EFFECTS OF THREE SETS OF INSTRUCTIONAL STRATEGIES AND THREE DEMOGRAPHIC VARIABLES ON THE FOOD AND NUTRITION TEST PERFORMANCE OF SOME JAMAICAN TENTH-GRADERS

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This study was designed to find out if students taught food and nutrition concepts using the lecture method and practical work would perform significantly better than their counterparts taught with the lecture and teacher demonstrations and the lecture method only. The sample comprised 114 Jamaican 10th-graders (56 boys, 58 girls) selected from four coeducational high schools. A Food and Nutrition Test (consisting of 40 objective test items) was the instrument used to assess the students' performance. The results indicated that (a) the experimental group significantly outperformed the two comparison groups in the posttest; (b) students with high cognitive abilities in food and nutrition in the experimental group significantly outscored their counterparts with average and low cognitive abilities in the experimental group as well as their peers with high, average and low cognitive abilities in the comparison groups; and (c) there were no gender and socioeconomic background differences in their posttest performance.

INTRODUCTION

Public concern has for a long been expressed on the dismal, annual performance of many Jamaican 11th-graders in integrated science examinations that the Caribbean Examinations Council (CXC) conducts. As Table 1 shows, whereas there has been an appreciable annual increase in the numbers of Jamaican 11th-graders who sat the CXC's general proficiency examinations on integrated science from 1996 to 2002, the percentages of students who obtained Grades 1 and 2 decreased annually. This could be due to the fact that the more able students were opting to study the separate traditional science subjects (biology, chemistry and physics). Other possible factors which have been implicated from many research findings to have contributed to significant differences in high school students' performance in science include the differences in the students'(a) gender (Evans, 2001; Edwards & Soyibo, 2003; Forrest, 1992; Soyibo & Evans, 2002), (b) cognitive abilities (Ellis-Hall & Soyibo, 2004; Esiobu & Soyibo, 1995; Ezenne, 2003; Hamilton, 1985; Leo-Rhynie, 1978), (c) socioeconomic background (Beaumont-Walters & Soyibo, 2001; Charles, 2001; Edwards & Soyibo, 2003; Ellis-Hall & Soyibo, 2004; Soyibo & Pinnock, 1998), and (d) the methods used to teach them (Archibong, 1997; Bucknor & Soyibo, 2001; Stohr-Hunt, 1996; Thompson & Soyibo, 2002; Ugwu & Soyibo, 2004). Note that the findings of all the studies on the link between each of the four variables and students' science performance are inconclusive.

Table 1
Performance of Jamaican Students at the General Proficiency Level in Integrated Science 1996-2002

Year	Number of examinees	Percentage obtaining Grade 1	Percentage obtaining Grade 2	Percentage obtaining Grade 3
1996	912	17.00	47.04	31.03
1997	1293	12.00	48.26	32.70
1998	1709	3.30	25.50	47.90
1999	1949	2.90	22.70	47.70
2000	2473	0.90	16.40	57.30
2001	2853	3.66	25.83	55.21
2002	2413	0.88	17.64	50.00

Source: Caribbean Examinations Council (1996-2002).

In respect to gender differences in high school students' science performance, whilst many studies have reported that male students generally outperformed their female counterparts in science and mathematics tests (Comber & Keeves, 1973; Forrest, 1992; Soyibo & Evans, 2002; Third International Science and Mathematics Study (TIMSS), 1997), some reported no gender differences (Beaumont-Walters & Soyibo, 2001; Ellis-Hall & Soyibo, 2004; Edwards & Soyibo, 2003; Esiobu & Soyibo, 1995; Greenfield, 1996; Ugwu & Soyibo, 2004). With particular reference to integrated science, whereas Soyibo and Pinnock (1998) found no significant gender differences in Jamaican 11th-graders' performance in integrated science, Stockhausen and Soyibo (2004) reported significant gender differences in Jamaican 9th-graders' performance in integrated science in favour of the girls. On the other hand, Evans (2001) reported that over the last 15 years, Jamaican female students markedly outperformed their male peers at the primary and secondary levels in all school subjects. She observed that the harsh treatments that teachers meted out to Jamaican male primary and secondary students and the inability of these students to read materials written in the English language were among the principal causes of male underachievement in schools. Again, Millar (1999, p. 296) noted that, all over the Caribbean, girls have surpassed (and continue to surpass) the boys in school achievement at the early childhood, primary, and secondary levels and that at the tertiary level, males continue to maintain the advantage in engineering-related subjects, but have lost it in virtually all other subjects - although in science-based disciplines the gap is still relatively small. Furthermore, recent evidence from Northern Ireland indicates that at both the "O" and "A" levels, boys received lower grades than girls in all sciences (Millar, 1999).

Several studies have demonstrated that students' cognitive ability is a most valuable asset in their learning of science. Some researchers (e.g., Hamilton, 1985; Leo-Rhynie, 1978) reported an inter-correlation among measures of abstract reasoning and spatial ability to be statistically significant in all science specializations among Jamaican students who sat the CXC's science examinations. These are two intellectual skills of special importance in performing fairly complex cognitive tasks. Ellis-Hall and Soyibo (2004) reported that some Jamaican 11th-graders with high chemical and mathematical abilities, scored significantly higher than their counterparts with average and low cognitive abilities on structured questions on the mole concepts. Esiobu and Soyibo (1995) discovered that Nigerian 10th-graders with high cognitive ability in biology, excelled over their peers with average and low cognitive abilities on an achievement test on ecology and genetics, while Ezenne (2003) found that Jamaican 11th-graders with high mathematical ability significantly outperformed their classmates with average and low abilities on numerical problems on kinematics (linear motion). However, the literature contains mixed findings on the effects of cognitive abilities on students' achievement in small learning groups. For instance, whereas some researchers have shown that mixed-ability group benefited all ability groups (e.g., Mollod, 1970); others found that it benefited only the low-ability groups (e.g., Amaria, Brian & Leigh, 1969).

There are conflicting research findings on the relative effects of differences in students' SEB and their science performance. In this study, SEB refers to whether a student's parent or guardian was a professional (high SEB) or a nonprofessional (low SEB). Parents with a high SEB tend to be more capable of giving educational support, developing educational goals, and have higher expectations of their children than parents with a low SEB (George & Kaplan, 1998). In the House of Commons report (Mills & Mills, 2003), it was disclosed that children of professional parents had heard an average 45 million adult words per year, while children of parents on welfare only heard 13 million words. Because words form vocabularies and vocabularies aid understanding and the use of words, it means that children from a high SEB are more likely to develop a good language base and by extension achieve more academically than their peers from a low SEB. We conjecture that it was partly for these reasons that various studies have demonstrated that students from a high SEB tended to significantly outperform their counterparts from a low SEB in science (Beaumont-Walters, & Soyibo 2001; Comber & Keeves, 1973; Stockhausen & Soyibo, 2004). But, Houtz (1995) recorded that the science performance of 7th and 8th-graders from a low SEB significantly improved while there was no significant difference in the performance of their peers from a high SEB because of the alteration in the teaching technique used to teach them. Regarding students' performance in integrated science, whereas Soyibo and Pinnock (1998) recorded no significant SEB differences in Jamaican 11th-graders' performance, Stockhausen and Soyibo (2004) discovered statistically significant SEB differences in Jamaican 9th-graders' science performance in favour of students from a high SEB. However, some studies have documented the absence of SEB differences in Jamaican students' performance in science (Blair-Walters & Soyibo, 2004; Edwards & Soyibo, 2003; Ellis-Hall & Soyibo, 2004; Ezenne, 2003; Ugwu & Soyibo, 2004).

It is a popular notion that the used of practical-oriented approaches facilitate students' better understanding and performance in science than the use of the lecture and teacher demonstration methods. Nonetheless, a search in the literature shows inconclusive findings. Several studies have demonstrated that students taught science using practical work displayed better attitudes to science and had superior science achievement than those taught science using the lecture method (Archibong, 1997; Stohr-Hunt, 1996; Thompson & Soyibo, 2002; Ugwu & Soyibo, 2004). But, Watson, Prieto, and Dillon (1995) and Toplis (1998) reported that the use of practical work had only a marginal impact on 9th-graders' understanding of combustion and 8th-graders' understanding of acids and alkalis respectively. In fact, Bucknor and Soyibo (2001) recorded no significant differences in the knowledge of acids and bases of Jamaican 10th-graders taught using the lecture method, teacher demonstrations and practical work and those who were taught with the lecture and teacher demonstration methods. Noteworthy is that Mulopo and Fowler's (1987) finding that Zambian 11th-graders taught chemistry with the lecture method significantly outperformed their counterparts taught using the discovery approach, contradicted the findings of many studies (Archibong, 1997; Esiobu & Soyibo, 1995; Storhr-Hunt, 1996; Thompson & Soyibo, 2002; Ugwu & Soyibo, 2004; Walford-Palmer, 2004).

RATIONALE FOR THE STUDY

Edwards (2001) reported that while some Jamaican 9th-graders who were taught the concept of physical change with the lecture and practical work did significantly better than their peers taught with

(a) the lecture and teacher demonstration methods and (b) the lecture method only, there were no significant differences in the three groups of students' performance on the concept of chemical change based on the instructional methods employed to teach them. Conversely, Thompson and Soyibo (2002) discovered that selected Jamaican 10th-graders who were taught electrolysis with a combination of the lecture, teacher demonstrations, discussion and practical work not only significantly outperformed their counterparts taught electrolysis with (a) only the lecture method, and (b) teacher demonstrations and discussion method, but also had significantly better posttest attitudes to chemistry than students in the two latter groups.

Consequently, a justification for this study was to find out which of three sets of instructional methods would most significantly improve the performance of a group of Jamaican 10th-graders' on a food and nutrition test: lecture and practical work, lecture and teacher demonstrations, and lecture method only. This approach was considered to be pertinent and worthwhile partly because the lecture and teacher demonstration methods are commonly utilized in teaching science in many Jamaican high schools (Science Education Committee, 1999). In addition, we are not aware of any study like this one that has been conducted in the English-speaking-Caribbean or elsewhere.

PURPOSE OF THE STUDY

Despite the foregoing inconclusive findings, the authors conjectured that this study's participants taught the concepts of food and nutrition using the lecture and student practical work would perform significantly better than their classmates who were taught with both the lecture and teacher demonstrations and the lecture method only. This conjecture was put to the test in this study in which the following hypotheses were tested.

1. The experimental students' posttest performance on the food and nutrition test based on their treatment, gender, cognitive abilities in food and nutrition, and socioeconomic background (SEB) would be statistically significantly better than that of their comparison group counterparts.
2. The correlations among the experimental students' treatment, gender, cognitive abilities in food and nutrition and SEB and their posttest performance on the food and nutrition test would be statistically significant whereas those of their comparison group peers would not.

METHODOLOGY

Research Design

A non-randomised, one experimental group and two comparison groups, pretest-posttest design was used because intact classes were engaged so as not disrupt their normal schedules. The study also had an *ex post facto* research component to determine if there were any significant correlations among the students' treatment, gender, SEB, cognitive abilities in science and their posttest performance on food and nutrition.

SAMPLE

The study's main study sample were 114 Jamaican 10th-graders comprising 58 female and 56 male students selected from four coeducational high schools in Kingston and St Andrew, Jamaica. The schools consisted of a traditional high school, one technical high school and two newly upgraded high schools. The experimental group consisted of 34 students (14 boys, 20 girls), while 39 students were in the first comparison group (10 boys, 29 girls), and 41 students in the second comparison group (32 boys, 9 girls). The students were admitted into their schools based on their performance in the

Grade Six Achievement Test they took in 1999. The students were categorized into cognitive ability levels based on their performance in the integrated science test they did in the first term of 2003/2004 academic year. Those who scored 80% and above were classified as having high cognitive ability in science, those who scored between 50% and 79% were regarded as having average cognitive ability in science, while those who scored between 0 and 49% were labelled as having low cognitive ability in science. The composition of the students based on their cognitive abilities in science is shown in Table 3.

One of the schools had no science laboratory facilities, one had moderate science laboratory facilities, and the remaining two had good science laboratory facilities. Only one of the four teachers who taught the main study students was a female. Two of the teachers were trained as teachers with a first degree; one was a trained teacher with a diploma, while the fourth teacher had a diploma from an agricultural college without a teacher training experience. All the teachers had more than five years of high school integrated science teaching experience. The pilot sample comprised 60 10th-graders (15 each from each of the schools engaged in this study) with 28 boys and 32 girls but they did not participate in the main study.

INSTRUMENTATION AND PROCEDURE

A Food and Nutrition Test (FNT) - consisting of 28 multiple-choice items, and 5 fill-in test items with a maximum score of 12 - was used to measure the students' understanding of the food and nutrition concepts set out in CX's Integrated Science (Single Award) Syllabus (2002). The maximum score on the test was 40. The test items were set on the following concepts in the syllabus: photosynthesis, experiments on photosynthesis, food tests, test for starch, balanced and unbalanced diet, digestion in humans, experiments on enzymes and diffusion, and structure and functions of the human teeth.

Table 2
Test Table of Specifications for the Food and Nutrition Test

Cognitive demand	Questions' numbers	Total number of questions
Knowledge and comprehension	1-16	16
Interpretation and analysis	17-28	12
Drawing and labelling skills	29-40	12
Total		40

Using a test table of specifications (Table 2), the FNT was employed to assess the students' knowledge and comprehension (16 items), interpretation and analysis (12 items) and drawing and labelling skills (12 items). The items' difficulty indices - based on the pilot students' answers - ranged from 0.02 to 1.00. According to Ebel and Frisbie (1991) test items with difficulty indices of 0.30 and above are regarded as good and acceptable in educational research. Hence, although 17 of the items had facility indices below 0.30, they were retained in the final instrument administered to the main study's students. This was because on a close examination, we discovered that the items required sound theoretical or practical skills which most of the students did not have. Furthermore, ten of the items required drawing and labelling skills which were not usually taught the students at the primary and secondary levels. The FNT's Kuder-Richardson (KR-21) Cronbach alpha coefficient was 0.82, using Ebel and Frisbie's (1991) correction formula for underestimation that may characterise KR-21. This coefficient, according to Miller (1991, p.175) is "very strongly reliable" and suggests that the test's internal consistency reliability was high and satisfactory.

Before being taught the food and nutrition concepts, all the main study students were given the FNT as a pretest. The treatment lasted six weeks. There were two science lessons per week, each a double period of 40 minutes. Hence, there were 12 lessons.

The experimental group was taught using the lecture method during the first 40 minutes. This was followed by students' practical work in small groups of 4-5 students per group for the next 25 minutes and class discussion that lasted 15 minutes. The practical tasks were written on the chalkboard and the students were taught how to record in their science notebooks the procedure for each task and their main observations and conclusions.

Each of the experimental group member was assigned a particular task and shared materials with other members. All members discussed their observations and conclusions before reporting them in their notebooks. Their teachers went round the groups to give appropriate assistance. Fifteen minutes before the end of each lesson, the teacher briefly discussed with them their main findings, collected their notebooks for grading and gave them feedback during the following lessons.

The first comparison group students were taught as two groups by two teachers. During the first 40 minutes, their teachers taught them using the lecture method and the students wrote down notes in their notebooks. This was followed by the teacher demonstration of the practical task for the next 25 minutes for students to observe and write down their observations and conclusions. The last 15 minutes were spent on the class discussion of the teacher's demonstrations. The students recorded the results they were expected to obtain in their notebooks as if they had carried out the practical exercises themselves. Their teachers collected their notebooks for grading and gave them feedback during the following lessons.

The second comparison group students were taught using the lecture method only during the first 40 minutes during which they wrote down notes in their exercise books. During the second 25 minutes, their teachers wrote on the chalkboard the procedures for the experimental tasks they were expected to have performed on the concepts taught as well as the observations/results and conclusions. The students wrote these down in their notebooks. The last 15 minutes were used for discussing the results of the experiments they should have performed. Their teacher then collected their notebooks for marking and gave them feedback during the following lessons. On the whole, students in the comparison groups were taught the same contents and practical tasks on the food and nutrition concepts prescribed for coverage during the six weeks, but they did not perform the practical activities themselves like their experimental group peers.

The first author had discussions with the teachers on how to prepare and deliver their lesson plans and was able to observe four of the lessons taught by the teachers–one taught by the experimental teacher, one each taught by the two first comparison group teachers and one by the second comparison group teacher. The first author also examined the teachers' lesson plans and observed that they were similar. Based on the data obtained, there was evidence that the teachers did follow the protocols prescribed for the experimental and comparison groups in this study. A week after the treatment, the FNT was re-administered to the main study's students as a posttest.

RESULTS AND DISCUSSION

The first hypothesis of this study was to determine if the posttest performance of the experimental group on the FNT based on their treatment, gender, cognitive abilities in food and nutrition, and SEB would be statistically significantly better than that of their comparison group counterparts. Their means, standard deviations and mean gains on the test were computed (Table 3).

Table 3
Means, Standard Deviations on Food and Nutrition Test Before and After Treatment

Variables	n	Pretest Mean	Pretest SD	Posttest Mean	Posttest SD	Mean Gain
Treatment						
Experimental group	34	17.97	4.80	26.15	4.71	8.18
Comparison group I	39	11.03	3.43	17.15	6.09	6.12
Comparison group II	41	7.39	3.36	14.51	5.08	7.12
Gender						
Experimental group						
Male	14	19.50	4.88	25.29	5.30	5.79
Female	20	16.90	4.55	26.75	4.29	9.85
Comparison group I						
Male	10	10.70	2.75	15.10	4.65	4.40
Female	29	11.14	3.67	17.86	6.43	6.72
Comparison group II						
Male	32	6.75	3.07	14.12	5.35	7.37
Female	9	9.67	3.54	15.89	3.95	6.22
Cognitive abilities						
High						
Experimental group	9	21.22	2.91	30.00	1.73	8.78
Comparison group I	1	14.00	0.00	29.00	0.00	15.00
Average						
Experimental group	11	19.64	3.93	26.55	2.81	6.91
Comparison group I	8	14.13	3.94	25.00	3.38	10.87
Comparison group II	2	14.00	0.00	21.00	0.00	7.00
Low						
Experimental group	14	14.57	4.38	23.36	5.44	8.79
Comparison group I	30	10.10	2.80	14.67	4.20	4.57
Comparison group II	39	7.05	3.08	14.18	4.98	7.13
SEB						
High						
Experimental group	19	18.89	4.55	26.95	4.79	8.06
Comparison group I	4	13.00	1.63	18.75	4.27	5.75
Low						
Experimental group	15	16.80	5.00	25.13	4.57	8.33
Comparison group I	35	10.80	3.52	16.97	6.29	6.17
Comparison groupII	41	7.39	3.36	14.51	5. 08	7.12

The preliminary one-way analysis of variance conducted to find out if there was a significant difference in the pretest mean scores of the three treatment groups revealed that there was a significant difference ($F(2) = 70.819$, $p < .001$). A close look at Table 3 reveals that the difference was in favour of the experimental group followed by the comparison group I and lastly the comparison group II. These results imply that the experimental students' knowledge of the food and nutrition concepts tested in this study was significantly superior to that of their comparison group counterparts before treatment began.

Table 3 further shows that the posttest mean score of the (a) experimental group is substantially higher than that of the two comparison groups, (b) females in the experimental group and comparison groups I and II is slightly high than that of their male peers, (c) students with high cognitive abilities in food and nutrition in the experimental group is the highest followed by the mean of students with average and low cognitive abilities in the experimental group, while the mean of students with low cognitive abilities in comparison group II is the lowest, and (d) students from a high SEB in the experimental group is the highest, followed by the mean of students from a low SEB in the experimental group, whilst the mean of students from a low SEB in the comparison group II is the lowest.

To determine if the posttest means were statistically significantly different from one another, a four-way analysis of covariance (ANCOVA) was computed using their pretest scores on the food and nutrition test as covariates. This was done, because, as stated above, there was a statistically significant difference in the pretest means scores of the experimental and comparison groups. Displayed in Table 4 are the results of this analysis.

Table 4
Analysis of Covariance on Posttest Food and Nutrition Scores Based on Treatment, Gender, Cognitive Abilities and Socioeconomic Background

Source of variation	SS	df	MS	F
Pretest scores a covariates	476.276	1	476.276	29.546
Treatment (expt x comp groups)	118.023	2	59.012	3.661*
Gender	38.030	1	38.030	2.359
Cognitive abilities	178.918	2	89.459	5.550**
Socioeconomic background	0.274	1	0.274	0.017
Model	4158.805	7	594.115	36.856**
Residual	1708.713	106	16.120	
Total	5867.518	113	51.925	

* $p < .05$ ** $p < .01$

Table 4 suggests that there are significant differences in the students' posttest means on the FNT attributable to the main effects of treatment and cognitive abilities on food and nutrition. To explore these findings, the Scheffe tests of the main effects of treatment and cognitive abilities were applied for *post hoc* analyses. Based on the Scheffe test, the experimental group students' mean score was significantly higher than that of the comparison groups I and II ($F(2) = 47.122$, $p < .001$). This implies that the experimental group taught with the lecture method and student practical work in small groups performed significantly better than the comparison groups taught with (a) the lecture and teacher demonstrations, and (b) the lecture method only respectively. Similarly, based on the Scheffe test, the mean of students with high cognitive abilities in food and nutrition in the experimental group was significantly higher than that of their counterparts with average, and low cognitive abilities in the experimental group as well as that of students with high, average and low cognitive abilities in the comparison groups ($F(2) = 52.428$, $p < .001$). This means that the experimental group students with high cognitive abilities in food and nutrition, did significantly better in the food and nutrition test in this study than their peers with average and low cognitive abilities in the experimental group as well as their classmates with high, average and low cognitive abilities in the comparison groups.

The finding that the experimental group taught with the lecture method and student practical work in small groups performed significantly better than the comparison groups taught with (a) the lecture and teacher demonstrations and (b) the lecture method only, was expected. This was in part due to the salutary impact of the practical tasks to which the experimental students were exposed. This finding receives some indirect corroboration from the findings of many past studies which have demonstrated that students taught science using practical work displayed better attitudes to science and had superior science achievement than those taught science using the lecture method (Archibong, 1997; Rodney & Soyibo, 2003; Stohr-Hunt, 1996; Thompson & Soyibo, 2002; Ugwu & Soyibo, 2004). But we could not find any study on tenth-graders' performance on food and nutrition concepts with which this study's finding could be compared.

The authors expected the finding that the experimental students with high cognitive abilities in food and nutrition performed significantly better in the posttest than their counterparts with average and low cognitive abilities and their peers with high, average and low cognitive abilities in the comparison groups. This was because several previous studies have documented significant cognitive abilities' differences in high school students' science performance in favour of students with high cognitive abilities in science (Ellis-Hall & Soyibo, 2004; Esiobu & Soyibo ,1995; Ezenne, 2003; Mollod, 1970; Okebukola, 1984).

The absence of significant gender and SEB differences in the students' posttest performance on the FNT is not surprising to the authors. This is because, as we stated earlier, many previous studies have recorded no gender differences in students' science performance (e.g., Beaumont-Walters & Soyibo, 2001; Ellis-Hall & Soyibo, 2004; Edwards & Soyibo, 2003; Esiobu & Soyibo, 1995; Greenfield, 1996; Soyibo & Pinnock, 1998; Ugwu & Soyibo, 2004). Similarly, some previous local studies have documented the lack of significant SEB differences in Jamaican students' science performance (e.g., Blair-Walters & Soyibo, 2004; Edwards & Soyibo, 2003; Ellis-Hall & Soyibo, 2004; Ezenne, 2003; Ugwu & Soyibo, 2004). Albeit, we were unable to access any previous studies which had explored gender and SEB differences in 10th-graders' performance in food and nutrition test with which this study's two findings could have been compared.

The authors determined the magnitudes of the effect sizes of the four independent variables on the students' posttest scores on the FNT by dividing the differences between the means by the pooled standard deviations. The results are shown in Table 5.

Table 5
Treatment Effect Sizes on Students' Posttest Performance on the Food and Nutrition Test

Variables	n	Mean	Pooled SD	Effect sizes
Treatment				
Experimental group	34	26.15		
Comparison group I	39	17.15	5.29	1.95
Comparison group II	41	14.51		
Gender				
Experimental group				
Male	14	25.29	4.80	0.30
Female	20			
Comparison group I				
Male	10	15.10	5.54	0.50
Female	29	17.86		
Comparison group II				
Male	32	14.12	4.65	0.38
Female	9	15.89		
Cognitive abilities				
High				
Experimental group	9	30.00	1.73	0.58
Comparison group I	1	29.00		
Average				
Experimental group	11	26.55		
Comparison group I	8	25.00	3.10	1.15
Comparison group II	2	21.00		
Low				
Experimental group	14	23.36		
Comparison group I	30	14.67	4.87	1.83
Comparison group II	39	14.18		
Socioeconomic Background				
High				
Experimental group	19	26.95	4.53	1.81
Comparison group I	4	18.75		
Low				
Experimental group	15	25.13		
Comparison group I	35	16.97	5.31	1.77
Comparison group II	41	14.51		

Evident in Table 5 is that the effects of the students' treatment (instructional methods used to teach them) are the highest (195%), followed by the effects of their cognitive abilities in respect of the experimental students with low cognitive abilities, and SEB in favour of the experimental group students from a high SEB. The gender effects are the lowest and these are consistent with the data in Table 4 discussed earlier. Similarly, the effect sizes in respect of treatment and cognitive abilities confirm the data in Table 4. With the exception of the effects of gender, the effects of the other variables were more pronounced on the experimental students than on their comparison group peers. Note that the effect sizes attributable to SEB differences conflict with the data in Table 4 which showed that there were no significant SEB differences in the students' posttest performance on the FNT.. Considering this study's findings, half of the first hypothesis was accepted while the other half was rejected.

The second hypothesis of this study was that the correlations among the experimental students' treatment, gender, cognitive abilities in food and nutrition and SEB and their posttest performance on the FNT test would be statistically significant whereas those of their comparison group peers would not. To test this hypothesis, point-biserial correlation coefficients (Table 6) were computed because genuine dichotomies existed among two of the independent variables - gender and SEB (Guilford & Fruchter, 1978, p. 308).

Table 6
Point-Biserial Correlation Coefficients Relating Students' Gender, Cognitive Abilities and Socioeconomic Background to Their Posttest Performance on Food and Nutrition

Varia-bles	Experimental Group					Comparison Group I					Comparison Group II				
	T	G	CA	SEB	SS	T	G	CA	SEB	SS	T	G	CA	SEB	SS
T	1.0	.16	.75	.19	.65	1.0	.20	.58	.09	.50	1.0	.15	.29	.08	.24
G	.16	1.0	.11	.08	.07	.20	1.0	.12	.08	.07	.01	1.0	.08	.09	.05
CA	.75	.13	1.0	.15	.54	.58	.06	1.0	.09	.15	.29	.08	1.0	.12	.11
SEB	.19	.08	.15	1.0	.18	.09	.08	.09	1.0	.09	.08	.09	.12	1.0	.08
SS	.65	.07	.54	.18	1.0	.50	.07	.15	.09	1.0	.24	.05	.11	.08	1.0

Note: Only coefficients between .54 and 1.00 are significant at $p < .01$ level.
T = Treatment, G = Gender, CA = Cognitive Abilities, SEB = Socioeconomic background, SS = Science Scores

Table 6 indicates that (a) while there is a positive, statistically significant and strong relationship between the experimental students' treatment and cognitive abilities, the relationship between the comparison group I students' treatment and cognitive abilities is positive, statistically significant and "substantially" reliable (Miller, 1991), and (b) the relationship between the experimental students' and comparison group I students' treatment and posttest score on the FNT is positive, statistically significant and substantially reliable (Miller, 1991). The table further shows that either there is no relationship between the remaining independent and dependent variables or there is no significant relationship between the remaining independent and dependent variables for the three groups of students. These findings confirm the data in Table 4 discussed earlier. Because only the relationship between the experimental students' treatment and their posttest performance on the FNT was statistically significant more than that of the two comparison group students, the second hypothesis had to be partly rejected.

CONCLUSIONS AND EDUCATIONAL IMPLICATIONS

This study showed that the experimental students (a) taught with the lecture method and student practical work in small groups, and (b) with high cognitive abilities in food and nutrition performed significantly better than the comparison group students on the FNT. However, it would seem illogical on the basis of one sample to conclude with absolute certainty that the use of the lecture method and practical work in small groups statistically significantly improved selected Jamaican 10th-graders' posttest performance on a FNT more than the performance of their counterparts who were not exposed to student practical work. Nonetheless, this study suggests this potential which -to the best of our knowledge - has not been previously investigated. Hence, caution should be exercised in considering this study's conclusion. Nevertheless, we recommend that the experimental teaching approach could also be used in teaching other food and nutrition concepts - not explored in this study - to other 10th-graders in Jamaica and elsewhere to enhance their understanding and performance on food and nutrition concepts.

The absence of significant gender and SEB differences in the students' posttest performance suggests that Jamaican 10th-graders could learn food and nutrition concepts equally well regardless of the differences in their gender and SEB, especially if the experimental teaching techniques are used to teach them.

As there were no significant gender and SEB differences in the students' posttest performance on the FNT, we suspect that other variables, besides these variables were likely to have contributed to significant differences in their performance. Such variables - which should be explored in future studies on this topic- include the differences in the students' learning styles, self-esteem, subject preference, teachers' qualifications and teaching experience. Larger samples need to be engaged in future studies to amplify and validate this study's findings.

REFERENCES

Amaria, R. P., Brian, L. A., & Leigh, G. O. M. (1969). Individual versus cooperative learning: Influence of intelligence and sex. *Educational Research, 11*, 95-103.

Archibong, A. U. (1997). The relative effectiveness of activity-based approach and lecture method on the cognitive achievements of integrated science students. *Journal of the Science Teachers Association of Nigeria, 32*(1 & 2), 37-34.

Beaumont-Walters, Y. & Soyibo, K. (2001). An analysis of high school students' performance on five integrated science process skills. *Research in Science & Technological Education*, *19*(1), 133-145.

Blair-Walters, S. & Soyibo, K. (2004). Correlations among five variables and the biology performance of a sample of Jamaican high school students. *Journal of Science and Mathematics Education in Southeast Asia, 27*(1), 117-138.

Bucknor, C. & Soyibo, K. (2001). Effects of lecture, demonstration and practicals on tenth graders' attitudes to chemistry and knowledge of acids and bases. *Journal of Education and Development in the Caribbean, 5*(1), 47-58.

Caribbean Examinations Council (2002). Integrated science syllabus. St Michael, Barbados: CXC.

Charles, A. (2001). *An analysis of Eastern Caribbean grades 10 and 11 students' conceptual frames of reference for interpreting electrical phenomena*. Unpublished PhD thesis, University of the West Indies, Mona, Jamaica.

Comber, L. C. & Keeves, J. P. (1973). Science education in nineteen countries: An empirical study. *International Studies in Evaluation*: Stockholm: Almqvist & Wiksell.

Edwards, W. (2001). *Effects of lecture, demonstration and hands-on instructional approaches on grade nine students' knowledge of physical and chemical changes*. Unpublished MEd project, University of the West Indies, Mona, Jamaica.

Edwards, L. & Soyibo, K. (2003). Relationships among selected Jamaican ninth-graders' variables and knowledge of matter. *International Journal of Science and Mathematics Education, 1,* 259-281.

Ellis-Hall, N. & Soyibo, K. (2004). Relationships among four learner variables and the performance of selected Jamaican 11-th graders on some structured questions on the mole concept. *Journal of Science and Mathematics Education in Southeast Asia, 27*(2), 1-26.

Esiobu, G. O. & Soyibo, K. (1995). Effects of concept and vee mappings under three learning modes on students' cognitive achievement in ecology and genetics. *Journal of Research in Science Teaching, 32*(9), 971-995.

Ezenne, C. (2003). *Relationships among selected learner variables and performance of some Jamaican fifth formers on kinematics numerical problems.* Unpublished MEd project, University of the West Indies, Mona, Jamaica.

Evans, H. (2001). *Inside Jamaican schools.* Kingston, Jamaica: University of the West Indies Press, Mona.

Forrest, G. M. (1992). Gender differences in school science examinations. *Studies in Science Education, 20,* 87-122.

George, R. & Kaplan, D. (1998). A structural model of parent and teacher influences on science attitudes of eighth graders: Evidence from NELS:88. *Science Education*, 8(1), 93-109.

Greenfield, T. A. (1996). Gender, ethnicity, science achievement and attitudes. *Journal of Research in Science Teaching, 33,* 901-933.

Guilford, J. P. & Fruchter, B. *Fundamental statistics in psychology and education (6th ed)*. Tokyo: McGraw-Hill Kogakusha Ltd.

Hamilton, M. (1985). Performance levels in science and other subjects for Jamaican adolescents attending single-sex and coeducational high schools. *Science Education, 69*(4), 535-547.

Houtz, L. E. (1995). Instructional strategy change and attitude and achievement of seventh-and-eighth grade science students. *Journal of Research in Science Teaching, 32,* 629-648.

Leo-Rhynie, E. (1978). *An investigation into the relationship of certain variables to the academic achievement of selected Jamaican sixth form students.* Unpublished PhD thesis, University of the West Indies, Mona, Jamaica.

Paul Lofters (2002). *Correlations among selected learner variables and a sample of Jamaican eleventh graders' performance on the mole concept.* Unpublished MEd project, University of the West Indies, Mona, Jamaica.

Millar, K. (1999). *GCSE examination results*. Belfast: Queens University, Belfast.

Miller, D. C. (1991). *Handbook of research and social measurement (5th ed.)*. Newbury Parks, A: Sage.

Miller, E. (Ed.) (1999). *Education reform in the commonwealth Caribbean*. OAS: Interamer 54 Education Series.

Mills, D. & Mills, C. (2003). *Select committee on education and employment*. London: UK Parliament.

Mollod, R. W. (1970). Pupil tutoring as part of reading instruction in the elementary grades. *Dissertation Abstracts International, 31,* 22608.

Mulopo, M. M. & Fowler, H. S. (1987). Effects of traditional and discovery instructional approaches on learning outcomes for learners of different intellectual development: A study of chemistry students in Zambia. *Journal of Research in Science Teaching, 24,* 217-227.

Okebukola, P. A. O. (1984). Tackling the problem of large classes in biology : An investigation into the effects of a cooperative learning technique. *Journal of Science Teachers Association of Nigeria, 22,* 73-77.

Rodney, Y. R. & Soyibo, K. (2003). Effects of lecture, teacher demonstrations, practical work and discussion on Jamaican fourth-graders' attitudes to science and knowledge of machines and water. *Journal of Education and Development in the Caribbean, 7*(1 & 2), 27-42.

Science Education Committee (1999). *Science and technology for human resource development.* Kingston, Jamaica: Scientific Research Council.

Soyibo,K. & Evans, H. G. (2002). Effects of a cooperative learning strategy on ninth-graders' understanding of human nutrition. *Australian Science Teachers' Journal, 48*(2), 32-35.

Soyibo, K. & Pinnock, J. (1998). Relationships among some factors and students' integrated science knowledge. *Journal of Education & Development in the Caribbean, 2,* 153-157.

Stockhausen, N. & Soyibo, K. (2004). Relationships among Jamaican ninth-graders' variables and performance in integrated science. *Journal of Science and Mathematics Education in Southeast Asia, 27*(2), 62-80.

Stohr-Hunt, P. M. (1996). Analysis of frequency of hands-on experience and science achievement. *Journal of Research in Science Teaching, 33,*101-109.

TIMSS (1997). *Third international mathematics and science study.* Washington, DC: US Department of Education.

Thompson, J. & Soyibo, K. (2002). Effects of lecture, teacher demonstrations, discussion and practical work on 10th graders' attitudes to chemistry and understanding of electrolysis. *Research in Science & Technological Education, 20*(1), 25-35.

Toplis, R. (1998). Ideas about acids and alkalis. *School Science Review, 80,* 67-70.

Ugwu, O. & Soyibo, K. (2004). The effects of concept and vee mappings under three learning modes on Jamaican eighth graders' knowledge of nutrition and plant reproduction. *Research in Science & Technology Education, 22*(1), 41-58.

Walford-Palmer, M. L. (2004). *Effects of complex instruction and six learner variables on selected Jamaican grades 4-6 students' science performance*: A case *study.* Unpublished MEd thesis, University of the West Indies, Mona, Jamaica.

Watson, R., Prieto, T. & Dillon, J. S. (1995). The effect of practical work on students' understanding of combustion. *Journal of Research in Science Teaching, 3,* 487-502.