumptions. The "P_{is}" represent the path coefficients. Also included are path coefficients to capture the relationship between unmeasured residual variables U and W with the dependent variables V_4 and V_5 respectively.

To get the scores for the teachers, the responses were multiplied by 4 for SA, 3 for A ,2 for D, and 1 for SD, for positively worded items. The scores were reversed for negatively worded items. For the scores of the students on their perception of their lessons, the responses were multiplied by 3 for "Often", 2 for "Sometimes" and 1 for "Never", for positively worded items, with the scores being reversed for negatively worded items.

To get the estimate of the path coefficients, V_4 was regressed on V_1, V_2, and V_3 for question 4 and V_5 on V_1, V_2, V_3 and V_4 for question 5. Also, the path coefficient from the unmeasured residual variable to the dependent variable is simply the square root of the coefficient of non-determination. That is;

$$P_{4u} = \sqrt{1 - R^2_{4.123}} \quad \text{and} \quad P_{5w} = \sqrt{1 - R^2_{5.1234}}$$

For these analyses, the average of the scores of the students from each school were employed as the units of analysis. This is because the new programme was introduced in entire schools and not to individual students. The students were exposed to the same conditions and the same positive and negative experiences in their respective schools. For these reasons it has been emphasised that in curriculum studies, one should consider the school as the unit of observation (Wiley, 1970; & Lewy, 1977).

Results

1. Teachers' Perception of the Further-Mathematics Curriculum:

The frequencies of the teachers choosing each of the response categories for the items in section A of the Teachers' Questionnaire are presented in Table 1. The percentages are in brackets.

Table 1

Teachers' Responses to Their Perception of the Curriculum

Items	SA	A	D	SD
Teachers were not really involved in the development of the curriculum.	4	18	6	4
	(12.500)	(56.250)	(18.750)	(12.500)
The scope of the syllabus is too wide to be covered in three years.	9	11	8	4
	28.125)	(34.375)	(25.000)	(12.500)
The topics are too advanced for the students	5	14	11	2
	(15.625)	(43.750)	(34.375)	(6.250)
The topics are related to the needs of the society.	10	20	2	0
	(31.250)	(62.500)	(6.250)	(0.000)
The senior school Mathematics is enough to cater for the future mathematics needs of the students.	3	5	11	13
	(9.375)	(15.625)	(34.375)	(40.625)
Many students are finding the topics difficult.	12	17	3	0
	(37.500)	(53.125)	(9.375)	(0.000)
The students are responding positively to the lessons	2	14	7	8
	(6.452)	(45.161)	(22.581)	(25.806)
If I have my way, I will have the topics reviewed to relate more to the level of the students.	6	18	6	2
	(18.750)	(56.250)	(18.750)	(6.250)

On their involvement in the design of the curriculum, the teachers indicated that many secondary school teachers were not involved. This is evident from the list of participants who developed the draft of the curriculum and those who wrote it's final form (Federal Ministry of Education, 1985).

The former consisted of twenty eight participants of whom only five came from secondary schools. Ironically, all these five were from the same school.

The teachers were also of the view that, although the topics were needed by the society and relevant perceived needs, some of them were too advanced for the students. Examples of such topics are : statics, mechanics and dynamics, coordinate geometry, binary operations, calculating and processing devices, mappings and functions, and logic. This is evident in the very high attrition rates of the students from senior secondary class 1 to senior secondary class 3 which can be as high as 65% in some schools. Further, mappings and functions, logic and calculating and processing devices were identified by the teachers as unfamiliar topics and not covered by their textbooks.

2. Attitudes of the Teachers Toward Instructional Practices

The frequencies of the teachers choosing each of the response categories for the items in section C of the Teachers' Questionnaire are presented in table 2 below. The percentages are in brackets.

Table 2

Responses to Instructional Practices

Items	SA	A	D	SD
A teacher needs not follow strictly the outline of the lesson notes during the lessons.	5	11	11	5
	(15.625)	(34.375)	(34.375)	(15.625)
As long as the teacher teaches regularly, the lesson note is not necessary	4	2	14	12
	(12.500)	(6.250)	(43.750	(37.500)
What is important is one's knowledge of the subject matter and not lesson notes	7	5	14	6
	(21.875)	(15.625)	(43.750)	(18.750)
Much time is wasted in trying to explore ideas outside the syllabus.	1	8	18	5
	(3.125)	(25.000)	(56.250)	(15.625)
Students should be referred to text books for home works and assignments.	11	17	3	1
	(34.375)	(53.130)	(9.375)	(3.125)
The rule of mathematics are some things students have to learn.	9	15	5	3
	(28.930)	(46.880)	(15.625)	(9.375)
A teacher must make sure that he/she achieves all his/her objectives for a lesson to avoid carry-overs and backlogs	3	12	13	4
	(9.375)	(37.500)	(40.625)	(12.500)
A teacher should work through all problems on the chalk board.	-	15	12	5
	-	(40.880)	(37.500)	(15.625)
Much time is wasted in trying to make everybody understand the lesson.	7	11	11	3
	(21.875)	(34.375)	(34.375)	(9.375)

(Continued from previous page)

Items	SA	A	D	SD
Correction to students' work should be made only when time permits.	-	-	13	19
	-	-	(40.63)	(59.37)
Students often ask time wasting or irrelevant questions.	1	8	17	6
	(3.125)	(25.00)	(53.13)	(18.75)
A teacher must give direct command to his pupils if he wants them to learn well in class.	4	12	14	2
	(12.50)	(37.50)	(43.75)	(6.25)

On the preparation for lessons the teachers support the preparation of notes for teaching, although it is not certain whether they will follow these notes strictly. The teachers also believe in exploring ideas outside the syllabus as this can be worthwhile.

The teachers also support the idea of referring students to textbooks for home works and assignments. Although the teachers believed that the rules of mathematics are some things that students have to learn, they are likely to be the type that will allow for unplanned occurrences that are bound to occur from time to time in classroom situations. This is because they are of the opinion that a teacher needs not achieve all his\her objectives for a lesson within the lesson due to unforseen circumstances. They would also prefer to work through all problems on the chalk board as this will give as much insight as possible to the students on topic(s) being dealt with.

On their relationship with students, the majority of them (98.57%) were of the opinion portraying them as the type that promote a cordial teacher-student relationship in classroom settings. They indicated that as much as possible, all the students should be made to understand the lessons. They would allow the students to ask questions and make corrections to their work from time to time. To make the students learn well in class however, the teachers would rather give direct commands.

On their own part, the majority of the students (more than 80% in most of the schools) gave favourable opinions of their Further-Mathematics lessons and teachers. They opined that their teachers work through problems on the chalk board, allow them to express their views to problems in the class, they mark students' assignments, teach the subject well and are concerned that as many students as possible understand the lessons. It is quite evident that most of the these students' responses corroborate the teachers' responses. Generally, these teachers' attitudes toward instructional practices could promote desirable students' learning outcomes.

3. Teachers' Attitudes Toward Assessment Practices:

The frequencies of the teachers choosing each of the response categories for the items in section C of the Teachers' Questionnaire dealing with assessment practices are presented in Tables 3 and 4. The responses were separated for assessment instruments and assessment practices. The percentages are in brackets.

Table 3

Reactions to Assessment Instruments

ItemS	SA	A	D	SD
Questionnaires	5 (20.000)	11 (44.000)	8 (32.000)	1 (4.000)
Projets	5 (16.129)	23 (74.194)	2 (6.452)	1 (3.226)
Assignments	12 (37.500)	17 (53.130)	3 (9.375)	-
Tests	14 (45.161)	17 (54.839)	-	-
Examination	17 (53.125)	15 (46.875)	-	-

Table 4

Reactions to Assessment Practices

Items	SA	A	D	SD
Marks on class work and assign ments should be included in the final marks.	14	15	3	-
	(43.750)	(46.880)	(9.375)	-
Examinations and tests are ger·ed toward the cognitive aspect of learning only.	8	12	11	1
	(25.000)	(37.500)	(34.375)	(3.125)
Teachers should provide all students' need to know for examinations.	7	14	6	5
	(21.875)	(43.750)	(18.750)	(15.625)
The students are too many for periodic testing.	2	6	17	7
	(6.250)	(18.750)	(53.130)	(21.875)
The teacher's work-load does not permit periodic testing.	6	12	9	4
	(19.355)	(38.710)	(29.032)	(12.903)
The students can mark their own assignments.	-	7	14	9
	-	(23.333)	(46.667)	(30.000)

Examinations and tests are the major instruments widely used by the teachers in assessing students' learning outcomes in Further-Mathematics. Projects, assignments and class work are used to a lesser extent, although marks on them are included in the final, terminal and sessional scores of the students. It was also revealed that assessment practices were still predominantly geared toward the cognitive domain with the psychomotor domain being assessed sparingly in the form of projects. There was no evidence to support any form of assessment in the affective domain on subject basis. It was also found that while the student population in Further-Mathematics classes was not too large for periodic testing, the teachers' heavy work-load could mar such exercises. The Further-Mathematics teachers are quiet few and saddled with teaching General-Mathematics as well. In most cases, they are also responsible for gathering, collating, and analysing statistical data in their schools.

It is also worthy to point out that the over-emphasised place of examinations in the formal educational setting is already taking its toll on the teachers' attitudes toward assessment practices. The majority of the teachers believe in providing all the students' need for passing examinations. Just as they are concerned that as many students as possible understand the lesson, they are also concerned that as many students as possible pass the examinations. Moreover, the students indicated that sometimes discussions on examinations take a large proportion of classroom interactions.

4. Relationship Between the Teacher Variables and the Students' Perception of Their Lessons

Table 5

Multiple Regression Parameters of the Variables in the Students' Perception Model

Multiple R	0.78
Multiple R^2	0.6084
Standard error of estimate	4.73

Analysis of Variance

Source of variation	Degree of freedom	Sum of squares	Mean square	F-ratio
Due to regression	3	685.01	228.34	
Due to residual	28	1097.04	39.18	5.83*
Total	31	1782.05		

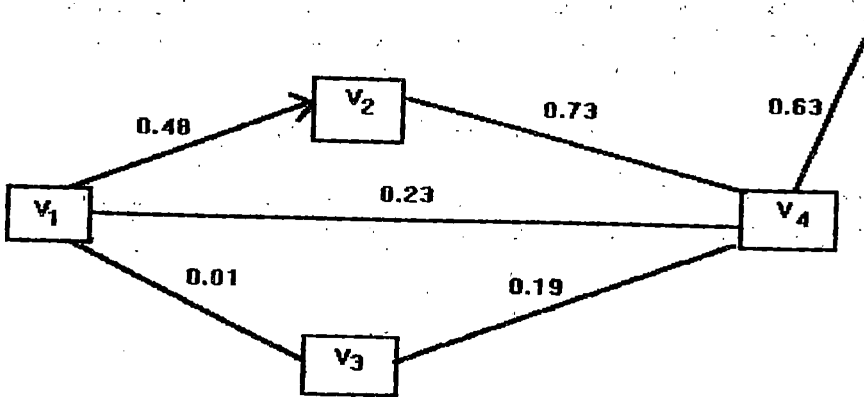
*Significant at = 0.05

The table shows that the independent variables (i.e teachers' perception of the curriculum, and their attitudes toward instructional and assessment practices) have a multiple correlation coefficient of 0.78. This coefficient is positive and quite high, thus suggesting that the teacher variables could exert a positive and strong influence on the students' perception of their Further-Mathematics lessons. The numerical estimate of the square of the multiple coefficient 0.6084 indicates that about 60.84% of the variations in the students' scores on their perception of their lessons could be jointly accounted for by the teacher variables.

From the analysis of variance table, the F-ratio of 5.83 is significant at the 0.05 level. This suggests that the teacher variables could be significant determinants of the students' perceptions of their lessons. The path diagram for the variables in these model is as follows:

Figure 3

Path Diagram for Variables in the Students' Perception Model With Numerical Estimates of the Path Coefficients



The path coefficients are standardised values. They therefore reflect causal effects in terms of standard deviation units. For example, $P_{41} = 0.23$ means that 1 standard deviation increase in the teachers' perception of the curriculum may lead to 0.23 (about one quarter) standard deviation increase in the students' perception of their lessons. Moreover, since all the path coefficients are standardised, comparison between the direct effects of causal variables (independent variables) are straight forward.

From the diagram, it could be observed that the teachers' attitudes toward instructional practices have the highest direct effect on the students' perception of their lessons, while their attitudes toward assessment practices have the least direct effect on the students' variable. Further, while the path coefficients associated with the teachers' attitudes toward instructional practices are moderately high, those associated with the teachers' attitudes toward assessment practices are quite low. This could lead to the inference that the multiple R-observed by regressing the students' perception scores on the teacher variables (table 5), could be largely attributed to the teachers' perception of the curriculum and their attitudes toward instructional practices.

By squaring the path coefficient from the residual variable, it was found that about 39.69% of the variance in the students perception of their lessons cannot be explained by the hypothesised causal model. The decomposition of the total effects of the independent variables on the dependent variable is carried out below:

Table 6

Decomposition of the Total Effects of the Independent Variables

Dependent Variable	Determinant (or independent) Variable	Total Covariance A	Direct Effect B	Indirect Effect C	Total Causal D	Non Causal E
V_4	V_1	0.67	0.23	0.35	0.58	0.088
V_4	V_2	0.87	0.73	None	0.73	0.14
V_4	V_3	0.19	0.19	None	0.19	0.12

With refernce to Table 6, the following can be noted:

(I) The total covariances are zero-order correlation coefficients between each pair of the variables indicated.

(ii) The direct effects are the standardised path coefficients of the direct path between each pair of variable specified.

(iii) The indirect effects are the sums of the products of the indirect paths from the independent variable to the dependent variable via an intervening variable. From Figure 1 only the teachers' perception of the curriculum was postulated to have indirect paths to the students' perception of their lessons via the teachers' attitudes toward instructional and assessment practices.

(iv) The total causal effect is the sum of the direct indirect effects (B + C).

(v) The non-causal effect is the effect of the independent variable on the dependent variable not explained by the hypothesised causal model. It is the total covariance minus the total causal effect (A-D)

This decomposition of the total effects of the independent variable on the dependent variable is as suggested by Jae-Onkim and Kohout (1975).

From this decomposition, it could be observed that the effects of the teachers' perception of the curriculum on the students' perception of their lessons is exerted more in an indirect manner than a direct manner. This indirect influence is exerted mostly via the teachers' attitude toward instructional practices. It could also be observed further that a higher proportion of the total covariance of the dependent variable is explained by the total causal effects of the independent variables.

5. Relationship Between The Teacher Variables, The Students' Perception of Their Lessons and the Students' Achievement In Further-mathematics.

Table 7

Multiple Regression Parameters of the Variables in the Students' Achievement Model

Multiple R	0.71
Multiple R^2	0.5041
Standard Error of estimate	3.15

Analysis of Variance

Source of variation	Degree of freedom	Sum of squares	Mean square	F-ratio
Due to regression	4	328.07	82.02	
Due to residual	27	153.95	5.70	14.39*
Total	31	482.02		

*Significant at = 0.05

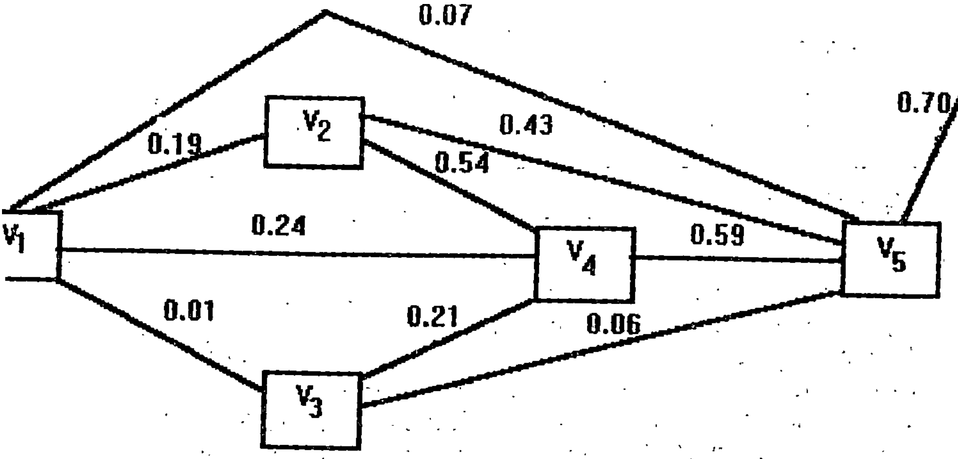
From the table it could be observed that the independent variables (V_1, V_2, V_3 and V_4) have a multiple correlation coefficient index of 0.71 with the dependent variable (V5). This coefficient is positive and high, which suggests that the dependent variable co-varies strongly and positively with the independent variables. The square of the correlation index of 0.5041 indicates that about 50.41% (about half) of the variance in the scores of the students in the achievement test could jointly be explained by the dependent variables.

The F-ratio value of 14.39 which is significant at the 0.05 level means that the joint influence of the independent variables in the model could be less due to chance factors. That is, the teacher variables and the students' perception of their lessons are significant determinants of the students' achievement in Further-Mathematics.

The path coefficients for the variables in these models are presented in Figure 4.

Figure 4

Path Diagram for Variables in the Students' Achievement Model With Numerical Estimates of the Path Coefficients



From the diagram, it can be observed that the teachers' attitudes toward instructional practices and the students' perception of their lessons, are the only independent variables with high direct effects on the students' achievement scores. The direct path coefficients of the teachers' perception of the curriculum and the teachers' attitudes toward assessment practices are very low. However, the teachers' perception of the curriculum appears to have a significant indirect influence on the dependent variable via the teachers attitudes toward instructional practices and the students' perception of their lessons. The path coefficients associated with the teachers' attitudes toward assessment practices are low. By squaring the path coefficient associated with the unmeasured residual variable W, it was found that about 49% of the variations in the students' achievement scores cannot be explained by this model.

The decomposition of the total effects of the independent variables on the dependent variable is carried out in Table 4 below:

Table 8

Decomposition of the Total Effects of the Independent Variables

Dependent Variable	Determinant (or independent) Variable	Total Covariance A	Direct Effect B	Indirect Effect C	Total Causal D	Non Causal E
V_5	V_1	0.61	0.07	0.502	0.572	0.04
V_5	V_2	0.81	0.43	0.318	0.748	0.06
V_5	V_3	0.25	0.06	0.120	0.18	0.07
V_5	V_4	0.88	0.59	None	None	0.29

From the table, it can be observed that the indirect effect of the teachers' perception of the curriculum on the students' achievement is far greater than it's direct effect. For the teachers' attitudes toward instructional practices, both the direct and indirect effects are moderately high while the teachers' attitudes toward assessment practices exert very low influences either directly or indirectly. The highest dircct effect on the dependent variable is exerted by students' perception of their lessons in Further-Mathematics.

Discussion of Results

The low direct influence of the teachers' perception of the curriculum on the students' variables could be due to the fact that the manifestations of this variable are expected to be exhibited in the teachers' instructional and assessment practices during the implementation of the curriculum. This is why the variable was treated as a predetermined variable and precedes all the other variables in the models.

The high and significant direct influence exerted by the teachers' attitudes toward instructional practices on the students' perception of their lessons could be attributable to the fact that students can form an opinion of their lessons only when exposed to such classes during teaching. During the teaching and learning process, the teacher's attitudes to instructional practices are brought to bear. Thus, exposure to lessons could be synonymous with exposure to the teacher's attitudes to instructional practices. This is more especially so in a situation where the teachers' attitudes toward instructional practices in science subjects have been found to be significantly related to teaching methods (Morrisay, 1981). Similarly, the significant direct influence of the teachers toward instructional practices to the students' achievement conforms with findings in earlier studies such as Chacko (1981) and Okpala (1985). It is expected that the teachers' attitudes toward instructional practices will be exhibited in actual classroom situations during teaching. This will then influence what is taught and what the students learn.

The inability of the teachers' attitudes toward assessment practices to have significant direct and indirect influences on the student variables may be due to the fact that the teachers are not taking assessment practices as integral parts of the teaching and learning process. In the course of this study, it was discovered that tests and assignments were being used mainly as instruments or devices for generating scores at the end of the term or session. This practice cuts across all subject areas and all the schools visited. In a situation where assessment practices are taken merely for record gathering or keeping purposes without ploughing back the result into the classroom activities as feed-back mechanisms, assessment practices may correlate poorly with the other variables specified in the models. This may also be the reason why all the path coefficients associated with the teachers' attitudes toward assessment practices in the two models are very low.

With the exception of the low influence of the teachers' attitudes toward assessment practices on the students' variables, these findings could have been perfectly in line with the theoretical assumptions for the models. There is therefore the need to emphasise among teachers, the integration of assessment practices into the teaching and learning process. Assessment practices should be used as monitoring and improving devices in the teaching process. The results of tests and assignments should be ploughed back into the classroom system as feed-back mechanisms.

Conclusion

The purpose of teaching at any level is to bring about desirable changes in the learners. Teachers form an important component of the education system of any country. Important in the sense that they are the filters between instructional materials and students. They are among the few in the country privileged in exerting a high degree of influence in moulding and modelling the future of the young and by implication, the future of the nation.

As demonstrated in this study, teacher variables such as their perception of the curriculum and attitudes to instructional practices in Further-Mathematics, have significant influences on students' learning outcomes in the subject. Efforts should therefore be geared toward promoting positive changes in these teacher variables. It should be remembered that the quality of the curriculum and the skills of the teachers are both vital to the success of the educational system. Any change in curriculum has no meaning unless the teacher understands it and accepts it . It is therefore imperative that teachers be involved in effecting curricula changes right from the developmental stages of the curriculum.

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