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C o n t e n t s

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An investigation of primary and JHS teachers' attitudes toward mathematics in some selected schools in the Central Region of Ghana

Davis, E. K. & Wilmot, E. M. 1

The effect of behavioural objectives used as advance organizers on senior secondary students' mathematics achievement

Ifamuyiwa, A. S. 11

The effect of conceptual and procedural learning strategies on the study habit of Nigerian secondary school students in mathematics

Adeleke, M. A. & Oloyede, E. O. 21

Reaching a National Consensus on the Duration of High School Education in Ghana: A Case for 3-Year Senior High Education

Acquaye, E. 27

Use of technology for college mathematics instruction: African instructors' experiences

Assuah, C. 41

Induction of Beginning Teachers in Ghana: Principles and Prospects

Nyoagbe, J. 55

Ghanaian teacher trainees' perception of the official Social Studies curriculum and the resources available for its implementation

Kankam, B. 61

Five Decades of School Mathematics in Ghana

Mereku, D. K. 73

An investigation of primary and JHS teachers' attitudes toward mathematics in some selected schools in the Central Region of Ghana

Davis, E. K. & Wilmot, E. M.[1]

Abstract

This study explored primary and junior high school (JHS) teachers' attitudes toward mathematics. A survey of attitudes toward mathematics of 114 primary and JHS teachers who were holders of three-year post secondary teachers' certificate "A" from 40 basic schools in the Cape Coast Metropolis and Elmina district in the Central region of Ghana was carried out using a questionnaire. Data collected were analysed using means and standard deviations. The t-test was used to investigate whether there was significant difference between primary school and JHS teachers' attitudes toward mathematics. The results from the study revealed amongst others that both primary and JHS teachers had favorable attitudes toward mathematics. The study also found no significant difference between the attitudes of the two sets of teachers toward mathematics. However, whilst the study found no significant difference between the attitudes of upper primary and JHS teachers toward mathematics, both upper primary and JHS teachers were found to have significantly more positive attitudes toward mathematics than the lower primary teachers. The study recommended the need to encourage lower primary school teachers to develop more positive attitudes toward mathematics.

Keywords attitude toward mathematics, mathematics achievement

Introduction

Literature suggests that attitudes of teachers play a vital role in mathematics teaching and learning in the classroom (Karp, 1991; Bishop and Nickson, 1983). Karp (1991), for instance, found a direct relationship between the attitudes of teachers toward mathematics and their teaching strategies. Karp (1991) found that teachers who have positive attitudes usually employ strategies which makes the learners independent whereas teachers who have negative attitudes usually employ strategies which makes learners more dependent. Studies have also shown a significant correlation between teacher's attitudes toward mathematics and their students' mathematics achievement in school (Caraway, 1985; Ernest 1988; Kulm, 1980). Kulm (1980), for instance, compared the attitude of teachers towards mathematics and their students' achievement and found a significant correlation between them. Kulm (1980) asserted that "teachers who can influence student attitudes and their achievement in their formative stages may be those that have the poorest attitudes themselves" (p.372). Some researchers have also argued that teacher attitudes influence pupils' attitude (Sullivan, 1989; Relich, Way and Martin, 1994). Relich and Way (1994), for instance, argue that teachers'

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attitudes towards mathematics influence pupils' attitudes towards mathematics and their mathematics learning.

Literature suggests a relationship between teachers' attitudes to mathematics and the level at which they teach (Gellert, Jablonka and Keitel 2001; Wilkins, 2002). Wilkins (2002) for instance found in a study involving 407 in-service elementary teachers that upper elementary teachers (grades 3-5) were found to have greater content knowledge and more positive attitudes toward mathematics than primary teachers (grades K-2). Gellert, Jablonka and Keitel (2001) also highlight the poor attitudes of elementary teachers toward mathematics (especially secondary and tertiary mathematics) as compared to secondary school teachers. They emphasize the need to break the cycle of poor teacher beliefs and attitudes at the moment they begin to conceptualize their mathematics teaching, (p. 69).

Other studies have also suggested a relationship between teachers' mathematics background and their attitudes toward mathematics and the teaching of mathematics (Ernest, 1988; Wilkins, 2002). Ernest (1988) for instance found in his study involving a group of primary school teacher trainees on practice teaching that those who were being trained as mathematics specialist tend to have more positive attitudes toward mathematics and its teaching than those with low levels of knowledge in mathematics. Ernest's study also found more variation in the responses of teachers with low levels of knowledge in mathematics. The former finding of Ernest seems to confirm that of Wilkins (2002) that has already been reviewed above.

From the discussion so far it is evident that there seems to exist a relationship between teachers' level of teaching (lower primary verses upper primary) and their attitudes to mathematics on the one hand and teachers' background in mathematics and their attitudes to mathematics on the other hand. What remains unclear which this study sought to explore was whether teachers of younger children (primary school teachers) and teachers of older children (JHS teachers) who have been exposed to the same training (same subject matter knowledge and pedagogic content knowledge in mathematics in their training) will differ in their attitudes toward mathematics. Thus this study sought to find whether differences exist in the attitudes of primary school and JHS teachers who went through the three-year Post Secondary certificate "A" teacher training programme (the generalist type of training).

Purpose of the study and research questions

Even though Ghanaian basic school students performance in mathematics both locally and internationally have not been good (Anamuah-Mensah & Mereku, 2005; WEAC, 2006), yet not many studies have been done in Ghana to ascertain the attitudes of teachers toward mathematics meanwhile Caraway (1985) for instance found some relationship between teachers attitudes toward mathematics and their students performance in mathematics. The purpose of this study was therefore to explore certificate "A" primary and JHS teachers' attitudes toward mathematics. It also sought to investigate whether there was any significant difference between the attitudes of primary and JHS teachers toward mathematics. The following research questions and hypotheses were posed to guide the study:

Research questions and hypotheses

1. What are the attitudes of primary school teachers toward Mathematics?
2. What are the attitudes of Junior High School teachers toward Mathematics?
3. Does the level at which the teacher operates influence his/her attitude toward Mathematics?

To explore the third question, the following hypotheses were formulated to guide the study:

1. There is no significant difference between the attitudes of primary and JHS teachers toward mathematics
2. There is no significant difference between the attitudes of lower primary school teachers and upper primary school teachers toward mathematics
3. There is no significant difference between the attitudes of lower primary school teachers and JHS teachers toward mathematics
4. There is no significant difference between the attitudes of upper primary school teachers and JHS teachers toward mathematics

Method

The Sample

Survey method was used to explore teachers' attitudes to mathematics and its teaching. One hundred and fourteen primary and JHS teachers were randomly selected from 40 public basic schools in the Cape Coast Metropolis and Elmina district in the Central region. The table of random numbers was used to select the schools (40 of them) based on the number of schools in each of the two districts and type of school (rural/urban, single sex/ co-education, performing/non performing schools). In each of the two districts all certificate "A" teachers who teach mathematics at the primary and junior high school in the selected schools were chosen to participate in the study. Thus the participants in this study included certificate "A" teachers who were teaching in both rural and urban schools, those teaching mathematics in single sex and coeducational schools as well as those teaching in performing and non-performing schools. Out of the hundred and fourteen primary and junior high school teachers who participated in the study sixty four (constituting 56.1%) of them were females whereas the remaining 50 (43.9%) were males. Seventy eight of them (sixty seven point five percent) were primary school teachers and the remaining 36 (31.6%) were junior high school teachers. Out of the 78 primary school teachers 41 (36%) of them were lower primary school teachers whereas the remaining 37 (32.5%) were upper primary school teachers.

Instrument

A questionnaire was used to collect the data. It consisted of 28 items all of which were closed ended type. The questionnaire consisted of two parts. The first part elicited information about the biographical data of the respondents and the second part elicited information about the attitudes of basic schoolteachers toward mathematics. The attitudinal items were a 5-point Likert-scale type and respondents had to choose from Strongly Agree, Agree, Undecided, Disagree, Strongly Disagree. The researcher developed the items and validated the instrument among primary and junior high school teachers in a pilot district. The reliability test gave a Cronbach alpha value of 0.83.

Research Procedure

Data collection was done in the Cape Coast Metropolitan area and Elmina district at the beginning of the third term of the academic year 2007/2008 (April, 2008) by the researchers. The questionnaire administration was done during the first three weeks of school reopening. The researchers visited the schools to administer the questionnaire. In each of the schools, the purpose of the study was explained to the headteacher and teachers before the administration of the questionnaires. Some of the questionnaires were completed in the presence of the researchers during the initial visit while the others were collected during subsequent visits to the schools.

Data Analysis

Means and standard deviations were used to present and discuss trends in primary and Junior High School teachers' attitudes toward mathematics. The t-test, at .05 level of significance, was used to determine whether there was significant difference in attitudes of primary and Junior high school teachers to mathematics. For the purpose of analysis the positive attitudinal items were rated as follows; 5-strongly agree, 4 - agree, 3 - undecided, 2 - disagree and 1 - strongly disagree whereas the negative attitudinal items were rated as follows; 5 - strongly disagree, 4 - disagree, 3 - undecided, 2 - agree and 1- strongly agree. Thus a mean of more than three indicates favorable attitude, a mean of less than three indicates unfavorable attitude whereas a mean of three indicates neither favorable nor unfavorable attitudes for each of the individual items. For their overall attitudes the most favorable attitude will have an overall score which is equals to the number of items times five, the most unfavorable attitude will have an overall score which is equals to the number of items times one and neither favorable nor unfavorable attitudes is expected to have an overall score which is equal to the number of items times three. Thus an mean overall attitude of more than 54 (i.e. 3 times 18items) shows a trend towards favourable attitudes

Results

The results of the study have been presented in two sections namely primary and JHS teachers' attitudes towards mathematics and Comparison of attitudes of lower primary, upper primary and JHS teachers toward Mathematics.

Primary and JHS teachers' attitudes towards mathematics

Table 1 shows the results of the attitudes of primary and JHS teachers toward mathematics in the sampled schools. The result shows that both set of teachers had favorable attitudes toward mathematics since the mean on all items for each of the two groups of teachers was almost four in each case (M=3.84 out of 5, sd=1.07 for primary school teachers and M= 3.96 out of 5, sd=1.10 for JHS teachers). This implies that these primary school teachers and JHS teachers generally agreed with the positive attitudinal items and disagreed with the negative attitudinal items. A look at results in Table 1 show that out of the 18 attitudinal items primary school teachers had mean score of less than 3.50 in three of them namely "mathematics is easy for me (M=3.12)" (statement two), "working Mathematics exercises is fun for me (M=3.43)" (statement ten) and "Mathematics thrills me (M= 3.19)" (statement eleven). The JHS teachers on the other hand had a mean score of less than 3.50 in only one item; "Mathematics thrills me (M= 3.19)" (statement eleven). Despite their favourable attitudes towards mathematics this results however seems to suggest that some primary school teachers in the area where this study was carried out still have low confidence in mathematics.

Table 1 **Means and standard deviations of teachers' attitudes towards mathematics**

Statement	Primary school teachers (N=78)		Junior high school teachers (N=36)	
	Mean	SD	Mean	SD
I hate Mathematics	3.99	1.22	4.28	0.97
Mathematics is easy for me	3.12	1.15	3.50	1.36
I do not like studying Mathematics.	4.03	1.12	4.08	1.08
Mathematics is boring to me.	3.88	1.08	4.11	1.09
I like Mathematics	3.91	0.98	4.25	0.91
Mathematics is a difficult subject.	3.53	1.18	3.64	1.25
I like studying Mathematics	3.97	0.93	3.97	0.97
I wish I do not come into contact with Mathematics.	4.12	1.18	4.03	1.25
Mathematics is interesting for me	3.90	0.85	3.92	1.11
Working Mathematics exercises is fun for me.	3.43	1.13	3.50	1.21
Mathematics thrills me	3.19	1.09	3.08	1.23
I have always been afraid of mathematics	3.99	1.16	4.08	1.11
Mathematics is not for teachers like me	4.26	0.99	4.25	1.13
Studying mathematics is very stressful for me	3.81	1.15	4.14	0.93
Mathematics is for the gifted	4.14	1.12	4.03	1.16
Mathematics is very useful	4.44	0.93	4.44	0.97
I find mathematics very easy to understand	3.56	0.99	3.92	0.94
Mathematics is one of the subjects I like very much	3.77	0.94	4.11	0.92
Total	3.84	1.07	3.96	1.10

Comparison of Attitudes of Lower Primary, Upper Primary and JHS teachers toward Mathematics

Table 2, below, shows the overall mean attitudes of primary and JHS teachers toward mathematics in the sampled schools. The result shows that both set of teachers had favorable attitudes toward mathematics since their overall mean score was more than 54 out of 90 in each case. The overall mean attitudes toward mathematics for the JHS teachers was not significantly higher than that of the primary school teachers ($M = 71.33$ out of 90, $sd = 10.55$ for JHS teachers and $M = 69.03$out of 90, $sd = 9.38$ for primary school teachers), $t(114) = 1.17$, $p > 0.05$. This implies that JHS and primary school teachers in the area where the study was carried out generally had similar attitudes toward mathematics. The standard deviations associated with the means of the two set of teachers however shows more variation in the responses of the JHS teachers on their attitudes toward mathematics as compared to the primary school teachers.

A look at the overall mean attitudinal scores of upper primary and lower primary school teachers shows that both set of teachers had favourable attitudes toward mathematics since their overall mean score was more than 54 out of 90 in each case. The overall mean attitude for the upper primary school teachers was however significantly higher than that of the lower primary school teachers (M = 72.54 out of 90, sd = 9.72 for upper primary school teachers and M =65.85 out of 90, sd = 7.91 for lower primary school teachers), $t(78) = 3.35$, $p < 0.05$. This implies that upper primary school teachers generally had more favourable attitudes toward mathematics than the lower primary school teachers

A look at Table 2 further shows that the overall mean attitudinal score of JHS teachers was 71.33 out of 90 with sd of 10.55 and that of the upper primary school teachers was 72.54 out of 90 with sd of 9.72. The overall mean score of the upper primary school teachers was not significantly higher than that of the JHS teachers ($t(73)=0.51$, $p>0.05$). This implies both set of teachers generally had similar attitudes toward mathematics.

A look at Table 2 again shows that the overall mean attitudinal score of JHS teachers was 71.33 out of 90 with sd of 10.55 and that of the lower primary school teachers was 65.85 out of 90 with sd of 7.91. The overall mean score of the JHS teachers was significantly higher than that of the lower primary school teachers ($t(77)=2.55$, $p<0.05$). This implies that like the upper primary school teachers, JHS teachers generally had more favourable attitudes toward mathematics than the lower primary school teachers.

Table 2 Mean and standard deviations on teachers' attitudes towards mathematics by level of teaching

Level of teaching	Number of respondents	Mean attitudinal score out of 90	Standard Deviation
JHS teachers	36	71.33	10.55
All primary teachers	78	69.03	9.38
Upper primary teachers	37	72.54	9.72
Lower primary teachers	41	65.85	7.91

Discussion

Primary school teachers' mean attitudinal score on all items of 3.84 out of 5 with standard deviation of 1.07 and JHS teachers mean attitudinal score on all items of 3.96 out of 5 with standard deviation of 1.10 indicate that both primary school teachers and the JHS teachers sampled for this study had favorable attitudes towards mathematics. This is an indication that both the primary school teachers and the JHS teachers generally agreed with the positive attitudinal items and disagreed with the negative attitudinal items, an indication of a trend towards positive attitudes. This is a positive trend as Karp (1991) found a direct correlation between teachers' attitudes to mathematics and their teaching strategies.

Results of the t test analysis on teachers attitudes to mathematics show that there was no significant difference between the attitudes of JHS teachers and the primary school teachers toward mathematics (M=71.33 out of 90, sd= 10.55, for JHS teachers and M=69.03 out of 90, sd=9.38 for primary school teachers, $t(114)= 1.17$, $p> 0.05$). This finding is not surprising since the two sets of teachers went through the same mathematics teacher preparation programme irrespective of the levels at which they are teaching. They were therefore exposed to the similar mathematics content. A look at the individual items on their attitudes toward mathematics however shows that JHS teachers seems find mathematics to be easy, and as fun as compared to the primary school teachers.

The results of the t test analysis on primary school teachers attitudes toward mathematics also show that upper primary school teachers attitudes toward mathematics was significantly higher than lower primary school teachers attitudes toward mathematics (M=72.54 out of 90, sd= 9.72, for upper primary teachers and M=65.85 out of 90, sd=7.91 for lower primary school teachers, $t(78) = 3.35$, $p < 0.05$). This finding seems to confirm that of Wilkins (2002) whose study seemed to portray that teachers of older children have a more positive attitudes toward mathematics and it teaching than teachers of younger children.

The results of the t test analysis on JHS teachers attitudes and that of lower primary school teachers attitudes towards mathematics also show that JHS teachers attitudes toward mathematics was significantly higher than lower primary school teachers attitudes toward mathematics (M=71.33 out of 90, sd= 10.55, for JHS teachers and M=65.85 out of 90, sd=7.91 for lower primary school teachers, $t(77)=2.55$, $p<0.05$). This finding also seems to confirm that of Wilkins (2002) whose study seemed to portray that teachers of older children have a more positive attitudes towards mathematics and it teaching than teachers of younger children.

The results of the t test analysis on upper primary school teachers and JHS teachers attitudes towards mathematics show that upper primary school teachers attitudes toward mathematics was not significantly higher than JHS teachers attitudes toward mathematics (M=72.54 out of 90, sd= 9.72, for upper primary teachers and M=71.33 out of 90, sd=10.55 for JHS teachers, $t(73)= 0.51$, $p> 0.05$), an indication that the two set of teachers had similar attitudes toward mathematics. This finding is a bit surprising because one would have expected that since upper primary school teacher had more favourable attitudes toward mathematics than the lower primary school teachers the JHS teachers were also going to have more positive attitudes toward mathematics than the upper primary school teachers. This finding seems to show that attitudes of teachers toward mathematics do not necessarily improve as one move up the academic ladder at the basic school level (lower primary, upper primary and JHS levels).

Conclusion and Recommendation

The study revealed that generally both primary and JHS teachers had favorable attitudes towards mathematics. The study found no significant difference between the attitudes of primary and JHS teachers toward mathematics. It also found no significant differences between the attitudes of upper primary school teachers and the lower primary school teachers toward mathematics. JHS and Upper primary school teachers were however found to have significantly more positive attitudes towards mathematics than lower primary school teachers. The implication of this finding is that it appears even though teachers of younger children(basic 1-3) seems to have weaker attitudes than those of older children (basic 4-9), teachers' attitudes toward mathematics does not generally seem to relate to the level at which they teach.

Even though literature suggests that it is difficult to change teachers' attitudes (Fleer and Robbins, 2005; Amato, 2004), the author would recommend that opportunities must be provided for teachers, especially lower primary school teachers through training to challenge their beliefs about mathematics to enable them develop more positive attitudes toward mathematics.

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The effect of behavioural objectives used as advance organizers on senior secondary students' mathematics achievement

Ifamuyiwa, A. S.[2]

Abstract

Behavioural objectives were used as advance organizers to teach some senior secondary school year two (SSS 2) mathematics topics. The study adopted a pretest, posttest control group quasi experimental design. Ninety SSS 2 students from two purposively selected senior secondary schools, who were the participants, responded to the researcher developed and validated mathematics achievement test (MAT), the research instrument. The t-test of significance was the main statistical tool used for data analysis. The experimental class which received the advance organizers obtained mean posttest score which was significantly higher than the mean posttest score of the control class. Results revealed that the use of behavioural objectives as advance organizers is an effective strategy for teaching and learning mathematics. The strategy is also capable of improving students' mastery of content at the comprehension level than at the knowledge level of cognition. Based on the findings, the study recommended that behavioural objectives and other forms of advance organizers should be used by mathematics teachers to complement the teaching of mathematics at the secondary school level.

Keywords advance organizers; behavioural objectives; mathematics instruction; students' achievement; knowledge level of cognition; comprehension level of cognition

Introduction

Abdulahi (1980) has shown how prior knowledge affects the learning process by distinguishing between 'rote learning' and 'meaningful learning'. While agreeing with Ausubel (1960), Abdulahi (1980) submitted that meaningful learning, occurs when there is an interaction between the learner's existing knowledge and the new learning material; and where there is no such interaction, rote learning takes place. Those parts of the learner's existing cognitive structure that can provide for the interactions which may lead to meaningful learning are described as 'subsumers'. Thus, a subsumer is any concept, generalization or principle that the learner already knows that can provide for association for the various components of the new knowledge. On the other hand, 'advance organizers' are used in the absence of subsumers. As new learning must be linked to existing knowledge for meaningfulness, advance organizer is introduced in the form of a topic which contains ideas with which the learner will have some familiarity. Advance organizer provides cognitive bridges or links for binding together both existing and new knowledge. A number of definitions of the term "advance organizer" might be necessary at this point.

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Advance Organizer, according to Woolfolk (2001), is "a statement of inclusive concepts to introduce and sum up material that follows". Ausubel (1960) defined advance organizer as "a cognitive instructional strategy used to promote the learning and retention of new information"; while Anderson (2004) defined it as "a method of bridging and linking old information with something new". An advance organizer is information that is presented prior to learning that can be used by the learner to organize and interpret new incoming information (Mayer, 2003).

Advance organizer as a concept was developed and systematically studied by David Ausubel who was greatly influenced by the teachings of Jean Piaget (Geier, 1999). Ausubel worked consistently to prove that advance organizers facilitate learning and much of his research has influenced others since 1960. Ausubel had postulated that when instructional "organizers" are introduced in advance of the actual learning material, there is an increase in achievement of a learner because the "organizers" will function to create subsumers which facilitate meaningful learning. Ausubel's advance organizer can best be classified as a deductive method. Deductive methods or reasoning provide the rule to follow then the example leading to the correct answer or learning. This is opposite to inductive method or reasoning that provides the example to follow then the rule. Advance organizers are also highly useful in the process or transferring knowledge. Arising from the deductive reasoning, students are able to use the rule then the example for learning to occur. The effects of advance organizers, according to Mayer (2003), should be most visible for tests that involve creative problem solving or transfer to new situations, because the advance organizer allows the learner to organize the material into a familiar structure. Since the advent of advance organizers, research has been able to prove that the strategy work best when there is no prior knowledge involved, because an advance organizer becomes the student's prior knowledge before learning the new material. Although, many find advance organizer to be a useful tool for teaching students new concepts when they do not have previous knowledge of a concept, there are those who feel that advance organizers are not beneficial, especially to students who have a good understanding of concepts and do come with previous knowledge. Although it is seen that advance organizers do not benefit these good students, they may benefit slower learners and those that do not have a wide knowledge of topics available to them (Mayer, 2003).

In explaining meaningful learning, Ausubel (1960) introduced the concept of a "subsumption model" as a pedagogic device in which central and highly unifying ideas are stated in terms already familiar to the learner, to which he can meaningfully relate new ideas by subsumption. It is also recognized that the "cognitive structure" of the learner can be manipulated in order to enhance meaningful learning. One of the ways this can be brought about involves the use of introductory materials or "organizers" which may consist of appropriate subsumers. The introduced subsumers, according to Ausubel (1963) thus become "advance organizer" or "anchoring foci" for the reception of new materials. Ausubel's theory is concerned with how individuals learn large amounts of meaningful material from verbal/textual presentations in a school setting (in contrast to theories developed in the context of laboratory experiments). According to Ausubel, learning is based upon the kinds of superordinate, representational, and combinatorial processes that occur during the reception of information. A primary process in learning is subsumption in which new material is related to relevant ideas in the existing cognitive structure on a substantive, non-verbatim basis. Cognitive structures represent the residue of all learning experiences; forgetting occurs because certain details get integrated and lose their individual identity. Based on this, Ausubel proposed the use of advance organizer as a major instructional mechanism. The organizer is introduced in advance of learning itself, and is also presented at a higher level of abstraction, generality, and inclusiveness; and since the substantive content of a given organizer or series of organizers is selected on the basis of its suitability for explaining, integrating, and interrelating the material they precede, this strategy simultaneously satisfies the substantive as well as the programming criteria for enhancing the organization strength of cognitive structure (Ausubel, 1963). Ausubel stressed that advance organizers are different from overviews and summaries which simply emphasize key ideas and are presented at the same level of abstraction and generality as the rest of the material. Organizers act as a subsuming bridge between new learning material and existing related ideas. Ausubel's theory has commonalities with Gestalt theories and those that involve schema as a central principle. There are also similarities with Bruner's "spiral learning" model, although Ausubel emphasizes that subsumption involves reorganization of existing cognitive structures not the development of new structures as constructivist theories suggest. Ausubel clearly indicates that his theory applies only to reception (expository) learning in school settings. He distinguishes reception learning from rote and discovery learning; the former because it doesn't involve subsumption (i.e., meaningful materials) and the latter because the learner must discover information through problem solving. A large number of studies have been conducted on the effects of advance organizers in learning and learner's performance.

Clawson and Barnes (1973) attempted to determine the effects of different types of advance organizers. Their work showed that advance organizers with pictorial, graphic, and manipulated materials were more effective than verbal and expository advance organizers. Khale and Nordland (1975) investigated the differential effect of an advance organizer on the meaningful learning of information presented to the learner in a structured programme of individualized instruction. The results of their study indicated that advance organizers did not function to increase meaningful learning. Lucas and Fowler (1975) examined the effects of three types of advance organizers on learning. The experimental groups were exposed to audio, video and written advance organizers while the control group was exposed to a history passage. The results showed that there were no significant differences between the experimental and control groups on any of the factors. Watkins (1983) examined the effects of using different modes of advance organizer on the performance in music by some non-music majors. The results showed that both the advance organizer and the modes of it did not show any significant effect on the performance of the students. But the advance organizer models when compared with the advance organizer alone revealed improved performance for each of the treatment interventions. Lautz (1983) examined the effects of advance organizer and subsumers on learning. The investigator exposed the experimental groups to verbal, graphic and comparative organizers while the control group had no organizer. The results showed that advance organizer models were facilitative to both immediate and delayed test performances. In a study carried out by Abdulahi (1980) in Nigeria, behavioural objectives were used as advance organizer in teaching chemistry to a group of students. The results showed that there were no statistically significant treatment effects. The mean scores of the experimental group were however superior to those of the control group. In a related study Ausubel (1960) found a significant difference between a group which used advance organizer consisting of 500 words on a passage related to the actual learning material and a control group without an advance organizer.

Studies on what constitutes an advance organizer have produced conflicting conclusions while inconsistent results have also been reported in literature on the effects of advance organizers. This has uncovered the need for further study on the nature and effect of advance organizers. Thus, the present study was to determine the effect of behavioural objectives on students' achievement in senior secondary school mathematics instructions when used as advance organizer. According to Abdulahi (1980), a behavioural objective refers to the behaviour one would like a learner to be able to demonstrate at the end of an instruction. Since it projects specific learning outcome, a behavioural objective can be used as an introductory overview of the learning material, thus functioning as an advance organizer. Like other advance organizers, behavioural objectives could stimulate the cognitive structure of the learner for possible incorporation of new information.

Research questions

This study sought to find answers to the following questions:

- Will there be any significant difference between the pretest achievement scores of students exposed to the experimental and control interventions?
- Will there be any significant difference between the posttest achievement scores of students exposed to the experimental and control interventions?
- Will there be any significant difference between the students' knowledge and comprehension levels of cognition after being exposed to the experimental and control interventions?

Research Method

Design

This study adopted a pretest-posttest control group quasi-experimental design (Campbell and Stanley, 1960).

Population and Sample

The target population for this study comprised all the second year students in public Senior Secondary Schools (SSS) in Ibadan metropolis, Oyo State, Nigeria. There are twenty-one public senior secondary schools in the metropolis. SSS year two students were considered for the study because the researchers believed that:

- The students have attained some level of maturity and confidence needed for participation in the study having been taught SSS mathematics for at least one year.
- The students were not being prepared for any immediate external examinations that could distract them from full participation in the study.
- The Trigonometry topics used as intervention in the study is contained in the SSS year two Mathematics curriculum.

The following criteria, using the judgmental sampling technique, were used to select the schools that took part in the study:

- The school must be a public co-educational secondary school;
- The SSS year two students in the school must not have been taught any of the trigonometric topics treated in the study;
- The school has graduate mathematics teacher(s) teaching SSS year two students;
- The school intend to present candidates for the 2009 May/June Senior School Certificate Mathematics Examination.
- The school must have SSS year two students offering Mathematics, Chemistry, Biology, and Physics.

From the six secondary schools that met the criteria above, two were purposively selected to participate in the study. The two schools chosen were those that have equal number of students (45 each) in their SSS year two science classes. Thus, a sample of ninety (90) SSS year two students (52 boys and 38 girls) participated in the study. The two classes of ninety students were then assigned randomly into an experimental class and a control class, with equal numbers in each class. The experimental class was taught using behavioural objectives as intervention/treatment while the control class was taught without the use of advance organizer.

Test Construction/Instrument

The topics in trigonometry aspect of SSS II Mathematics curriculum covered in this study are limited to Pythagoras' theorem, the ratios of sine, cosine and tangent of angles, angles of elevation and depression, the sine rule and the cosine rule. These topics were selected because each can be taught at knowledge, comprehension and application levels of complexity (Bloom, 1956). Again, the choice of the topics was based on the report, from the West African Examination Council's (WAEC) chief examiner's in Mathematics, that students generally performed poorly in the trigonometric aspects of the year 2008 school certificate Mathematics examination questions (WAEC, 2008).

Test items for the study were selected from students' mathematics textbooks (SSS 2), past WAEC question papers and published materials. The criteria used in devising the instrument were:

- The instrument should consist of items measuring knowledge, comprehension and thinking levels of the selected topics.
- The test items should be appropriate to the level of understanding as specified in the behavioural objectives list.
- In order to increase the content validity of test instrument, a panel of secondary school mathematics teachers, to include at least two SSS 2 teachers, should approve that the test items covered all the topics specified in the behavioural objectives.

The resultant instrument was a test named the *Mathematics Achievement Test (MAT)*. The MAT is a 40-item multiple-choice Mathematics achievement test with four options per item. The MAT was constructed and validated by the researcher to measure students' achievement in Mathematics covering the selected trigonometric topics covered in the study and was based on appropriate knowledge, comprehension and thinking levels of cognitive domain (Yoloye, 1982). The first 15 items of the validated instrument covered knowledge skills, the next 15 items covered comprehension skills while the last 10 items covered thinking skills. To test the reliability of the instrument, the 40-item MAT was administered on a sample of 40 students (22 boys and 18 girls) in a school that was not part of the study, but whose students are similar in age and class to the students involved in the study. From the students' responses, a reliability coefficient of 0.81, using the Kuder-Richardson method [Formula 21] was obtained.

Treatment and data collection procedure

The two mathematics teachers in the selected schools were the instructors for the students that took part in the study. They were trained for one week on how to administer the intervention and control treatments. Before instruction, the test was administered to the experimental class and the control class at the same time as pretest. Then, the two groups were taught by their different instructors for the duration of the instructions. The students in the experimental class were given the behavioural objectives for each lesson and all the topics treated during the teaching period before each lesson/topic was taught. The lessons/ topics in the control class were taught without behavioural objectives. However, other instructional materials which were part of the learning package were given to both the experimental and the control classes at the same time.

Both experimental and control classes were not aware that they were being involved in a study. Also adequate protection was made against any knowledge of or access to the list of behavioural objectives by the control class. Although each class was taught by a different instructor, efforts were made to minimize differences in teaching styles and undue enthusiasm on the part of instructors by having the instructors plan their lessons together, use the same textbooks, teaching aids, quizzes and tests. As much as possible the instructors also used the same length of time to teach each topic. The teaching period lasted for six weeks. The items in the pretest instrument ware rearranged and re-administered on both classes, as posttest, at the end of instructions to measure the learning that had taken place.

Data Analysis

The objective test scores were corrected for guessing by means of the formula

$$\text{Test Score} = R - \frac{W}{k-1}$$

Where R = number of items the students got right
W = number of items the students got wrong
k = number of alternatives in the multiple choice test item.

The independent-samples t-test, at the .05 confidence level, was used to compare means of the two classes on the pretest, posttest, and on the knowledge and comprehension components of the test for possible test of significant difference.

Results

The sequence of the presentation of the results obtained in this study is in accordance with the research questions raised to guide its investigation.

Research Question 1

Will there be any significant difference between the pretest achievement scores of students exposed to the experimental and control interventions?

Table 1: Difference between the Students' Pretest Achievement Scores

Class	N	Mean	S.D.	df.	t	Sig.of t
Experimental	45	17.11	1.23	88	1.36	.179
Control	45	16.20	4.34			
Total	90					

Table 1 shows the means and standard deviations of the pretest scores of the two classes. The result revealed an insignificant outcome ($t = 1.36$, $p > .05$). This implied that the mean pretest score of the students in the experimental class is not significantly different from that of the students in the control class at the .05 confidence level.

Research Question 2

Will there be any significant difference between the posttest achievement scores of students exposed to the experimental and control interventions?

Table 2: Difference between the Students' Posttest Achievement Scores

Class	N	Mean	S.D.	df.	t	Sig.of t
Experimental	45	28.22	3.29	88	12.88*	.000
Control	45	17.80	4.32			
Total	90					

* revealed significant t at .05 confidence level

Table 2 shows the means and standard deviations of the posttest scores of the two classes. Comparison of the difference between the posttest mean scores of the two classes yielded a significant outcome ($t = 12.88$, $p < .05$). This result implied that the students in the experimental class (exposed to behavioural objectives as advance organizers) recorded significantly better posttest achievement scores than their colleagues in the control class.

Research Question 3

Will there be any significant difference between the students' knowledge and comprehension levels of cognition after being exposed to the experimental and control interventions?

Table 3: Difference in the Students' Posttest Knowledge and Comprehension Scores

Class	N	Mean	S.D.	df.	t	Sig.of t
Experimental	45	8.78	1.36	88	0.78*	.000
Control	45	8.47	2.30			
Total	90					
Experimental	45	10.42	1.59	88	8.92*	.000
Control	45	6.69	2.31			
Total	90					

* revealed significant t at .05 confidence level

Table 3 shows the means and standard deviations of the students' posttest scores in the knowledge and comprehension levels of the two classes. The results revealed non significant outcome in the students' scores at knowledge level ($t = 0.78$, $p > .05$) but a significant outcome in their scores at comprehension level ($t = 8.92$, $p < .05$). These outcomes revealed that while there seems to be no significant difference between the mean scores of the two groups of students at their knowledge level of cognition, the students exposed to the experimental intervention significantly achieved better than those in the control class at their comprehension level of cognition.

Discussion and Conclusion

The results of the present investigation showed that the pretest mean score of the students in the experimental class was not significantly different statistically from that of the students in the control class. This outcome is a confirmation that the two groups of students entered the instruction/experiment on equal strength since their pretest scores revealed no significant difference; the higher mean score recorded by the experimental class notwithstanding. This finding is necessary in order to show that if any significant difference is observed in the posttest mean scores then such difference would not be attributed to chance but the effect of the intervention. Consequently, the posttest's mean score of the students in the experimental class was found to be significantly different from that of their colleagues in the control class. This finding has again revealed the efficacy of the use of advance organizer in enhancing students' achievement in mathematics. This finding, though not in agreement with the outcome of a similar study conducted by Abdulahi (1980) in chemistry, is however corroborating the studies of Clawson and Barnes (1973) and Lautz (1983) which showed that advance organizers with pictorial, graphic, and manipulated materials were more effective than verbal and expository advance organizers. An interesting but surprising finding in this investigation is the obtained significant difference between the experimental class and the control class at the comprehension level of mastery but a non-significant difference between the two groups at the knowledge level of mastery. The implication of this finding is that when behavioural objectives are used as advance organizers in mathematics instruction, there is a higher possibility that the students' would perform better at the comprehension level of mastery than at the knowledge level of mastery. The finding is surprising because it is an opposite outcome against the much held believe and general expectation that mastery of content is easier to attain at the knowledge level than at the comprehension level. One likely explanation for this outcome is that because the students in the experimental class were provided with the behavioural objective of a lesson prior to its instruction, the learners' attention were actually directed to the most important aspects of the lesson which involves what they were able to pick from the lesson in terms of understanding the main concepts than the mere ability to recall facts, definitions and formulae, which knowledge skill is more concerned with. All these findings indicate trends which suggest that more studies are still needed to determine the effect of behavioural objectives when utilized as advanced organizers.

Specifically, this study investigated the effect of the use of behavioural objectives when used as advance organizers on mathematics achievement at the senior secondary school level. The study is an addition to empirical studies on the effectiveness of the use of advance organizers in mathematics instructions in the classroom. The results of the study revealed that the use of behavioural objectives as advance organizers is an effective strategy for teaching and learning mathematics at the senior secondary level. The strategy is also capable of improving students' mastery of content at the comprehension level than at the knowledge level. Based on the findings of the study, it is hereby recommended that behavioural objectives and other forms of advance organizers should be used by teachers of mathematics in instructing their students at the secondary school level. It is equally recommended that one effective strategy, which has the potential of enhancing students' achievement in mathematics, for mathematics instructions in schools is the use of behavioural objective as advance organizers.

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The effect of conceptual and procedural learning strategies on the study habit of Nigerian secondary school students in mathematics

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Abstract

This study examined the effect of varying learning strategies making use of procedural and conceptual learning strategies on secondary school students' study habits in mathematics. A total of 124 senior secondary school students, from Osun state in southwestern Nigeria divided into three groups were involved in this study. Two experimental groups were randomly assigned to the two learning strategies and the third group was the control group. The study adopted modified non-equivalent pretest posttest control group design. Intact classes were used but the modification was that all the three groups contained science students. The three groups were taught simultaneous linear equations. The study habits of students were assessed using a questionnaire of reliability coefficient of 0.84. Both learning strategies yielded significant difference in students' study habits with conceptual strategy having higher score. The study concluded that students' study habits in mathematics could be improved using an innovative learning strategy.

Keywords study habit, learning strategy, conceptual, procedural, achievement

Introduction

Researches into study habits of students have begun long ago. In the twentieth century, a number of studies have reported some association between study habit and academic performance of students. These studies include those of Brown and Holtzman (1955), Chabazi (1957), Diener (1960) and Ward (1961). Hadwin and Winne (1996) defined a study habit as the selection and coordination of alternative study tactics in order to achieve a goal. Maree, Pretorius and Eiselen (2003) defined study habit as acquired yet consistent study methods aimed at effective learning. Some of the components of students' study habit that have been reported to have influence on academic achievement are studying alone, studying in a quiet environment, maintaining attention in lectures, preparing and keeping a time table of evening study, paying attention to details in textbooks, keeping methodical notes and allowing adequate time for the preparation of written work. It is postulated that the study processes used by a student during learning will be related to both the amount learned and the quality of his learning (Biggs, 1979). In mathematics for instance, both the amount and the quality of learning a student has are likely to have some role they play in determining the problem

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solving performance of such student. Since mathematics knowledge cannot be acquired passively (Bressaud, 1999), good study habit in mathematics should include

- Solving non-routine problems
- Taking responsibility for ones learning
- Spending sufficient time studying mathematics
- Acquiring effective problem solving strategies.

Since problem solving ability is an integral determinant of students' achievement in mathematics, the study habit that leads to improved problem-solving ability could be the pivot for their better achievement in mathematics. However, appropriate study habit may not be easy for students to develop. In the ideas of Kochlar (2000), students need to be guided for developing good study habits and adequate preparation to learn well and therefore do well in examinations. A good study habit that leads to improved problem solving skills involves studying outside the class work, commitment to understanding how and why a procedure works and reading for complete understanding by pausing to work through examples and asking oneself questions. Study habit, which promotes complete conceptual understanding rather than memorization during problem solving processes, gives room for the learner to understand the various choices that could be applicable in solving a particular problem. And this enables one to be competent in handling problems, which have not been encountered before since mathematics builds on itself, a problem solver needs experience, and possession of this experience may take him/her to a problem solving stage where the solution to a problem could be talked about without using mathematical notations.

Study habit has been reported to have significant influence on achievement of students in all school subjects. However, what is yet to be well explored is whether the study habits of students could be improved with the use of innovative teaching strategies and other school works. In mathematics for instance, an essential component of acquiring expertise in mathematical thought processes is problem solving. It is reasonable to assume that a person who wants to be a good problem-solver should develop good study habits. How much can it then be reasonably assumed that a student who is striving to improve problem-solving skills may also be inclined towards improved study habit? An attempt was made in this study to answer this question by making use of conceptual and procedural learning strategies to teach problem-solving skills to secondary school students and then finding out how much the study habit of the students would be improved after the treatment.

Statement of the Problem

Students' academic growth is usually considered in totality rather than in isolation of subjects. When innovative ideas are conceived in an aspect of education, little attention is usually focused on how such innovations could benefit other aspect of students' learning. Studies have reported how improved study habit can raise student's level of academic achievement, but very little is known on how improved achievement in a subject can improve the study habit of the students thereby helping them in other subjects. There is therefore the question of how much will students study habit is improved if they are trained in problem-solving skills using conceptual and procedural learning strategies.

Purpose of the study

The study was designed to find out if the study habit of students would improve when exposed to achievement improving learning strategies. Specifically, the study was to:

(i) find out if the study habit of students exposed to conceptual learning strategy would improve after the treatment;

(ii) examine if the study habit of students exposed to procedural learning strategy would improve after the treatment;

(iii) compare the relative improvement in study habit of students after exposure to conceptual and procedural learning strategies.

Research Hypotheses

1. There is no significant difference in the study habit of students taught problem-solving skills using conceptual- learning strategy.
2. There is no significant difference in the study habit of students taught problem-solving skills using procedural- learning strategy.
3. There is no significant difference in the study habit of students taught problem-solving skills using conceptual learning strategy and those taught using procedural learning strategy.

Procedure

The study adopted a modified non-equivalent pre-test post-test control group design where three intact classes were purposively drawn from a population of Senior Secondary Class Two (SSII) in Osun State of Nigeria. The modification was the selection of science students into both the experimental and control groups. This was done based on the assumption that science students have similar characteristics in terms of attitude and readiness to the learning of mathematics. Therefore science class selection provided for uniformity of the three groups selected. The three groups, respectively, were taught same aspects of simultaneous equations using Conceptual Learning Strategy, Procedural Learning Strategy and the Conventional Method. The three intact classes were drawn from three schools randomly selected from three local government areas selected in Osun State of Nigeria. Altogether, 124 students were involved in the study comprising 42 in group 1 (Experimental Group 1) 44 in group 2 (Experimental Group2) 38 in group 3 (Control Group). The instruments used for the study included three instructional packages designed and validated for the teaching of Conceptual learning Strategy group(CLS), Procedural Learning Strategy group(PLS) and the Conventional Method group(CM). Also designed and validated for the study is another instrument for the study habit assessment tagged Students' Study Habit in Mathematics Questionnaire (SSHMQ). There were twenty items in this instrument consisting of both positive and negative items. The instrument is a five-point Likert scale with response options of Undecided (0), Never (1point for positive (+ve), 4 points for negative (-ve) items) Sometimes (2points for +ve, 3points for –ve items), Often (3points for +ve, 2 points for –ve items) and Always (4points for +ve, 1point for –ve items). The instrument was adopted from the study of Adeyemo (1986) of "Relationship Between Students' Study Habits and Academic Achievement in Nigeria". The scale has reliability coefficient of 0.84 and well established face and content validities.

With the instructional packages, students in the three groups were taught the selected content areas for eight weeks, employing the services of three trained research assistants who are university graduate mathematics teachers. Pre-test and posttest were carried out using the questionnaire. Separate posttest teaching discussions were held with the three research assistants.

Results and Discussion

The pretest scores of the students in the SSHMQ were compared in the three groups using one way Analysis of Variance. Summary of the result of the analysis is as presented in Table 1.

Table 1 **Summary of the Difference in the Pretest Study Habit Scores of Students in the two Experimental Groups and one Control Group.**

Source	Sum of Squares	df	Mean	F.	Sig.
Between group	7.776	2	3.888	0.155	0.856
Within group	3031.668	121	25.055		
Total	3039.444	123			

$p > 0.05$

Result shown in Table1 indicated a non-significant difference in the study habit of students in the three groups of learning strategies to which students were assigned. This provided the basis to assume that differences observed in student's study habit after exposure to the learning strategies could be due to the learning strategies.

Hypothesis 1: There is no significant improvement in the study habit of students taught problem-solving skills using conceptual learning strategy (CLS).

This hypothesis was generated to examine the effectiveness of conceptual learning strategy in improving students' study habit. Pretest and post-test scores in study habit of students exposed to conceptual learning strategy were compared using t-test. Result of the analysis is as presented in Table2.

Table 2 **t-test Summary of the Difference in Pre- and Post- tests Study Habit Scores of Students exposed to Conceptual Learning Strategy**

Group	N	Mean ($\overline{X}$)	SD	df	t	Sig.
Pretest Scores	42	24.45	5.38	82	15.70	0.00
Posttest Scores	42	46.19	7.18			

$p<0.05$

Table2 presented figures showing a significant difference in the study habit scores of students before and after they were exposed to problem-solving training using conceptual learning strategy ($\overline{X}_1 = 24.45$, $\overline{X}_2 = 46.19$, df = 82, t = 15.70, $p < 0.05$). This result has shown that student's study habit could be improved if he/she is exposed to innovative learning strategy such as conceptual learning strategy.

Hypothesis 2 There is no significant improvement in the study habit of students taught problem-solving skills using procedural learning strategy (PLS).

This hypothesis was generated to examine whether or not there will be a significant difference in the study habit of students as a result of exposure to procedural learning strategy. Students' study habit scores before and after exposure to procedural learning strategy were compared using t-test analysis. Result of the analysis is as presented in Table3.

Table 3 **t-test analysis of difference in pre- and post test study habit scores of students exposed to procedural learning strategy**

Group	N	Mean ($\bar{X}$)	SD	df	t	Sig.
Pretest Scores	44	24.00	4.79	86	1.94	0.56
Posttest Scores	44	26.09	5.33			

$p>0.05$

Result in Table 3 presented a non-significant difference in pre- and post tests study habit scores of students taught with procedural learning strategy ($\bar{X}_1$ = 24.00, $\bar{X}_2$ =26.09, df = 86, t = 1.94, p >0.05). This result indicates a non-significant improvement in study habit scores of students after they were exposed to procedural learning strategy.

Hypothesis 3 There is no significant difference in the study habit scores of students taught problem-solving skills using conceptual learning strategy and those of the students taught using procedural learning strategy.

This hypothesis tested the difference in the extent of improvement in study habit of students when they are taught using conceptual and procedural learning strategies. The hypothesis was tested by comparing the gain scores in study habit of students in conceptual learning strategy (CLS) group with the gain scores of students in procedural learning strategy (PLS) group using t-test analysis. Result of the analysis is summarized in Table 4.

Table 4 **t-test summary of difference in the study habit gain scores of students in conceptual learning group and those in the procedural learning group**

Group	N	Mean ($\bar{X}$)	SD	df	t	Sig.
Gain Score in Conceptual Group	42	21.74	8.50	84	11.31	0.00
Gain Score in Procedural Group	42	2.39	7.30			

$p<0.05$

Result in Table 4 indicated a significant difference in the gain scores recorded by students in the conceptual learning group when compared with those recorded by the students in procedural learning group ($\bar{X}_1$ = 21.74, $\bar{X}_2$ = 2.39, df = 84, t = 11.31, p<0.05). This result showed that study habit of students was significantly improved with the use of conceptual learning strategy (CLS) of teaching problem solving-skills whereas improvement of study habit with the use of procedural learning strategy (PLS) is not significant.

Discussion and conclusion

The findings of this study have shown that students' study habit could be improved when students are exposed to well-designed instructional strategies. Conceptual learning strategy was found to improve students' study habit when used to teach problem-solving skills and the improvement recorded was significantly better than that recorded with the use of procedural learning strategy. The features of conceptual learning strategy involves that a student who learns with it should be able to recognize, identify, explain, evaluate, judge, create, invent, compare and choose appropriate steps in solving mathematical problems, seriousness, concentration and commitment are required on the part of the learner so much so that while studying such dedication is expected of every student being taught using such strategy. The ultimate end of procedural learning strategy on the other hand is making certain specific procedures required in working out a mathematical task a routine and to be executed with fluency. This type of learning therefore may only require students to memorize and as such not more challenge is posed to the learner even when studying. Study-habit is usually considered as something that is needed to be acquired as a result of necessity on the part of every mathematics student in order to succeed.

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Reaching a National Consensus on the Duration of High School Education in Ghana: A Case for 3-Year Senior High Education

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[A paper presented at the '*National Forum on Duration of Senior High School'*, organized by Ministry of Education, on the 28th May 2009, at the Auditorium of the College of Physicians and Surgeons in Accra]

Abstract

The Senior High School (SHS) is one of the levels of education within the structure of pre-tertiary education in Ghana. The duration of the SHS cannot, therefore, be determined without due consideration to the entire structure, the inputs and outputs of the other levels, namely KG, Primary and the Junior High School (JHS). Drawing from this fact, this paper has emphasized that JHS is the first stage of secondary education and therefore be managed as a level within the secondary education sub sector. This paper is an attempt to provide a better understanding of the reasons, particularly those regarding the quality of teaching and learning at the basic level, that accounts for the poor educational outcomes at the basic and senior secondary level which many advocates of the 4-year senior high school programme use as the basis of their argument. The paper argues that the low performance in the senior secondary schools technically starts from the primary school through junior secondary school to senior secondary school. The problem arises from a complex of internal and external factors which could be solved within the right environment (curriculum, teacher and infrastructure) as exhibited in some schools in this country. The paper concluded by indicating that if indeed the recommendations, especially those on subjects/content to be offered at the lower and upper primary, JHS, allocation of periods, other instructional quality procedures, are addressed, there will be no need to extend the duration of pre-tertiary education in Ghana by one year; and if even there should be any extension, it should be at either the primary or the JHS level.

Introduction

The Senior High School (SHS) is one of the levels of education within the structure of pre-tertiary education in Ghana. The duration of the SHS cannot, therefore, be determined without due consideration to the entire structure, the inputs and outputs of the other levels, namely KG, Primary and the Junior High School (JHS).

According to the Government White Paper, several defects formed the basis for the previous government's education reform which introduced a 4-year Senior High School system to replace the previous SSS system (MOESS, 2004). In presenting this paper, all the 'the thirteen

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defects' in the secondary education system enumerated in the Government White Paper are acknowledged. It is important at the onset to make these two observations on the defects.

Firstly, it is crucial to point out that the defects which were largely curriculum oriented (or related), were not overlooked by President's Committee on Review of Education Reforms (PCRER) (see the Anamuah-Mensah Committee report). Prior to the submission of its recommendations, the Committee carefully and strategically considered all the defects before proposing the 2-6-3-3 structure of pre-university education (Anamuah-Mensah, et. al., 2002). Secondly, if the Ghana Education Service has not been able to correct these manifest defects for nearly two decades, the solution is not increasing the duration at the SHS level. The solutions for overcoming these defects had been clearly outlined in the Anamuah-Mensah Committee report.

The defects cut across the entire pre-tertiary structure. They must be mitigated by making conscious effort to visualize the complexities of the challenges outlined. The Anamuah-Mensah Committee recommended that the 3-year duration for the senior secondary school should be maintained. The Committee gave specific reasons for their decision on the issue based on our philosophy of education and the complexities of the challenges. For ease of reference they are:

i. The poor quality of education at the basic level has had a direct bearing on quality at the senior secondary school level. If the quality at the basic level is improved as proposed by the Committee (mainstreaming 2-year kindergarten as an integral part of basic education coupled with other recommendations to improve basic education), it will have a positive effect on quality at the senior secondary school level without changing the duration;
ii. Results from some senior secondary schools demonstrate that it is possible to achieve high standards within the 3-year period, given adequate resources;
iii. The internationalization of the SSSCE, which will be known as WASSCE compels Ghana to conform to the 3-year duration as done by other member countries of the West African Examination Council (WAEC);
iv. The deHeer-Amissah Review Committee recommended a reduction in the content of SSS curriculum, which was considered at the time to be overloaded for a three-year programme. That recommendation has been implemented and since then there has been improvement in performance;
v. There is a problem of selection of programmes. This can be addressed by strengthening guidance and counseling services at the junior secondary (Anamuah-Mensah, et. al., 2002).

One can discern from these reasons that the problem with secondary school education in Ghana is certainly NOT a duration issue. It a management issue as well as that of operation procedures needed to optimize teacher deployment and utilization and community participation to accommodate the expanding system and maintain the 3-year duration.

To provide a better understanding of the reasons, particularly those regarding the quality of education at the basic level and educational outcomes at the basic and secondary levels, the paper will provide a brief historical perspective on the structure of education and submissions from CHASS, but focus on

- Inefficiencies in the basic school curriculum;
- Opportunity to Learn (OTL) in basic schools;
- Educational outcomes at the basic level; and
- Educational outcomes at the SHS level.

Historical Perspective

A quick review of the prior/independence transition from the elementary school through the secondary school to the tertiary sub sector may clarify the position of this paper.

Though the structure was 6-year 'Primary', 4-year 'Middle Form', 5-year 'Secondary' and 2-year 'Sixth Form', the transition commenced at standard 2 or Middle Form 2. Learners had 'second' and 'third' and at times 'fourth' chances for entry into secondary schools. Pre-tertiary education especially for those who were admitted in our tertiary institutions was up to 17year and not necessarily 17 years as some of us seem to portray. The transition even in latter days commenced from Primary 6. This category of learners who were later admitted in our tertiary institutions had a 13-year pre-tertiary education and at least 3-year tertiary education. These categories of children are still being born and the minimum duration of 3 years at the SHS would be a fair opportunity for them.

It must be emphasized that the JHS from its introduction into our structure of education was supposed to be a 3-year 'lower' HIGH school' with aim of building on the 'achievements' of the primary sub sector and providing the foundation for teaching and learning activities organized for a 3-year'upper HIGH school. The JHS should therefore be managed as a level within the secondary education sub sector. In this context, the duration of Secondary education in Ghana prior to the New Reform was six (6) years. It is therefore imperative that in considering the duration for our secondary education (or the High School System) we should take cognizance of the 'precious' three years that our children are supposed to be upgraded by those entrusted with their education. These years of secondary education as well as those spent at the kindergarten and primary levels must not be allowed to be a waste.

CHASS Submissions

A more forceful argument for increasing the duration of SSS to four years was put up by the Conference of Heads of Assisted Secondary Schools (CHASS) earlier on during the National Education Forum in 1999. Firstly, the heads argued that the inadequate infrastructure of many rural schools particularly, the 200 schools established after 1987 (and more of such have opened) made it difficult for such schools to attract quality teachers. This placed them at a tremendous disadvantage against the old and better endowed schools. Currently, many of them are still under enrolled and can hardly attract both students and quality teachers.

This is an infrastructure problem which is not peculiar to SSS. It equally affects the very foundation of the pre-tertiary education system in particular and the whole education system in general.

Secondly, CHASS argued that the extension would:

- Allow students time to assimilate and apply what had been learnt and the teacher time to evaluate and reinforce his teaching and comfortably cover the syllabus.
- Remove the stress on the timetable and allow the students more time for private studies, reading and co-curricular activities
- Make the secondary programme less examination centred and minimize the present craze for extra classes and private tuition.

These time-bound reasons are real. However if each stage of the system is performing efficiently and effectively as intended, for example, adequately preparing the JSS Leavers in what is needed to commence an SSS programme in a conducive environment, the stage would be set not only for a smooth take off but also comfortably covering the intended curriculum.

The inadequate time being argued for, from experience, is worse in the basic schools. This is due to waste in contact hours resulting from absenteeism of both teachers and pupils, late commencement of classes after break followed by prompt closure school per day. Other causes include the shift system (a third world solution to enrolment crises) in the municipal and metropolis; long rehearsals with schools for state ceremonies, etc. indeed, a study of time-on-task in most of our SSS also confirmed such wastage of contact hours and lack of effective supervision for quality teaching and learning

The plans for the advocates of the 4-year SSS as early as 1992 (and currently) was that the first year would be used for remedial instruction in English Language, Mathematics and Science and also go through programme selection. If indeed we need one more year to enable us improve students' knowledge in the said subjects, it means the foundation is weak. What went wrong and what should we do since our SSS can never absorbed all the JHS graduates in order to enable them to benefit from the important subjects needed for life long learning, whatever one's chosen pathway. Adding one year to the SSS programme and subsequently running a 4-year first stage University programme is unfortunate. It is also a waste of time for those (through no fault of theirs) who intend to choose other pathways within the entire structure as well as those terminating,

Inefficiencies in the basic school curriculum

The structure of education can, on the one hand, be considered as the way in which the educational system is to be organised. On the other hand, it can be regarded as the supporting framework of the educational system or the essential parts of the system which include the *curriculum, teachers* and *infrastructure*. The *curriculum* is the major supporting framework of any educational system and all other essential parts and how these are to be organised depend on the curriculum.

In the last decade, the basic school curriculum had seen two major revisions in 2001 and 2007. The first was in response to the Free Compulsory Universal Basic Education (FCUBE) initiative pursued by the Ministry of Education which sought to sustain in all primary schools pupils educational qualities that will ensure their full participation in the society (MOE, 1996). The second was in view the new educational reforms in 2007.

In the last three years attempts have been made by the MOESS to encourage the development and purchase of textbooks that match the revised syllabuses. Several textbooks are now available for teaching at the primary and junior high school levels though not adequate (Mereku et. al., 2007). Little improvements had occurred because the very characteristics of the curriculum make learners recipients of information. The common teaching approaches used had been demonstrations and lecturing. Most teachers have been just purveyors of information without facilitating of learning.

Analyses of the intended curriculum in Ghana have revealed that the curriculum has the following characteristics:

- A lot of emphasis is placed on learners knowing basic facts, principles, skills and procedures, and providing explanations about these. Little emphasis is placed on making connections between these so as to develop the reasoning abilities of the learners in order to extend the knowledge developed to its applications in real life.
- Far more emphasis placed on knowledge and understanding than the curriculum developers have intended. Anamuah-Mensah and Mereku (2005) observed that over 70% of the items in the BECE elicited responses in the lowest cognitive domain (i.e. 'knowledge of facts and procedures or knowing'); included only few (12%) items that required the students to solve routine problems; and none that required some higher level of reasoning form the students. Curriculum analysis in high achieving countries with similar structure and duration indicates that the intended curriculum gave equal emphasis to activities in all the cognitive domains
- There is no differentiation of the curriculum for students with different levels of ability
- Overloaded nature of the curriculum of the various subjects. Parents and other stakeholders often believe that learning occurs when teachers teach. They, however, underestimate how much learning occurs through the child's independent activity and experience. The school is therefore regarded as the sole educational agency in society and this perception had led to a situation where curriculum guides for schools include a long list of objectives for basic schooling. The number of topics in a broad sample of low achieving countries including Ghana was substantially larger than for textbooks in most other countries.

Studies on the implemented curriculum or the classroom context in Ghana revealed the following:

- Owing to the overloaded nature of syllabuses, there seem to be rapid movement from one topic to the other suggesting that teaching of the subjects is rather superficial, with students often failing to acquire deeper understanding of any particular topic. Teaching is largely by exposition with little opportunities for learners to engage in practical and problem solving activities.
- Most lesson plans are based on teachers' activities and not what learners will be doing during the lesson
- Teachers spend more of their assigned time in direct instruction and less in settings that allow for professional development and collaboration. To this effect no teacher is officially responsible for pupils/students moving from one stage to the next higher stage nor to account to the time for handling the pupils/students within a given year. Forecast, lesson plans and terminal reports are not enough to help the teacher in the next grade to effectively mange his or new students

- Teachers in the JHS are largely taught by teachers with low qualification than the curriculum developers have intended and most of them are '*have tos'*.

There is the need to make the school curriculum more pragmatic as extensively recommended by the President's Committee on Review of Education Reforms (PCRER). One in which the teacher can assume the role of a facilitator and teach largely through problem solving and participatory activities. Of course the teacher needs to be sufficiently motivated to focus on all factors that influence school effectiveness within a given time/duration

Teacher commitment, quality and preparation coupled with students' preparedness to learn are major underlying factors to the coverage of curriculum and to instructional quality within a given period. Within the supporting framework, however, four issues are seen as particular threats to sustained improvement in educational quality at the pre-tertiary level:

- *Slow response to the rapid growth of school enrolment and its associated large classes* which do not promote instructional quality. In a class of mixed ability, good students are not challenged to progress and slow learners are often handicapped. When management capacity does not keep up with system growth (workable pupil-teacher-ratio) and operational procedures does not change to accommodate the expanding system, time is sacrificed and quality of education drops sharply.
- High teacher and students' *absenteeism and lateness* to school and to classes. This negative attitude of both teacher and pupils across the sub-sector cut to the heart of student learning *by denying students the approved instructional time***.**
- *High teacher turnover***.** The loss of experience teachers is seen as a threat to what students learn, instructional quality and waste of resources, as replacement teachers have to recruited and trained.
- *Teachers' inability to adhere to profile dimensions and their associated weightings* included in the various syllabuses to guide lesson planning, preparation and instruction. This threat has led to emphasis on lower cognitive dimensions of knowledge and understanding and the sacrifice of application, analysis and synthesis. The result is rote learning geared largely to the memorization of facts, simply for the purpose of passing examinations. This state of affairs is perpetuated by the types of items used to build examination papers.

Opportunity to Learn (OTL) in basic schools

Opportunity to learn (OTL) refers to equitable conditions or circumstances within the school or classroom that promotes learning for all students. It includes provision of curricula, teaching/learning material, facilities, teachers, and instructional experiences that enable students to achieve high standards. The term also refers to absence of barriers that prevent learning. Delivery of educational opportunities (defined by the national curriculum and high expectations of student outcomes) includes a number of inputs and processes. *OTL Standards* are in fact indicators that will assure a fair and appropriate provision of these inputs and processes.

The Ghana Basic Education Comprehensive Assessment System (BECAS), the new assessment system which replaced national tests that were used to monitor primary school pupils' achievement and progress in English and Mathematics, was begun 2005. To ensure the new system assesses closely what teachers actually teach, the BECAS team carried out a survey of the contexts of learning in primary schools to inform the development of a new comprehensive assessment system (Mereku, et. al, 2005). The study examined whether or not the opportunities provided in primary schools for learning are good enough to promote learning for all of pupils and assure high levels of outcomes for all pupils. The study which involved 1,063 teachers sampled from the ten regions of the country was carried out in schools in July 2004. A questionnaire was used to gather data from schools.

Managing instructional time

On the issue of managing the instructional time for teaching English and mathematics, 89.7% of the teachers indicated they started classes on time. Some of the reasons given by the 10.1% that did not start classes on time are:

- pupils stay far away from school and are always late
- administration work (head teacher) and also stays far from school
- due to the shift system because transition from morning to afternoon becomes difficult
- I travel a long way to school and transport is difficult to get in this area
- most pupils come from villages and on market days some pupils send food stuffs to the market before coming to school
- pupils come from surrounding villages hence come late
- pupils come to school late during the afternoon section
- some children come from far village
- some of the children come to school late
- teachers stays far away from town school is situated
- tidying up of the compound eats into the time for the first lesson
- transportation problems

On the question of following the timetable while teaching, 53% of the teachers indicated they did. Some of the reasons given by the 47% that did follow the timetable are

- Ability of the pupils and the pace at which they work
- Activities like sports, culture grounds work disrupt the time table
- As a non detached head teacher I combine classroom work with administrative
- Children are slow learners and slow in writing
- Class size too large
- Class size and many subjects
- Co-curriculum activities
- Co-curriculum, no textbooks in some subject especially English
- Difficult to plan/teach all the subjects
- Duration of lesson period inadequate, pupils write slowly
- Ghanaian language for instance cannot be taught because I'm not good at that (i.e. Fante)
- Inadequate materials, irregular attendance by pupils
- Late arrival of pupils in afternoon shift
- Noisy environment

Coverage of the national curriculum content

As a result of the teachers' low teaching qualifications, the inadequate supply and/or unavailability of teaching learning resources and poor management of instruction time, a substantial proportion of the primary school mathematics and English curricula go untaught

The study revealed that:

- About 30% of the teachers indicated that they were able to cover only half of the English syllabus.
- Only about 20% completed the content of the English syllabus,
- 31% of the teachers indicated they were able to cover only half of the mathematics syllabus content and 21% indicated they were able to cover all the content.
- In the two content areas, only about 50% of the teachers indicated they were able to cover up to 70% the syllabi.

OTL standards for schools

The study did not only show that OTL standards for most schools were very low, but also showed that there are grave inequalities between schools as well as districts in following:

- availability and adequacy of textbooks,
- availability and adequacy of instructional materials,
- teachers' instructional practices and management of instructional time, and
- teachers' preparedness to implement the content standards.

Though curriculum content standards are clearly defined by the syllabuses of the various subjects taught at the basic level, the study has exposed that no OTL standards have been set to guide the implementation of these content standards. The CRDD should be made to set OTL standards that will assure a high level of achievement for all pupils.

The government has to take another look at the education budget in order to be able to supply schools with not only textbooks but also the relevant educational input/resources needed to assure a high level of achievement for all pupils.

Educational outcomes at the Basic level

In view of these inefficiencies in the basic school curriculum, Ghanaian students who participated in the 2003 Trends in International Mathematics and Science Study (TIMSS) performed poorly; i.e. Ghana was second from the bottom out of the 45 participating countries (Anamuah-Mensah, Mereku and Asabere-Ameyaw, 2004). In 2007, the Ghana's JHS2 students' performance in mathematics and science, though improved significantly, remains among the lowest in Africa and the world. In the two subjects, mathematics and science, Ghana's scores of 309 and 303 respectively, were among the lowest, and were statistically significantly lower than the TIMSS scale score average of 500 (Anamuah-Mensah, Mereku and Ghartey-Ampiah, 2008).

At the primary level, recent evidence provide in NEA Reports is that literacy and numeracy have generally not improved. In 2005, the NEA administered to about 3% of P3 and of P6 pupils nationwide, indicated that only 16.3% of the P3 pupils reached proficiency level of 55% in English and 18.6% in Mathematics. Again, only 23.6% of the P6 pupils reached the proficiency level in English and 9.8% in Mathematics (Adu, Acquaye, Buckle & Quansah, 2005). In 2007, the NEA results indicated that the performance of pupils was weak in both English and Mathematics in the two class levels. The mean scores in English for P3 and P6 respectively were 37.6% and 44.2%. The mean scores in Mathematics for P3 and P6 respectively were 35.0% and 35.7%. Comparing achievements of P3 pupils in 2007 to those of 2005, the mean scores, minimum-competency and proficiency were lower in 2007 than in 2005 for both English and Mathematics. These results indicate that most pupils by P6 are neither literate nor numerate (Adu, Acquaye, Buckle & Quansah, 2007).

Educational outcomes at the SHS level

The analysis of the SSSCE/WASSSCE results confirms reason (iv) of the **PCRER (**West African Examinations Council, 2009)**.** In the last decade (1999 -2008), there was a steady increase in students' performance in the senior secondary/high school certificate examinations. Figure 1 shows the overall national percentage of students qualifying with credits in 6 subjects at a sitting including the core subjects (English, Mathematics (Core) & Integrated Science).

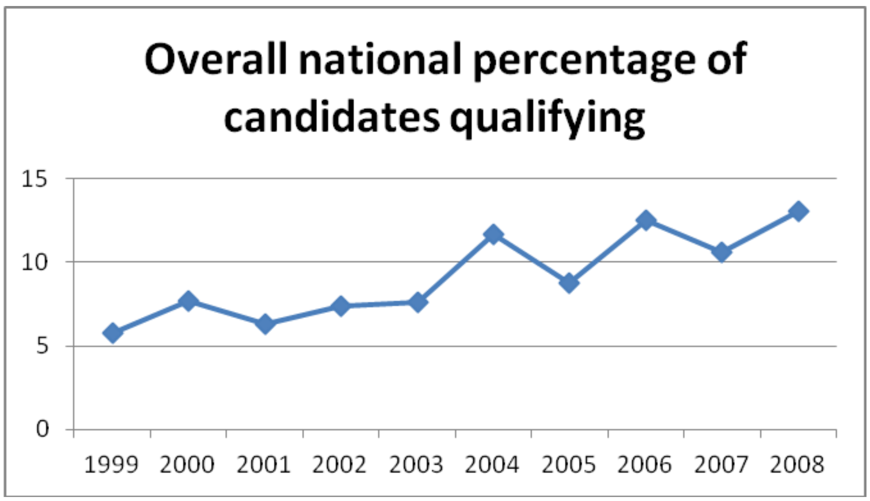

Figure 1 Overall national percentage candidates qualifying

That is, in the last ten years, the percentage of students qualifying rose from about 6% in 1999 to 13% of the candidates who took the SSSCE/WASSSCE. While the number of candidates who sat the examinations increased from 57,816 in 1999 to 131,268 in 2008 (i.e. increasing 2½ fold), the number of students qualifying rose from 3,352 in 1999 to 17,121 in 2008 (i.e. increasing 5 fold). The steady increases are indicators of positive gains which could be attributed to the good foundation and structures put in place in education by the government before 2000.

However, a review of students' performance by region and in terms of endowed/less endowed school reveals the influence of inequalities in the distribution of infrastructure, teacher deployment and utilization on instructional quality in the SHS which should demand our attention than extension of duration.

In the last ten years, there had been inequalities among the regions in the percentage of students qualifying in the SSSCE/WASSSCE. The average of the percentage of students qualifying in each region in the last decade is presented in Figure 2.

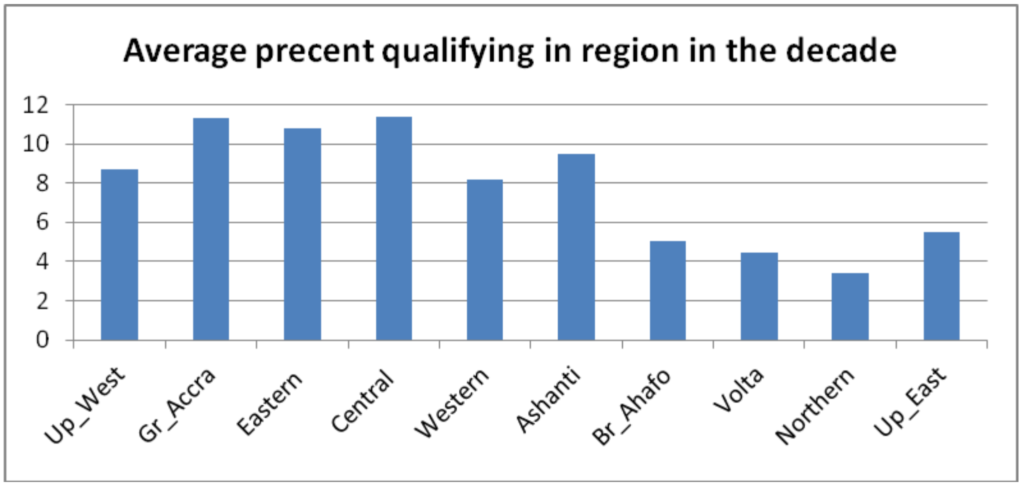

Figure 2 Average percentage of students qualifying in each region from 1999 to 2008

Figure 3 shows the percentage of students qualifying in each of the less endowed schools in the regions during the decade.. During the era of the SSSCE (i.e. before 2006), the performance of the three northern regions, BA and Volta was below the overall percentage of student who qualified nationally. But in the last three years since the introduction of the WASSSCE, the performance in these regions had improved. However, with the exception of Upper West, the other four regions are still trailing behind the national percentage of students who qualify.

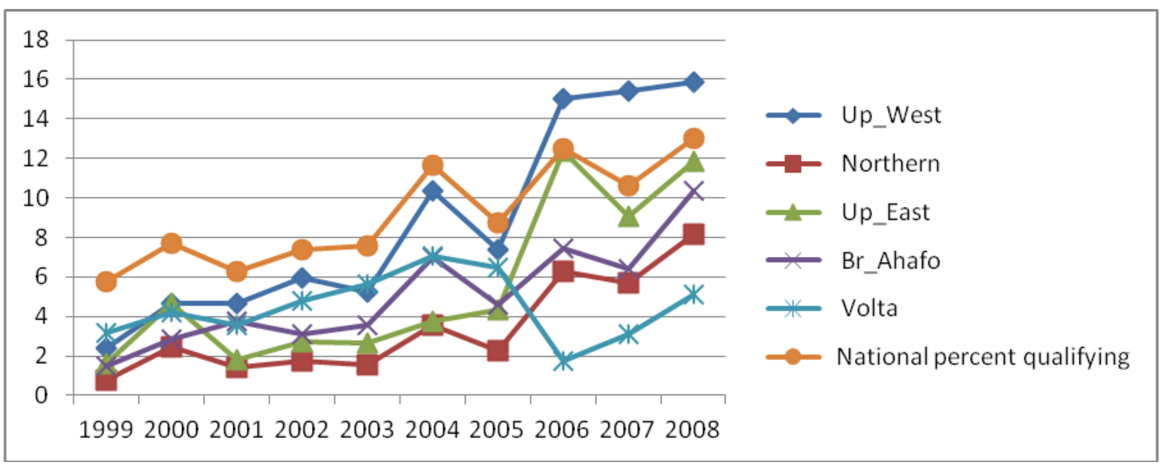

Figure 3 Percentage of students qualifying in each region in the decade

Figure 4 shows the percentage of students qualifying in each of the endowed schools in the regions during the decade. During the era of the SSSCE, the performance of the Western Region, though higher than four of those considered above, was trailing below the national percentage qualified. The performance of the four other regions – Ashanti, Eastern, Central, Greater Accra – was higher than the national percentage qualified. In the last three years since the introduction of the WASSSCE, the performance in these regions had improved; but Ashanti and Central had gone below the national percentage qualified.

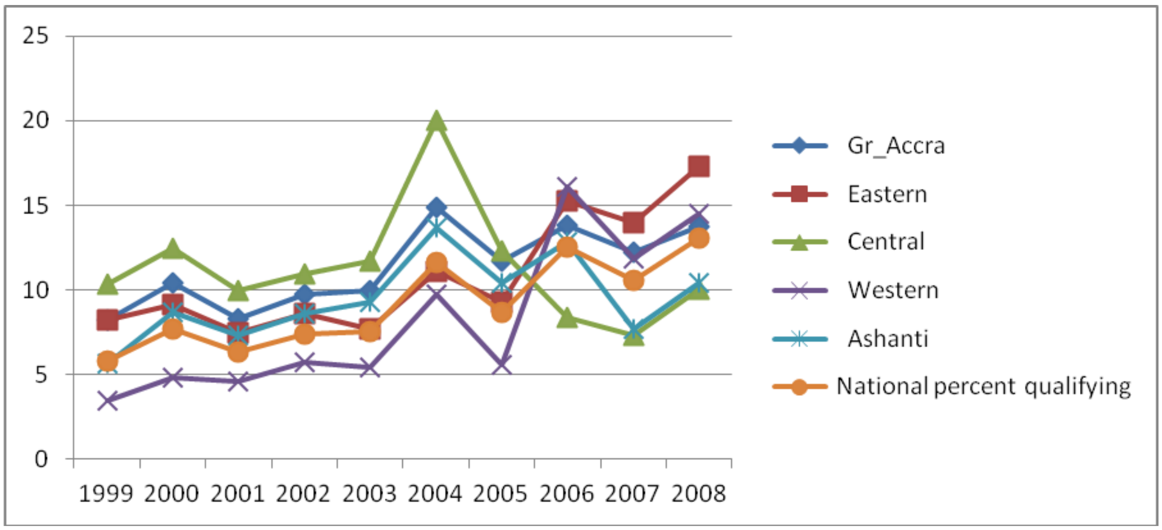

Figure 4 **Percentage of students qualifying in each of the endowed schools/ regions in the decade**

It is indicative that the proportion of students qualifying with credits in 6 subjects **at a sitting** including the core subjects (English, Core Mathematics & Integrated Science) is not the only indicator of quality secondary education. Because of the inequalities in the distribution of infrastructure across the country, differences will continue to exist in the performance of students across regions with less and less students qualifying from the poorer schools. The average percentage of students qualifying each year in the decade under review is presented in Figure 1 above. With the myriads of problems currently plaguing the educational system, extending the duration for one more year cannot significantly change the proportion of students qualifying.

Considering the different abilities and capabilities of students in general and the different pathways and opportunities available to our students after SHS, those who are not able to obtain 6 subjects **at a sitting** are not failures. Their precious time as well as those who can make it to the university should not be wasted by the extension.

Conclusions

All the per-tertiary level schools in Ghana run a national curriculum without any percentage flexibility. However, how teachers interpret the intended curriculum and implement the curriculum (i.e. deliver what they teach to students) is reflected in the learning outcomes demonstrated by the national and international examinations discussed above. The general public as well as interested stakeholders usually make comments about these results and the low performance in general with or without an in-depth analysis of the causes. The effects of such comments, decision and policy directive have led to the 4-year SHS.

The challenges confronting the Service as well as interested stakeholders need not discourage us but rather make us more determined to closely undertake policy analysis, make strategic choices and find appropriate solutions. It is in this context, I believe, that His Excellency, the former President adopted a strategic approach by constituting a 30-member committee to review education **reforms** in Ghana, with wide consultations, under the chairmanship of Prof. Jophus Anamuah-Mensah, the then Vice Chancellor of the University of Education, Winneba. Though most the defects enumerated in the White Paper were curriculum related and were not overlooked by the committee, the recommendations that were made for overcoming these defects are yet to be implemented.

The seemingly low performance in the senior secondary schools, as we have seen in the presentation above, technically starts from the primary school through to junior secondary school and then to senior secondary school. The problem arises from a complex of internal and external factors which could be solved within the right environment as exhibited in some schools in this country. I therefore strongly believe that increasing the duration of the SSS by one more year does not solve the problem. It rather ignores the antecedent causes of the problems and prolongs finding solutions to them. Again Prof. Anamuah-Mensah has also cautioned that whether it is 3-year or 4-year SSS, the issue of addressing the challenges at the basic level (KG, Primary and JSS) is key to the quality we are all yearning for at the SSS.

The above discussion has exposed a number of inefficiencies in the school curriculum, pedagogical and contextual factors especially at the primary and the JSS levels. These inefficiencies have fully been considered by the Anamuah-Mensah Committee report and given recommendations for a better education system. Indeed, when the curriculum is efficiently organized and the PCRER recommendations, especially those on subjects/content to be offered at the lower and upper primary, JHS, allocation of periods other instructional quality procedures, are adhered to, there will be no need to extend the duration of pre-tertiary education in Ghana by one year. It has been argued that the extension is to enable the majority of students to benefit by having more time to correct deficiencies from the basic level as well as cover the SHS curriculum. The benefit here goes to the minority of students continuing their education from the JHS level. This constitutes less than 40% of the students from the basic level. The outcomes illustrated by the WAEC results above suggest that only about 6% (i.e. 15% of this 40%) of basic school cohorts qualify each year with credits in 6 subjects at a sitting including the core subjects.

As has been pointed out by the advocates for 4-year SHS, the problem is related largely to inefficiencies in the curriculum from the basic level, and for that reason a year's increase in the duration at the SHS level can only marginally improve the poor educational outcomes we are currently recording at the WASSSCE. It stands to reason therefore that if there should be any extension, then it should be at either the primary or the JHS level.

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Use of technology for college mathematics instruction: African instructors' experiences

Assuah, C. [5]"

Abstract

Though studies by the National Council of Teachers of Mathematics (NCTM) had proven that use of technology makes mathematics instruction more effective and had strongly recommended its use in the curriculum, a few mathematics instructors still face problems incorporating technology in their teaching. This study examined the challenges or problems 5 African instructors encounter in the use of technology in teaching, at the college level in the U.S. Data were gathered from a series of interviews and instructors' responses to researcher-designed tasks focusing on technology in teaching. The result of this study suggests that African instructors were inhibited by a variety of factors in the use of technology, which included the inability of governments to provide the full complement of manipulatives. The results also suggest that instructors used technology from outdated sources.

Keywords mathematics instruction, technology in teaching

Introduction

The world has become so complex that traditional mathematics methods for solving problems have given way to new ones. Today, everyone needs to be abreast with technological advances in order to operate meaningfully in a competitive world (Handler, 1993**)**. The National Council of Teachers of Mathematics (NCTM) (2000) notes that, "teacher educators are challenged with the task of preparing teachers to utilize technology as an essential tool in developing a deep understanding of mathematics for themselves and for their students, and to emphasize the importance of learning with technology rather than learning about technology" (NCTM 2000, p. 170). According to NCTM (2000), features of technology, whether mathematics-specific or more generic, should be introduced and illustrated in the context of meaningful content-based activities. Teaching a set of technology or software-based skills, and finding mathematical topics for which they might be useful, is comparable to teaching a set of procedural mathematical skills and then giving a collection of word problems to solve using the procedures (NCTM, 2000). Further, the NCTM stresses that the use of technology in mathematics teaching is not for the purpose of teaching about technology, but for the purpose of enhancing mathematics teaching and learning with technology.

"Technology is essential in teaching and learning of mathematics; it influences the mathematics that is being taught in schools and enhances students' learning" (NCTM, 2000, p.11). Teachers who learn about technology while using it to explore mathematics topics are more likely to see its potential benefits. According to Butzin (2001), the focus should be on integrating technology into teaching and learning, and must not be predicated on learning

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about technology. To be competitive in the global job market, African mathematics instructors, even though not technologically savvy as their European and American counterparts, are challenged to integrate technology into mathematics instruction for preservice and in-service education programs (Ghimier, 2006). In this paper, I describe the challenges or problems African instructors encounter in the use of technology for mathematics instruction at the college level.

Literature Review

McKenna (2000) indicates that for technology to be effective in schools, the curriculum should not only integrate the use of technology, but must also provide teachers a mastery of the technological tools used for instruction. The use of graphic calculators in schools in the United States and United Kingdom have improved students' understanding of algebraic concepts, because teachers place more emphasis on graphs and their interpretations (Kissane, 2000). According to Kissane (2000), teachers previously placed little emphasis on graphs in school algebra for the reason that, students took so long to draw graphs and make meaningful interpretations. Emphasis on the use of graphic calculators in school algebra motivates students to seek efficient and insightful ways in looking at equations and problems, because both graphic and numerical representations come into play (Kissane, 2000).

Wiest (2001) asserts that computer programs may be used for problems with various mathematics concepts, including formulas, constructions, and proofs. The use of computers for accessing information and communicating with others mathematically is very important, especially if the focus is on higher order thinking with an emphasis on inquiry, reasoning, and engagement in worthwhile mathematical tasks (Wiest, 2001). Further, Wiest (2001) highlights some common uses of computers in mathematics education which include facilitating the attainment of core objectives in mathematics, and teaching students skills and concepts.

Technology keeps changing so dramatically that people who do not regularly update their knowledge and skills become outdated in its usage (Daggert & Pedinott, 2005). Daggert and Pedinott (2005) contend that many people initially welcome the introduction of technology and use of computers with skepticism, but soon realize that without them, life would be unproductive. If people become acquainted with the basics of computers and technology, they would possess the technological skills to easily transition to other advanced technologies (Daggert & Pedinott, 2005). Furthermore, students who have grown up in the age of information technology have a great advantage over older generations in terms of the learning curve (Daggert & Pedinott, 2005). For students to obtain a real-world rigorous and relevant education, they need to explore and master the concepts behind the up-and-coming technologies (Dagger & Pedinott, 2005).

The NCTM's (2002), *Principles and Standards for School Mathematics*, emphasize the use of technology as an essential tool for teaching and learning mathematics effectively. Technology extends the mathematics that is taught and enhances students' learning by using the constructivist approach (NCTM, 2002). Constructivism allows students to construct their own understanding of mathematical concepts, so that the primary role of teaching is not to lecture, explain, or to transfer mathematical knowledge, but to create situations for students to make the necessary mental constructions (Anderson, Reder, & Simon, 2000). Zhonghong (2002) used the constructivist approach of learning to demonstrate that preservice teachers' knowledge on geometry problems greatly improves if they learn with dynamic software such as the Geometer's sketchpad. The Sketchpad enables students to discover properties and relationships, make conjectures, and construct geometric objects with minimum difficulty, but with precision (Scher, 2002).

The rationale for using technology for instruction is that it enhances computational power, and also provides convenient, accurate, and dynamic drawing, graphing, and computational tools (NCTM, 2002). These devices enable students to extend the range and quality of their mathematical investigations and mathematical ideas in more realistic settings. The NCTM (2002) acknowledges the use of technology as essential tools within a balanced mathematics program. Consequently, teachers must be prepared to serve as knowledgeable decision-makers in determining when and how their students can effectively use these tools.

For technology to be effective in the classroom, Lynch (2006) contends that teachers must be conversant with the technology that is being used to enable them to transfer knowledge through the constructivist approach. As the world increasingly becomes sophisticated in technology applications, the use of technology related packages should not be left only to tertiary-school professionals (Kit-Tai, 1990), because researchers who report findings on the use of technology are now revealing meaningful technological values, and performing appropriate significant tests. As teaching methods become technologically advanced and complicated, more courses should be offered in the use and applications of technology in schools (Kit-Tai, 1990). The importance and uses of computers in schools cannot be underestimated, because it aids mathematics instruction (Dugdale, 2001). According to Dugdale (2001), computers offer new ways of teaching probability and data analysis in the classroom. Furthermore, when students obtain sufficient experience in gathering data with physical objects, they will be able to use computer simulation to streamline the process by quickly producing large runs of experimental trials (Dugdale, 2001).

In sum, an appropriate use of technology for mathematics instruction should not replace all mathematics methods and procedures, but should act as a critical tool to enhance students' understanding of mathematics concepts, and form the basis of higher order mathematics (NCTM, 2002). The goal of the study reported in this paper was to examine the challenges or problems African instructors encounter in their instruction at the college level, as they incorporate technology in their teaching. The study was guided by the following research questions: (a) What type of technology do African instructors incorporate in their mathematics instruction in Africa? (b) What type of technology do African instructors incorporate in their mathematics instruction in the United States? (c) Do African instructors' knowledge of technology make them comfortable incorporating it in their mathematics instruction? (d) How do African mathematics instructors react to the use of technology in the U.S.?

Method

Design and theoretical framework

The research design for this study is grounded in a phenomenological framework. The purpose of phenomenological research is to provide an actual and conscious overview of the phenomenon that evokes the reader's life experiences. It utilizes participants' lived experiences to make meaning out of an observed phenomenon through interpretation (van Manen, 1997). Thus, this study was to examine the challenges or difficulties that instructors from Africa go through in their instruction of mathematics in the U.S. In this design, the researcher first identified the phenomenon to explore, and considered factors such as: (1) the necessary constituents of these experiences, and (2) the existence of these experiences concerning the nature of the human being, before arriving at the research questions (van Manen, 1997)

Researcher background

I started incorporating technology in my teaching in 1995, while a high school mathematics teacher in Ghana. At that time, the government of Ghana had begun an initiative in schools to motivate science and mathematics teachers to get involved in Information Communication Technology (ICT) which was gradually gaining momentum. When I arrived in the United States in 2003, I incorporated technology in my teaching, while a master's student, and as a doctoral student. As part of my duties, I ensure computers are functioning properly before professors give their instruction. My knowledge and experience in the use of technology has increased as a result of these activities.

Participants

Five instructors namely: Anthony, Marian, Zach, Ebenezer, and Esther participated in the study. All of them have studied both in African universities and American universities.

Anthony, originally from Senegal and thirty years old, has lived in the U.S. for the past ten years. He has a master's degree in statistics and has been teaching an introductory statistics course for the past five years. Marian, a woman in her late thirties, is from Botswana. She has a doctorate degree in mathematics, and has been teaching graduate and undergraduate mathematics courses for the past nine years. Zach, a Zimbabwean and thirty-five years old, has a doctorate degree in statistics. He has been teaching graduate level statistics courses for the past five years. And finally, Esther from Ghana is getting her master's degree in statistics. She teaches an introductory statistics course. She is twenty-nine years old.

Data Collection

The initial source of data was a questionnaire consisting of open-ended questions, followed by an interview. The questionnaire focused on challenges and difficulties participants encounter in incorporating technology in their teaching. It also sought for the different technologies used in both Africa and the United States. The second stage of data collection was shaped by an initial analysis of data from the first stage and, as a result, the second stage included interview questions consisting of challenges and difficulties they encounter in incorporating technology in their teaching. The interview was purposely done to clarify the inconsistencies from the responses in the questionnaire.

Each participant was interviewed for 20 minutes. Typical questions included: What does incorporating technology in teaching mean to you? How different is the use of technology in teaching in Africa from that of United States? While in Africa, did you incorporate technology in your teaching?

Limitations

First, the sample size was not diverse because participants were selected from the same locality. To help improve on the validity of the results, a diverse sample from several universities would have been more representative.

Second, further questions on the qualitative data might have influenced participants' long-term thinking over multiple months or years. Some relevant literature suggests that many of the insights that come from qualitative processing may not show up until long after the study ends (Greenberg, Rice, & Elliot, 1993). Thus, it is possible that participants may have experienced more meaningful effects of the qualitative-based processing some months later after the procedure ended, than on the day the data was actually collected.

Data analysis

The data analysis was grounded in an analytical-inductive method in which instructors' responses were coded and then classified according to relevant themes. Coding of the data began with already generated codes such as: (1) reaction of instructors to the use technology, and (2) impact of the use of technology on teaching instruction, which were derived from the theoretical framework of the study. The inductive approach in coding was utilized in a case-by-case basis to identify themes in the data. By this approach, each participant's responses were compared and analyzed for similar themes with the other participants. The frequencies of similar responses among the participants were categorized into relevant themes. Because, the data were two-fold, individual instructors' responses in the open-ended questions were compared with the interview questions for consistencies and inconsistencies. On completion of the coding, a domain analysis of the data sets was conducted as a means of identifying, organizing, and understanding the relationships among the primary themes that were found through the coding process (Spradley, 1979)

Results

This section presents the results of the study and is organized by four guiding research questions. Although data were collected from each individual instructor, in reporting the results, themes related to instructors' challenges or problems they encounter in the use of technology are reported for the group rather than for individual instructors. The presentation includes representative excerpts from the interviews (followed by names, which are pseudonyms).

What type of technology did African mathematics instructors incorporate in their instruction while in Africa?

The instructors commented that technology was hardly used in their instruction in Africa, because they graduated at a time when owning a personal computer was only a luxury. Typewriters were even uncommon in many schools, and if the schools did have them, the school curricular did not enforce their use. The responses of the instructors are categorized under the following themes: technology from improvised manipulatives; technology from outdated sources; and technology from natural events or occurrences.

Technology from improvised manipulatives

The instructors used improvised manipulatives, which often are obtained from trees, or carved, out of clay. The idea behind it is good, since it encourages innovations and creativity among students. A major drawback is that students spent a lot of time getting these manipulatives for their classes, and as result, lost of learning time which is crucial in the curriculum. The following instructors' responses are representative:

> "The training colleges emphasized the use of manipulatives in schools, but not all schools had the full complement of manipulatives to effectively accomplish the requirements in the curriculum. To assist the students, I needed to improvise from local sources" (Anthony).
>
> "The supervisors of schools expected instructors to meet certain standards in their monthly evaluations for promotions. In order to progress through my career, I had to create my own manipulatives to enhance my teaching" (Marian).
>
> "Choosing the right materials as manipulatives consumed a major part of my course planning. But, since I had no alternative, I had to do so" (Zach).

Most African governments wanted quality education for their students, but could not provide the necessary inputs to support that agenda. Many instructors thought it was the governments' attempts to find scapegoats for the mismanagement of schools. The following comment from an instructor buttresses that point:

> "Yes, I agree we had to meet objectives. But, could that be done with these limited resources? The government only did that to stretch us thin. That was very unfortunate" (Ebenezer).

Technology from outdated sources

All the instructors agreed that the technology used at that time was either outdated, or inapplicable to the African context, because the technology that was used in schools was imported from overseas. Two instructors commented on this as follows:

> "Just importing technology from overseas without evaluating its long-term benefits to schools, really underscored the ignorance of educators at that time. The choices they made have adversely affected the progress of schools" (Esther)
>
> "I believe some countries had the resources to go for any modern technology. The problem is that the corrupt nature of some governments prevented them from doing so" (Anthony)

Technology from natural events or occurrences

Because resources were limited, many instructors used technology from naturally occurring phenomenon, such as patterns from flowers to teach tessellations. In teaching pattern formation for example, a teacher might use the rainbow as an illustration. An instructor had the following comment to make:

> "Because of lack of manipulatives in schools, I could only teach best with reference to naturally occurring phenomenon, which every student had experienced in life" (Marian)

What type of technology do African instructors incorporate in their mathematics instruction in the United States?

All the instructors agreed that to be able to teach effectively in U.S. schools, one needed a solid grounding in technology. They commented that although technology keeps on changing, one needs to be abreast with the changing trends to be competitive. With the proliferation of computer use on college campuses, instructors who are not computer savvy will become unpopular to many students. The responses of the instructors are categorized under the following themes: Web-based Course Tools (WebCt); Sketchpad; Fathom; and Graphing calculator.

Web-based Course Tools (WebCt)

All the instructors admitted to using WebCt as a means of organizing their classes, sending out information, putting up questions on the discussion board, and assessing the progress of students easily, through cumulative records. The following instructors' responses are representative:

> "I couldn't believe I completed that the other day. The use of WebCt has reduced the toil I would've gone through doing that manually. It's indeed a pain to forgo the use of technology" (Zach).
>
> "Keeping up records of all students is a thing of the past. I now know WebCt does it better" (Ebenezer).

Sketchpad

All the instructors acknowledged that sketchpad enables them to manipulate geometric images using the computer. They admitted that it enables students to explore and understand mathematics in great depth which could not be realized by using other tools. Two instructors have the following to say:

> "I didn't know that sketchpad covers a wide range of areas such as animation and transformations. My students can now learn mathematics by using the constructivist approach" (Esther).
>
> "I'm particularly interested in the sketchpad because inductive and deductive proofs in geometry are well explained" (Anthony).

Fathom

The instructors agreed that Fathom is a program that is used to learn statistics, but not "to do statistics." This is perfect for people who want to become teachers rather than becoming statisticians. The following are representative responses from two instructors:

> "I thought that the most effective statistical software for data analysis was SPSS, but I was wrong in my judgment. Fathom does it better" (Anthony).
>
> "In the classroom, I can use Fathom to present vital pedagogical skills that is in perfect correspondence with the data analysis and probability component of the NCTM's principles and standards" (Marian).

Graphing calculator

All the instructors agreed that graphic calculator is a powerful new technology for teaching mathematics, particularly at high school and college levels. An instructor had the following to say:

> "By using a graphic calculator, I make statistical reasoning accessible to all students. Students can then analyze data numerically and graphically" (Zach)

Do African instructors' knowledge of technology make them comfortable incorporating it in their mathematics instruction?

All the instructors admitted that their technological skills have improved considerably since arriving in the U.S. They praised the U.S. government for making technology, particularly computers accessible to all in the universities and colleges. The problems and comfort they encounter in using technology for instruction are detailed under the following themes: technology use by instructors who completed graduate programs in U.S. schools; and technology use by instructors who completed graduate programs outside U.S. schools.

Technology use by instructors who completed graduate programs in U.S. schools Instructors who completed their graduate programs in U.S. are comfortable incorporating technology in their teaching. The reason is that as part of the graduate training, students use technology to do presentations, as well teach with technology, especially if one is a graduate assistant. The following are the representative responses of the instructors:

> "I've learned to use technology because presentations requirement for all students, are embedded in the course syllabi of many professors. You surely can't run from it" (Ebenezer).

> "With computers everywhere, it would be very nonsensical for one to ignore the advantages of the computer by not exploring it for its numerous benefits" (Esther).

Technology use by instructors who completed graduate programs outside U.S. school

Instructors who completed their graduate programs from Europe and Canada have an advantage over their peers who completed their programs in Africa. Two instructors have the following to say:

> "Technology use is not a steep climb for me, precisely because; I used it often in my instruction in Europe. Though, there are differences in applications of technology between Europe and U.S., they all point towards a common goal" (Anthony)

> "In Canada, I used similar technology. Therefore, I'm not overwhelmed by its use in the U.S." (Marian)

How do African instructors react to the use of technology in the U.S.?

Several themes were evident in instructors' responses to both the interviews and questionnaire. The themes corresponded well to reactions by instructors as previously coded. Several new themes which were not previously coded, however, did emerge from the data, and were specifically related to the uses of technology as detailed under the following themes: technology as a means of aiding instruction; technology as a means of aiding instruction; technology as a means of enhancing students understanding; and technology as a means of organizing course contents.

Technology as a means of aiding instruction

All the instructors commented that a primary role of the use of technology in teaching was to aid instruction, although they expressed varied opinions on how and when it should be used. The following instructors' responses are representative:

> "I think when I use technology; students are more motivated and attentive. They often participate more actively with interactive technology. Some of the students want us to use it often, because

> it creates a lot fun. With graphing calculators, they see how technology can be beneficial in cutting out the busy work" (Zach).
>
> "When I use technology, students usually get excited depending on the ease of the program in use. They work comfortably with it, and easier to maneuver or navigate through it" (Ebenezer).

Generally, instructors acknowledged the fact that students become excited and motivated when instructors teach with technology. They however, pointed out that, sometimes students become tired of the same old format used for class instruction, and become very excited if teachers use new and innovative ways of giving instruction. They reiterated that students like exposure to technology, but gradually get bored with its usage if mode of instruction becomes repetitive. One instructor gave her perspective in the following manner:

> "I think in making technology useful to students, instructors should show creativity by using real world examples as illustrations, rather than, resorting to one or two antiquated programs which have outlived their usefulness" (Marian)

Another instructor commented as follows:

> "Students of today are very ambitious and willing to learn new things. Because we are in the technological age, where things change very fast, so is their thinking. They greatly eschew repetitive procedures which make them act as robots" (Zach)

Somewhat surprisingly, giving the usefulness of technology, two instructors commented that, it might be interesting to highlight a negative impact of the use of technology on students' learning. The following responses came from those instructors:

> "It is indeed an undeniable fact that technology has simplified our mode of instructions. But I think if instructors become too dependent on its usage, it will stifle students thinking capabilities, and this will prevent them from undertaking more productive and beneficial academic exercise. To put it bluntly, too much of everything is bad" (Ebenezer).
>
> "Yes, we have to use technology, but deciding when and how to do that brings into focus the intellectual judgment of the instructor" (Esther).

Technology as a means of enhancing students understanding

A primary concern for three of the instructors was whether the use of technology was effective and productive in students' learning. When they expressed these concerns, they are really probing to see if technology helps students to learn. They commented that because technology is only a tool, the kind of technology that is being used, under what context, and in what ways, help to promote students learning. The following instructors' responses are representative:

> " I agree that technology has the potential to improve teaching and learning, but it depends heavily on instructors' purpose in using the technology, under which contexts they use it, and in which ways it is used"(Anthony).
>
> "I feel technology use should not be construed as effective pedagogy. Effective pedagogy can utilize technology as a vehicle to achieve its intended purposes. In other words, technology use forms only a microcosm of the entire learning process" (Marian).

Two of the instructors reiterated that technology really aids students' learning as evident in the following responses:

> "Yes, I agree technology impacts students learning positively, because very complicated computations are reduced to simplified forms" (Zach).

> "It is engaging and it allows alternate means of instruction. Students tend to enjoy a mix of instructional media" (Ebenezer).

Technology as a means of organizing course contents

All the participants commented that a primary role of technology in teaching is it organizes their course contents in a systematic, logical, and coherent manner. They all stressed that the time to retrieve information has greatly been reduced. As a result, their course contents are very well managed. Below are representative responses from three of the instructors:

> "I now understand why people like technology. I used to carry a stack of papers with me when I gave instruction, but not any longer. My courses are well organized using WebCt (Esther).

> "I can't believe how easily I'm able to retrieve information on polyhedrons, just by the touch of a bottom. I no longer have to draw them on the board to explain the angles. Technology now allows me to rotate a polyhedron in three- dimensional space, for students to explore and make conjectures" (Anthony).

> "I'm no longer inundated with my course load. I can now cover a lot more content on courses per day, thanks to technology" (Marian).

Technology as means of understanding concepts

The participants in the study reiterated that using technology for instruction has demonstrated a significant positive effect on students' understanding of concepts. The following instructors' responses are representative:

> "In the event of teaching probability and statistics, I use graphical software such as fathom to display charts and figures. Students easily get acquainted with the rudimentary display techniques it offers, to deepen their conceptual understanding" (Zach).

> "I think concepts formation and understanding are like laying a foundation of a building. When students repetitively watch graphical representations of concepts over and over again, they are able to apply it to solve problems" Ebenezer).

> "I guess three-dimensional representations of solid figures are captured vividly with the use of dynamic technological software such as Geo-gebra. In addition, interactive video is especially effective when the skills and concepts learned have a visual component and when the software incorporates a research-based instructional design" (Esther).

All the instructors acknowledged that teaching students to understand concepts acts as a catalyst for understanding higher order concepts, which in most cases become complicated when explained in class without any visual representation. An instructor commented on this with the following response:

> "I agree that understanding concepts thoroughly builds students' thinking capabilities. But if we're not modeling from simple two- to three -dimensional solid figures, we tend to complicate matters" (Esther).

Discussion and implications

This paper reports results from a study that examined the challenges or problems African instructors encounter in the use of technology for mathematics instruction at the college level. This section discusses the results in relation to the views of the type of technology African instructors incorporated in their instruction in Africa, the type of technology African instructors incorporate in their mathematics instruction in the United States, whether African instructors' knowledge of technology makes them comfortable incorporating it in their mathematics instruction, and African instructors' reaction to the use of technology in the U.S., as well as the implications for teacher and mathematics education research.

The instructors described a variety of technology they incorporated in their instruction: from improvised manipulatives, to outdated sources, through natural events or occurrences. These types of technologies suggest that African instructors taught under very stressful conditions and with limited resources to achieve desirable results. Perhaps if the instructors were provided with the necessary tools to perform their duties, they would have achieved unprecedented results on students' achievements.

Interestingly, the governments wanted the instructors to achieve a high level of standards on evaluations, but did not provide the resources for them to meet these standards. At the very least, the instructors should have been provided with the right tools to enhance their instruction (NCTM, 2000). Using traditional manipulatives for instruction was a novelty idea, but what good is it; if instructors and students alike spent precious school hours fashioning out and creating prototype manipulatives?

Using manipulatives from outdated sources was a hindrance towards African development (Handler, 1993**)**. That partly explains why most African students cannot compete favorably with their peers around the globe in mathematics. Again, using technology from natural events or occurrences brings to the fore the originality in learning patterns of shapes and figures, but could be very well expedited if computer simulations were used. The drawback in implementing this technological practice was the frequency for students to experience such phenomenon, for example, rainbow formation.

All the instructors described a significant difference in technology use in Africa from that of the U.S., and this places an enormous stress on instructors who are technologically deficient. United States always looks for innovations and creativity, to enhance teaching and learning (NCTM, 2000). The mandatory requirements for instructors to incorporate technology in their instruction in most schools, has forced instructors to learn all the nuances about technology, and this has improved their teaching methods. The use of WebCT, Sketchpad, and Fathom, help instructors to organize, manipulate geometric images, and enable students to learn statistics.

Undoubtedly, for the first few months that they assume faculty positions, they are overwhelmed by the use of technology, and sometimes become nervous about its use. They gradually master the use of technology with time thorough experience and intense practice. African instructors by their very nature are resilient, always accepts facts of life as they are, and struggle to keep up with the challenges that confront them. They acknowledge the fact that to compete favorably with their peers; they had to double up in their efforts to catch up with them.

Now, most of them have achieved mastery of the use of technology to the extent that American instructors who are often exposed to technology at very tender ages are impressed by the confidence with which African instructors incorporate technology in their instruction. The instructors' praise of the U.S. government for making computers available to all students is very laudable in that African instructors no longer had to spend huge sums of money in trying to acquire computers of their own, which are expensive.

Instructors trained in United States, Canada, and Europe have an advantage over their contemporaries from Africa. These instructors are exposed to technology as they transition from students' life to becoming instructors. Once they start teaching, they already have mastered the strategies to use technology effectively in their instruction (Wiest, 2001).

All the instructors were convinced that technology: aided their instruction; enhanced students understanding; was useful in organizing course contents; and aided understanding of mathematical concepts. The instructors remarked that if they incorporate technology in their instruction, students participated more actively, since it creates a lot of fun. Zhonghong (2002) reached similar conclusion in his study suggesting the constructivist approach of learning to demonstrate that preservice teachers' knowledge on geometry problems greatly improves if they learn with dynamic software such as Geometer's sketchpad. Students generally became excited and are willing to learn if instructors are confident in the use of technology (McKenna 2000).

The use of technology depends heavily on instructors' purpose in using the technology, and the contexts under which it is used (Lynch, 2006). An effective pedagogy can utilize technology as a vehicle or medium to achieve its intended purposes. In the field of course organization, use of technology often comes into play. Instructors' work has been made easier since they no longer spend a lot of time putting their courses together. This supports Dugdale (2001) assertion that computers offer new ways of approaching the teaching of probability in the classroom.

In light of the results of this study, instructors should seek and identify opportunities that come with use of technology in their instruction. Varied strategies in pedagogy could also be utilized by instructors, if they bring creativity and innovation. Thus, African instructors should be motivated to incorporate technology in their teaching. This might require the concerted efforts of governments of both United States and Africa.

Final comments

This study highlights a number of important results that provide further information concerning the challenges African instructors' experience in the use of technology, and its impact on mathematics education. It further creates awareness that the effective use of technology have significant implications for teacher education. In general, the study has indicated an overall positive impact of the use of technology for teaching and learning of mathematics. As a result, mathematics teacher educators need to encourage and motivate African instructors' to nurture positive attitude and good discipline about technology, and provide them with the effective technological resources they need to achieve good pedagogical practices.

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Induction of Beginning Teachers in Ghana: Principles and Prospects

Nyoagbe[6], J.

Abstract

A beginning teacher is a teacher in his probationary year. In Ghana, this is the first year after pre-service education. The need to provide support for the beginning teacher has become more necessary than before because there has been a drastic reduction in the ages at which most beginning teachers enter the service. Since students can now enter Initial Teacher Training College (ITTC) with Senior Secondary School qualifications, we now have situations whereby many very young entrants enter ITTCs at ages 18 or 19 years. This means they begin their teaching careers as early as the age of 21, very inexperienced in life, and therefore require a great deal of support. Even though teachers' conditions of service in Ghana states explicitly that all employees of the service shall serve a probationary period of one year on first appointment and that all probationers shall be given every possible assistance by their immediate heads to enable them establish themselves in the service, very little is done to support the probationary or beginning teacher. In this paper the writer describes how probationers are treated and argues that the lack of policy document outlining the principles that should inform or direct teacher induction programmes in Ghana is a major inefficiency in the nation's teacher education system.

Key words: beginning teacher; induction; probation; conditions of service

Introduction

The Ghana Education Service Council and Ghana National Association of Teachers (GNAT) Conditions and Scheme of Service and the Code of Professional Conduct for Teachers spells out in its first section the mode of entering the education service, who the members of the service are, the appointing authorities for various categories of teachers and officers (GES, 1975). Also included in the section are the requirements for probation and confirmation for beginning teachers. Again the teachers' conditions of service states explicitly that all employees of the service shall serve a probationary period of one year on first appointment and that all probationers shall be given every possible assistance by their immediate heads to enable them establish themselves in the service.

Another requirement is that, recommendations for confirmation of appointment or otherwise should be submitted by reporting officers to the confirming authority. Reporting officers in

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this context are Circuit Supervisors in the case of basic schools but in second cycle institutions headmasters could report on teachers.

Nature of induction in Ghana

It is often the case that teachers on probation are not seriously monitored and confirmation is given after three routine visits by a Circuit Supervisor who only visits the beginning teacher(s) as an administrative requirement in order to complete an appraisal form on the teacher(s).

Let me at this moment concede that I have not yet stumbled on any policy document outlining the principles that should inform or direct teacher induction programmes in Ghana. Perhaps the Directors of the Teacher Education Division or Basic Education Division of the GES have the policy document and should be in a better position to speak authoritatively on the subject. My discussion of the subject would revolve around personal experiences acquired since October 1966 when at the tender age of 15 years 3 months, I stepped into a classroom as a pupil teacher and at periodic intervals after that date, have added on one professional qualification or another. Education by installment, that is, the popular cliché. And at the end of each level of professional education and training some form of orientation had taken place although this cannot be said to be comprehensive, well structured or evaluated to assess the impact.

The kinds of orientation I have received or observed are those carried out at the beginning of term of the school year for beginning teachers. These programmes are centrally planned and the group is not disaggregated in terms of the differences among the various professional grades. Being one-day orientations organized by the District Education office, the programmes are usually loaded with talks about:

- The structure of the Education Service, the lines of authority and the mode of reporting
- The duties and responsibilities of the teacher and his relations with the school head and circuit supervisor
- Welfare matters especially as regards remuneration
- Some current educational policy matters relevant to the level e.g. FCUBE at the basic level
- Completion of personal record forms and Integrated Personnel Payroll Database (IPPD) inputs etc.

Union leaders may be invited at the discretion of the District Director to interact with beginning teachers concerning the union's philosophy, programmes and activities.

In second-cycle educational institutions and teacher training colleges, teacher induction is mainly institution-based where teachers work closely with the Assistant-Headmaster/Vice-Principal (academic) for assignment to classes, courses or parts of courses and as class/form masters. Some teachers may also be assigned additional work in the Domestic department of the school as house-masters/mistresses.

In an institution with a good tone, the Headmaster or Principal may introduce the beginning teacher(s) to their colleagues at the first staff meeting of the school year emphasizing the shared philosophies, values, assumptions, beliefs, expectations, attitudes and norms that knit the school/college together. Some specific areas such an institutional head would address would include how the school environment is kept, how people relate, the heroes of the institution who serve as role models, belief in "success", and the systematic and programmed routines of day-to-day life in the institution.

Invariably this form of orientation is a one day event, intended mainly to assign tasks to the beginning teacher and also serve as the basis for his appraisal. In short the emphasis is not so much on nurturing beginning teachers to become better, but rather the exercise is intended to gear them up for the multifarious tasks in the school, the performance of which would enhance the teacher's chances of positive assessment, confirmation of appointment after the probation year and promotion in subsequent years to a higher grade.

Certain basic questions arise in connection with teacher induction.

i) Why should teachers be inducted into the profession?

ii) Where and how long should induction take?

iii) Who should be responsible for teacher induction?

iv) What form should an effective teacher induction programme take?

The transition from a teacher training institution to the actual work environment where a beginning teacher is put in charge of a class is very challenging indeed. To quote one teacher in Australia's Northern Territory, "its was like jumping in at the deep end. It is a very steep learning curve moving from the university to the real world". A fresh teacher in Japan agreed saying "this first year has been very difficult. I am much busier than I had expected to be. It is entirely different from my student teaching experience. Everyday brings a new surprise".

The experience below, reported of a young teacher three decades ago by Akrofi (1985), demonstrates the nature of interaction that sometimes takes place between a head teacher with a beginning teacher in some Ghanaian schools.

> I took my first appointment at Mataheko with great joy and walked to the headteacher's office to say hello on the day of re-opening of the school. My presence looked like a welcome relief to many anxieties he had had over the shortage of teachers in his school. His lips parted in languid smile. 'Hello Kofi! You are welcome. Here are your books, your class is Class Five. Since you are already trained, you know everything, no problem, I wish you luck' (Akrofi, 1985:19).

From the Japanese and Australian experiences cited, one can deduce that young teachers need some induction. In Ghana however, the presumption is that newly trained teachers are fresh from college who must be loaded with the most current ideas and instructional strategies for which reason they hardly receive any form of professional support. Indeed some people may rationalize this scanty attention given to newly trained teachers by comparing their professional needs to those of untrained teachers who constitute some thirty percent of the entire teaching force on whom greater concentration may be needed.

Problems of beginning teachers

Some of the problems beginning teachers face as evidenced from cross-country studies include: classroom discipline, motivating students to learn, dealing with students' individual differences, relating with and conferencing with parents, organization of class work, procurement of logistics (instructional materials) and developing viable systems of student assessment (Veenman, 1984; Mereku, 1999).

On matters of teacher welfare one can mention non-availability of suitable living accommodation, delayed payment of first salary in certain cases for more than a year, communication barrier and generation gap between more experienced and beginning teachers and inhospitable school community. It has been documented that up to one-third of beginning US teachers leave the profession within the first few years as a result of not being properly inducted into the profession (Thomas, 1990).

In the face of all the challenges outlined above that beginning teachers have to contend with it is imperative that a well-structured induction system is developed which would address the concerns of beginning teachers and retain them in the profession.

As regards where and how long induction of beginning teachers should take, my submission is that induction of beginning teachers should be organized principally in-school with occasional breaks to meet resource persons mobilized by a school district to attend to a specific issue at a central point. Teacher induction even though a continuous activity should receive the utmost attention during the first year of teaching – the so-called probationary period within the Ghana Education System.

Planning and executing a teacher induction programme

The responsibility for planning and executing a teacher induction programme at the district level should rest with the Assistant Director responsible for human resource management even though greater collaboration is required from all district officers. But the greater part of induction work should take place in the school with the Assistant Head playing a very sustained and crucial role to be supported by other more experienced teachers.

Considering the limited experiential level of beginning teachers whose inadequacies can hardly be met from textual materials, it is to be expected that many of the required skills would be acquired through interpersonal contact with experienced practicing teachers.

In those countries such as Japan, New Zealand and Australia’s Northern Territory where teacher induction is entrenched, it is a cardinal duty of the school head to ensure that all teachers in the school co-operate with the specific teacher charged with the responsibility to help beginning teachers in their first year.

The frequent “sharing” between beginning and experienced teachers promotes a lively and close relationship that works extremely to the benefit of the beginning teachers.

In such systems where induction is effectively planned and executed, experienced teachers offering support to beginning teachers do not receive additional compensation but having served as a mentor for beginning teachers may be a requirement used for promotion to senior teacher or school administrator grade.

Perhaps the overriding advantage of deliberately planned induction programmes is that it helps beginning teachers to cope with their initial unrealistic expectations of themselves.

Contrary to the usual practice in Ghana where the first year of teaching is regarded as a probation year within which beginning teachers become jittery, have to strive to be confirmed in order to retain their tenure, it has been proven that in countries with very deep roots of teacher induction programmes, assessment of beginning teachers is down-played. The system de-emphasizes the administering of instruments of assessments of teacher competency and focuses more on helping teachers prepare for assessment. A beginning teacher's failure is seen as a failure on the part of his school administration.

Under this nurturing environment, beginning teachers do not feel threatened or uncomfortable when their peers or more experienced colleagues observe them teach. Similarly they are not scared about asking questions they fear will reveal professional inadequacies. No doubt the frequent observation by fellow teachers and in certain cases frequent visitations between one another's classrooms, and peer observations which are planned in a non-disruptive way assist beginning teachers to improve in their lesson delivery.

Another good practice worth noting is that in addition to observing and being observed, some school systems devote time for group planning, curriculum development meetings and team teaching. These interactions assist beginning teachers in planning, learning about and gaining access to resources and building new professional acquaintances and relationships. They also provide the opportunity for beginning teachers to contribute to the group.

Conclusion

Throughout the discussion we have noted the drastic change that beginning teachers face when they are transposed from their teacher training institutions to the world of work. Beginning teachers we have also observed cross-culturally have unrealistic expectations of themselves which makes it imperative for school administrators, to evolve mechanisms and process for integrating them with their more senior professional colleagues. In order that professional development and growth can be assured, there is the need to:

1. Establish a policy of teacher induction;
2. View beginning teachers as professional that should be supported and nurtured to grow;
3. Aspects of induction policy and programmes to be centrally managed at the school district level should be determined, resourced, executed and evaluated on a sustainable basis;
4. School-based induction programmes under the leadership of the Assistant school head supported by all experienced teachers (mentors) should be instituted as part of school organizational culture in all schools to complement what had been planned at district level;
5. Schools should make time and logistics available for effective induction programmes;
6. All barriers to communication in schools should be cleared to ensure successful orientation of new members of staff;
7. School policy should ensure that beginning teachers are assigned simpler tasks, less problematic classes etc and supported to attain mastery of the school situation before being offered more challenging tasks;

8. The urge to satisfy assessment demands from circuit supervisors should not be the overriding need to organize induction programmes for beginning teachers rather the thrust should be to systematically tune them up through all forms of support to retain them.

In order to ensure successful induction programmes for beginning teachers there should be an interface between teacher trainers and practicing teachers in the classrooms so that each could complement the other. In this partnership the teachers' professional associations should not be side-lined as they have enough capacity to address matters of professional ethics and conduct and issues associated with teacher welfare as well as involvement in the activities of subject associations and social justice programmes.

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Ghanaian teacher trainees' perception of the official Social Studies curriculum and the resources available for its implementation

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Abstract

This paper examines teacher trainees' perception of the nature, usefulness and adequacy of the official Social Studies curriculum prescribed by the syllabus issued by the Teacher Education Division of the Ghana Education Service. Using simple random sampling and stratified sampling methods, a sample of 233 students was selected from six Teacher Training Colleges in the Ashanti Region. A questionnaire consisting of mostly Likert-type items was used; and trainees were made to indicate the extent to which they agreed with the statements about the official Social Studies curriculum and the resources available for its implementation. The results show that over 90% of the trainees agreed the objectives of he social studies curriculum are valid and very necessary for the programme; they were very much aware that the purpose of Social Studies education is to train them to teach at the basic level; and agreed that the subject equips them with skills to teach at the basic level. On the content of Social Studies, the trainees agreed tremendously about its relevance. They were however undecided about the limitless scope of the subject which makes it uncomfortable to learn. The trainees also showed a high level of agreement with the need for a Social Studies room with materials like globes, charts, bulletin boards; and demonstrated grave disagreement with the adequacy of Social Studies textbooks and other reference materials.

Keywords official curriculum, implemented curriculum, social studies teaching recourses

Introduction

Knowledge of a subject area is paramount to students of that field of study. This would help them grasp the importance of the subject, and ensure commitment to its study. This research examined students' knowledge of Social Studies with respect to its objectives, content and scope. Objectives of a subject can be explained operationally as an intended behavioural change, which a learner is expected to exhibit after undergoing a learning experience (Yakubu, 2000). The content of a subject is said to be the body of knowledge or information, which is presented to students. According to Jarolimek (1984), the scope of Social Studies refers to the range of substantive content, values, skills and/or learner experiences to be included in a programme. Scope is thus seen as the breadth of a programme.

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Many Social Studies educationists in Ghana believe that Social Studies was introduced into the school curriculum with the intention of solving social problems which bedeviled the Ghanaian society. This view is stressed in the junior secondary school Social Studies syllabus. According to a Ghana Education Service (GES) report:

> The subject deals with societal problems relating to the survival of the individual and society. Society is a dynamic and an ever-changing entity, and so are societal problems (GES, 1998, p: ii).

It is expected that knowledge of Social Studies will assist students to understand the way of life of their society and enable them function effectively.

It is common knowledge that the availability of teaching/learning materials and resources helps tutors and students to gain understanding in Social Studies (Matthias, 1973; Jarolimek and Parker, 1997). The teaching/learning facilities make the teacher's work easier by reducing writing and chalking in the classroom. Learning is made practical and vivid; what learners learn has lasting impressions on their mind (Tamakloe, Atta, and Amedahe, 1996).

The objectives of the study on which this paper is derived was to find out how trainees in teacher training colleges perceived the objectives, content and scope of the Social Studies curriculum as well as their understanding of how Social Studies would help in the resolution of social problems. Also, the study sought to find the adequacy and effectiveness of teaching-learning facilities in the teacher training colleges.

Conceptual Issues

Students must have understanding in the programme they pursue in order to make reflective decision and to participate effectively in daily social activities. Such understanding must constitute facts, generalisations, skills, hypotheses, beliefs, and attitudes that students and teachers construct in social education programmes (Martorella, 1991).

The acquisition of "understanding" is mostly seen as a "cognitive" activity, though its component parts enclose all aspects of human learning, i.e. cognitive; affective and psychomotor. "Understanding" in a Social Studies class involves some mix of the head, the heart and the hand –knowledge, affection and skills. It is emphasised that understanding does not exist independent of learning. It arises from students' interactions with others within their social milieu (Resnick, 1981; Stanley & Mathews, (1985).

Educationists have expressed their understanding on the meaning of Social Studies. Preston and Hermans (198, p3) write that "Social Studies is the name commonly given to the curriculum area that embraces the social sciences. The field is enormous. Everything about human beings and their environment provides potential Social Studies content". To them, everything that is known and taught concerning social behaviour comes into the purview of Social Studies.

Other writers stress the integrative nature of Social Studies. For instance, Bar, Barth and Shermis (1977, p69) state that "social studies is an integration of human relations for the purpose of citizenship education". The African Social and Environmental Studies Programme (ASESP) (1994,p 5) views Social Studies as the integration of concepts in the sciences and humanities for the purpose of promoting and practising effective problem-solving, decision -making, citizenship skills on social, political and economic issues and problems.

Other writers stress content of Social Studies. Hayford (1992) writes that Social Studies focuses on the interrelations and interactions of people in all corners of the society: past, present and future. Social studies could equip students with knowledge, values, and skills essential for human survival. Thus, the learning experiences at the levels of education whether basic, second cycle or tertiary should be drawn not only for academic considerations but to enable people become informed, humane, rational and participating citizens.

Tamakloe (1991,p45) advocates that the structure of the content selected for teaching and learning processes in Social Studies must be such that it cuts across disciplines. He posits that

> This can be made possible if the content is thematic in nature. Themes such as "The School - Community"," Our Continent' and others like "Citizenship," "Cooperation", "Inter dependence" and "Nationalism" easily lend themselves to the type of organization which relies heavily on the use of concepts, facts, skills and values from various disciplines for the explanation, discussion and generalizations drawn for thorough explanation.

Available literature has also revealed understanding about the nature of Social Studies. The nature of Social Studies demands that knowledge be presented in a holistic manner and that all disciplines must promote one's understanding of issues and solutions to problems (Tamakloe 1991). This pre-supposes that there are no rigid lines that separate one subject, say economics from geography and that all issues should be treated in an integrated way. It is common saying that young students in their natural learning should not be put in watertight compartments. This emanates from the fact that their knowledge is the outcome of numerous experiences each contributing some new features to what they know. This is made possible through integration (Lucan, 1981). By nature, Social Studies views knowledge as a whole rather than as separate and disjointed entities (Grasha, 1985; Mathias, 1973; and Tamakloe, 1991).

The understanding of the scope of Social Studies varies from writer to writer and from country to country. Educationists for instance, who met to discuss Social Studies education in Africa at the Endicott Summerhouse in Massachusetts, considered the scope of Social Studies to be the integration of Geography; History, and Civics. Banks (1985), in contrast to the views of the Summer House Conference on the scope of the Social Studies, posits that at lower grades, the scope of Social Studies is based on institutions and communities such as the home, the family, the school, the neighbourhood and the community. He points out further that at the higher levels, a variety of elective courses such as Sociology, Psychology and the problems of democracy are offered. Melinger and Daves (1981) believe that the broad field of Social Studies has accredited social importance, but stress that the subject lacks a consistently discernible heart. But the field provides fertile grounds for unbounded advocacy.

On the objectives of Social Studies, many educationists have expressed divergent opinions. However, many Social Studies advocates stress citizenship education as the prime objective of the subject (Banks 1980, Aggarwal 1982). Martorella (1985) expresses that the basic purpose of Social Studies is to develop reflective, competent and concerned citizens. He adds that the focus of Social Studies is to develop the head, the hand and the heart. This means that the main concern of Social Studies is to help educands to develop the abilities and skills to meet challenges that confront them. It is against this background that the GES (1988) states the objectives of junior secondary school Social Studies as the reflection of Bloom's (1956) taxonomy of education which stresses cognitive, affective and psychomotor domains.

In a similar vein, the 3-year post-secondary teacher training colleges Social Studies syllabus (GES, 1993, p1) in an attempt to equip the teacher trainees with the subject content, the professional knowledge and skills to handle the Social Studies programme at the basic level. Thus,

> Our goal in teaching School Social studies in the Teacher Training College should be to help students to acquire knowledge and to effect a change in their attitudes and values in their society and the environment. It is also to equip them with the skills to teach for change in values and attitudes of pupils.

Teacher Education

Agyeman (1991) described Teacher Education as a special kind of apprenticeship in which teacher trainee are trained to master three forms of cognitive skills, namely:

(i) The subject to be taught by the student teacher when he becomes a teacher
(ii) The philosophy of the teaching profession and
(iii) The code of ethics of the profession.

With the Education Reform in 1987, Social Studies has been re-introduced into the teacher training colleges to equip trainee teachers with skills to cope with the varying conditions in the classroom and the environment (Tamakloe, 1987).

The dedication and commitment of the pre-service teachers of social studies, and indeed teachers in general, when they graduate are an essential ingredient in the success of any educational system. Bishop (1985) submits that a curriculum is only as good as the quality of its teachers. It is against this back drop that how teacher trainees perceive and imbibe the issues taught in the social studies programme need to be sought. This information will be essential in the assessment of the appropriateness of the curriculum.

The Ghana Education Service has stressed that all teacher-training institutions in Ghana are to prepare their students to teach integrated Social Studies instead of the separate subjects of History and Geography. In a study on the status of Social Studies in teacher training institutions, Tamakloe (1988) found that 74% of the institutions taught social studies as separate subjects of history, geography and civics, instead of integrated social studies.

Other studies in Kenya, Malawi, Nigeria and Uganda (Merryfield, 1986, Odada 1988; Okoh 1979) have demonstrated that those persons most directly responsible for the implementation of a Social Studies programmes, (student-teachers and teacher educators), were not clear about its meaning and how it differed from the separate subjects of Geography, History and Civics. There is evidence, however, that clarity of the subject can be enhanced by effective pre-service and in-service education programmes (Adeyemi, 1985; Barth, 1986).

Statement of the Problem

Social Studies was introduced into the Ghanaian teacher training programme in 1987. The subject is thus comparatively new to many of the experienced college tutors who were trained in the teaching of constituent single subjects. The relative newness of the Social Studies programme in Ghana's educational system poses problems to some of the students in teacher training colleges as regards understanding and appreciating the curriculum. The researchers' interaction with trainees at the St. Monica's Training College in Ashanti Mampong in 1998 revealed that even some who had background knowledge in Geography, Economics and History were not very sure about the scope of Social Studies curriculum.

At a workshop organised at one of the colleges in 1996 for all tutors in the training collages in the Ashanti Region, comments gathered from some of the students underscored the problem of understanding some issues in Social Studies. For instance, the students mentioned the scope of Social Studies as being too broad. Consequently, understanding of the subject by students in the training colleges may be different from what is expected by the official curriculum. These informed the need for this study.

Objectives of the Study

The study examined students' understanding of the Social Studies programme at the teacher training college level. Specifically, the study sought to:

i. examine students' perception on the objectives, content, and scope of Social Studies.

ii. investigate students' perception of the adequacy of teaching and learning facilities and materials for Social Studies education.

Method

A sample of the 650 final year students from the selected teacher training colleges in the Ashanti region, 240 students (37% of the total population.) were selected .The choice of sample size of 240 was based on Krejcie and Morgan's (1970) table for determining sample sizes from a given population. In each of the six teacher training colleges in the Ashanti region offering social studies, 37% of the total population was selected, thereby giving a proportional representation to the colleges selected for the study.

Research Instrument

The research instrument was a questionnaire consisting of 53 items. The questionnaire touched on background information of the students, objectives, content and scope of Social Studies, general information about Social Studies, and knowledge about integration in the field of study and teaching- learning materials and facilities. Questionnaires were distributed to the 240 students. In all, 233 questionnaires were retrieved. Therefore, the return rate was 97%.

The items on the questionnaire were structured along the lines of the Likert-type scale. The statements on the Likert-type scale were expressed on a five-point scale, which requested respondents to indicate the extent of their agreement/disagreement ranging from Strongly

Agree (SA), Agree (A), Uncertain (U), Disagree (D) and Strongly Disagree (DS). The extent of their agreement/disagreement was scored from Strongly Agree (5) through Strongly Disagree (1).

Findings and Discussion

Percentages were used in the analyses of data. The major findings and discussions were put under three broad headings: student's perception of objectives, content and scope of Social Studies; the relevance of Social Studies of finding solutions to social problems; and teaching-learning materials and facilities.

Student perception of objectives, content and scope of Social Studies

Table 1 shows the mean ratings of the trainees' agreement with the as of aspects of the social studies syllabus.

Table 1 **Mean rating of students' agreement with objectives, content and scope of the social studies syllabus**

Aspects of Social Studies Syllabus	Mean rating of agreement
1.1. Social Studies aims at equipping teacher trainees with professional knowledge.	4.52
1.2. Social Studies equips students with skills to teach at the basic level	4.52
1.3. Social Studies helps students to develop good values and attitudes	4.60
1.4. Social Studies aims at giving citizenship education to learners.	4.70
1.5. The content of Social Studies cuts across disciplines	4.55
1.6. The limitless scope of Social Studies makes it uncomfortable to learners.	3.42

The table shows that except for Item 1.6, which concerns the scope of the subject, the trainees showed a high level of agreement with all aspects – objectives, content and scope – of the social studies syllabus. That is, in each case over 90% of the trainees agreed the objectives are valid and very necessary for the programme; except for its scope that 52% agree makes it uncomfortable to learners.

Trainees' agreement (mean rating 4.52) with the first objective (Item 1.1) is in agreement with the assertion of Martorella (1985) and Aggarwal (1982) that Social Studies as a discipline aims at equipping students with knowledge. It implies that since students knew Social Studies is capable of equipping them with the desired knowledge to meet challenges that confront them as stated in the 3-year post secondary teacher training college social studies syllabus (GES, 1993), they would make conscious effort in learning the subject. It also implies that since the students are aware of the purpose for which they are pursuing their course, they would have no excuse to go and teach the subject when they are posted after their service education.

Trainees' agreement (mean rating 4.52) with the second objective (Item 1.2) clearly demonstrates the students agreed to the statement that Social Studies equips them with skills to teach at the basic level. This finding also suggests that students were very aware that the purpose of Social Studies education is to train them to teach at the basic level. This is in conformity with the objective of 3-year Post-secondary Teacher Training College syllabus (GES, 1993).

On the content of Social Studies, the trainees agreed tremendously that the subject

- cuts across disciplines (Item 1.5; mean rating 4.55)
- helps students to develop good values and attitudes (Item 1.3; mean rating 4.60) and
- aims at giving citizenship education to learners (Item 1.4; mean rating 4.70).

However, their agreement was highest on giving citizenship education. An important objective of Social Studies is to give citizenship education. The highest mean observed here shows that the students agreed with this objective. Generally, it can be said that the students knew that Social Studies aims at giving citizenship education. This affirms the findings of Superka et al, 1980; Aggarwal, 1980; Barth, 1983; Banks 1985 that the function of citizenship education is the primary goal of Social Studies in the school curriculum. It is expected pre-service teachers would teach issues in citizenship so that students become law- abiding

Trainees' agreement (mean rating 3.42) with Item 6, the limitless scope of the subject making it uncomfortable to learn, was low. This indicates most students were either undecided or disagreed with the statement. But the fact that about 52% indicated they agreed or strongly agreed with the statement has implications for social studies educators or tutors in the colleges. The limitless nature agreed the trainees corroborates the position of Aggarwal (1982), Beard (1963) and Bar et al (1977). For instance, Aggarwal (1982, p4) notes that "the scope of Social Studies is very vast and wide and in fact as wide as the world itself and as lengthy as history of man on his earth". In assisting students to cope with the limitless scope of Social Studies, Aggarwal (1982:40) states "its frontiers have to be encompassed so as to provide an overall integrated outline from various disciplines".

Teaching-Learning Materials and Facilities

Since the inception of the Social Studies programme in Africa, teachers and learners have consistently complained about the quantity and quality of materials for Social Studies (Africa Social Studies Programme, 1985). Instructional materials have great influence on students' understanding of Social Studies. Attempts were made to seek the opinions of students on the availability of instructional materials such as textbooks, teaching-learning materials, Social Studies room and other equipment.

Students' agreement with availability of teaching learning materials and facilities for teaching social studies in colleges is presented in Table 2.

Table 2 **Students' agreement with availability of teaching learning materials and facilities for teaching social studies in colleges**

Teaching learning materials and facilities	Mean rating of agreement on availability
2.1 Provision of Social Studies room is a must in all Teacher Training Colleges	4.62
2.2 Social Studies room should contain materials like globes, charts, bulletin boards	4.88
2.3 The absence of Social Studies room prevents me from understanding Social Studies.	3.64
2.4 Social Studies text-books are sufficient in my college	1.14
2.5 Other materials apart from Social Studies textbooks are there to help me to understand Social Studies	2.42

Table 2 shows that the trainees showed a high level of agreement with provision of Social Studies room (Item 2.1) and materials like globes, charts, bulletin boards in such rooms (Item 2.2). Out of the 233 respondents, 183 (78.5%) admitted that the social Studies room is a must in all teacher-training colleges. This finding supports Aggarwal (1982) who stresses the necessity of a Social Studies room in all the teacher-training colleges where social Studies is taught. The students further admitted that the Social Studies room should contain materials like globes, charts and bulletin boards. The provision of a social studies room will give the students "a place of their own" where materials specifically designed for Social Studies could be stored.

But 88 respondents (37.8%) agreed to the statement that the absence of a Social Studies room prevented them from understanding Social Studies. The mean agreement (3.64) over the statement that 'absence of Social Studies room prevents me from understanding Social Studies', indicates the majority was rather undecided on this. This has implications for social studies educators since Moftat (as cited in Aggarwal, 1982), pointed out that classroom furnishings and their arrangements have direct bearing upon the quality of results obtained from students supports.

Table 2 also shows that the trainees showed a very low level of agreement with provision of Social Studies textbooks (Item 2.4) and other Social Studies reference materials (Item 2.5). 136 respondents (58.4%) **of** strongly disagreed to the statement. The mean rating of 1.14 obtained shows their disagreement that Social Studies textbooks were sufficient in the colleges. The students further admitted that other materials such as globes, wall maps and rain gauges were not available in the training colleges. One tends to wonder how a programme that is acclaimed to solve societal issues (GES, 1988) should be implemented without textbooks and other instructional materials. It would not be strange therefore if the students develop negative attitudes to towards Social Studies.

Discussion

The revelation of the paucity of textbooks is no different from the observations made by Merryfield (1986) with respect to Malawi and Nigeria. Merryfield stated that textbooks for students were non-existent in the teacher training colleges. The findings also confirm the observations made by Lijembe (1983) and Oshungbohun (1984) that there were inadequate textbooks and this limited effective social studies instruction in Africa.

One tends to believe that the shortage of textbooks might be attributed to the fact that most countries in Africa moved more quickly in instructing teachers to teach Social Studies than in providing them with textbooks with which to teach (Merryfield and Mutebi, 1991). The lack of textbooks on Social Studies may result in students not getting the general survey or unit of an information base of the subject, reference and other bibliographical materials for sources of additional information (Cobbold, 1999).

Conclusion and recommendations

The overall conclusion is that the students in the selected teacher training colleges in Ghana had had understanding of the Social Studies programme in terms of objectives, content and scope; as well as the integrated nature of the subject and its usefulness in the resolution of social problems.

Once the students have understood the issues in the course they are pursuing, their views should be considered in designing the Social studies programme. If one accepts the assumption that what one is interested in greatly affects the quantity and quality of his learning, it follows that students' view at various ages and developmental levels should be considered in designing the Social Studies programme. Though students' views must be considered in the design and appraised to find out if they are in line with or would lead to the welfare of students.

In designing a Social Studies programme, consideration should be given to the provision of teaching-learning materials such as textbooks and a Social Studies room. The finding of the study revealed that the unavailability of Social Studies textbooks and a Social Studies room in particular affected the teaching and learning in the Training Colleges. Care should therefore be taken to avoid rushing the process of any curriculum design no matter the time constraints and the pressure from policy makers. It must be emphasized that no matter how good teachers are, certain educational materials should be provided in the colleges to make the trainees function as good, qualified and effective teachers.

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Five Decades of School Mathematics in Ghana

Mereku, D. K.[8]

Abstract

In this paper, an attempt had been made to provide a historical background to the development of school mathematics in Ghana since the nation's independence from British rule in 1957 and how these have influenced current practice in teaching mathematics and the culture of learning the subject. Some recommendations have been made to improve students' performance in the subject.

Keywords new math, mathematics content emphasis, mathematics teaching, learning culture of mathematics

Introduction

Mathematics is one of the important subjects within the list of foundation subjects that constitute the core curriculum for basic (i.e. compulsory primary and secondary) education in most countries throughout the world. The subject occupies a privileged position in the school curriculum because the ability to cope with more of it improves one's chances of social advancement. It attained this position since it was made to replace classical languages like *Latin* or *Greek* which prior to the early half of the twentieth century were used as screening devices for entry to higher education and certain professions (Howson and Wilson, 1986).

As advances in information and communications technologies have increased the usefulness of the subject and will continue to do so in this millennium, there is the need to understand how these advances and other developments in the subject have revolutionised the content of, and emphasis in, school mathematics since independence in Ghana. To do this, the article provides a historical background to the development of school mathematics in Ghana since independence. It discusses the world-wide changes in school mathematics curriculum that resulted in re-naming the subject '*modern mathematics'* in Western Europe and '*new-math'* on the other side of the Atlantic. It also examines how these have influenced students' underachievement in the subject. The final part focuses on current practice in teaching and learning mathematics fifty years after the nation's political independence from foreign rule and the way forward for school mathematics in Ghana.

School mathematics before independence

Before Ghana's independence from British rule in 1957, the form of mathematics included in the curriculum at the elementary school level was arithmetic. The traditional school arithmetic taught largely involved mechanical number facts and tables of measurements. According to Gyang (1980), there were several books at the primary level but the '*Simon and Milliken's*

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Arithmetic' and the '*Larcombe's Arithmetic series'* were the most predominant textbooks used in the subject at the elementary level. The series written by Dr. J. H. Larcombe were intended for native English children in England, but used extensively also in schools in the British colonies. Larcombe's books covered three areas namely: four rules and regulations; domestic arithmetic; and literal arithmetic (i.e. use of formulae). The series made provision for different age groups from 5 to 15 years plus and were designed to ensure the maximum efficiency in the subject, and in particular, to develop good mental skills which should be the pivot of all teachings. The hundreds of schools in the Gold Coast before independence used Larcombe's series.

One remarkable feature of the series was its accompanying speed test in mental arithmetic. Larcombe's Graded Speed Tests in Mental Arithmetic were developed for pupils aged from 9 to 14 years and were to be administered at the average rate of a minute per sum. The aim of these graded tests was to foster greater rapidity and accuracy in dealing with numbers and sums. Each book contained in all nearly 1000 sums. Topics covered by the arithmetic tests were number, money, weight and measure, fractions, decimals, proportions, percentages, rates, taxes, mensuration and systems of measurement -both imperial and metric (Larcombe, 1948).

During this era the cane, which was an acceptable negative motivational technique in those days, was used excessively to make pupils to know the tables of numbers and those of measurements, and to solve problems of a practical nature in measuring, commerce, and so on. The word "brought" is used here because the teachers' methods forced pupils to use repetitive and rote learning techniques. In the account that follows, Gyang (1979), a leading mathematical educationalist in Ghana, shows clearly how punishment, force and fear were prominent features of mathematics teaching in his own primary school days in the early 1950s.

> The cane was used indiscriminately so that many of the pupils did not like mathematics and developed true hatred for it. ..... Problems in arithmetic were read out by the teacher, usually only once through, and we were expected to put down only the answer. There were usually ten questions and there was trouble for any one who had any of them wrong. After that we used to line up to recite some tables learnt and to have some oral drills in arithmetic. We actually behaved like parrots and the teacher had his cane always by him ready to beat anyone who had anything wrong. ...... I can still remember a number of my classmates who ended their schooling prematurely just because they could not cope with the mathematics that was taught" (Gyang, 1979:23).

Before independence, school mathematics taught at the secondary level was in three main branches namely arithmetic, algebra and geometry. They were taught largely using British grammar school textbooks such as '*School Arithmetic'* and '*School Algebra'* by Channon and Smith (1938, 1948); and '*School Geometry'* by Durell (1939). These were also used in teacher training colleges.

World-wide curricular innovations in school mathematics at the time of Ghana's independence

The curricular changes in school mathematics that reached the African continent in the 1960s were motivated by a number of educational and mathematical forces. It is worthwhile then before we attempt to describe the various curricula changes that occurred in Ghana to try to identify the reasons and developments that have stimulated the changes. Since a detailed account of the reasons and developments can be found in a number of sources[9], their discussion here will be rather brief.

The century preceding World War II saw the discovery of more mathematics than ever existed in the history of man. Several new results were reached in mathematics and announced. New methods and techniques for solving both old and new problems were developed and new concepts were created. These developments led to a careful formulation of ideas and a greater precision of mathematical language. Sets, and to a lesser extent, functions, emerged as unifying concepts (van der Blij, *et al*., 1981). The development of the ideas of sets and the view that young children could learn much more than educators had previously thought possible advocated by leading psychologists like Jereme Bruner[10] led to the acceptance of Suppes' (1963) premise that "all mathematics can be developed from the concept of set and operation upon set".

The significant role that technology played in the World War II, and the way it was looked up to, in the post-war period and in many newly independent developing countries, as the key to development led to a great emphasis on technology as a force for progress and development. Mathematics, which had played so important a part in these technological achievements, was given special emphasis in the drive for more and better-trained technologists (van der Blij *et al*. op cit.).

The impressive socio-economic developments that took place in the post-war years had led to the provision of more, and expansion of existing, school facilities. This had made it possible for student populations, particularly at the secondary level, to expand massively. The move from an 'elitist' to a 'comprehensive' school system was one reason for the expansion in schools. In the developing countries, the implementation of universal primary education policies and improvements in opportunities for secondary and further education had led to the increase in student populations. This led to a growing concern to 'make comprehensive' the school mathematics curriculum which was originally designed for an intellectual elite. That is, to re-organise the curriculum so as to cater for a broader spectrum of students in secondary schools and to meet the needs particularly of students in the lower half of the ability band.

These developments combined to provide a climate that was conducive to change and motivated the innovators in school mathematics to initiate curriculum development projects in the late 1950s and the 1960s. During this same period in the United States, university mathematicians began voicing their dissatisfaction with the preparation of incoming students. This led to the desire among the mathematicians to improve the content and pedagogy of the school mathematics curriculum.

The desire to improve school mathematics to meet these developments in education led to the emergence of curriculum development committees or projects and associations[11], and the

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[9] See Griffiths and Howson (1974), Sherman (1972), Van der Blij, Hilding and Weinzweig (1981), Howson (1983) and Urevbu (1990), Mereku (2004).

[10] The dictum of Jerome Bruner that 'any subject can be effectively taught in some intellectually honest form to any child at any stage of development was based on his theory about the sequence of instruction involving the enactive, iconic and symbolic stages'.

[11] In England, the Association for the Improvement of Geometrical Teaching (AIGT), which became known as the Mathematical Association, had set a pace for the redesigning of the School mathematics curriculum. Also the Association for Teaching Aids in Mathematics, which later became known as the

organisation of several conferences under the auspices of international bodies such as UNESCO, OEEC (and its successor OECD) and ICMI (the International Commission for Mathematics Instruction). The international conferences attracted all concerned about the need for a broad education in technology to meet the rapid growth of new fields of industry. It attracted not only mathematicians and researchers but also politicians and administrators from ministries of education and commercial publishers from different parts of the world. However, since the innovations began at the university level, the curricular changes were dominated by mathematicians and researchers from universities.

Post independence developments in school mathematics curriculum in Ghana

The later part of the 1950s and the first few years of the 1960s marked the period that most African countries gained their independence from foreign domination. At independence, governments were full of optimism and there was a widespread feeling throughout the newly independent states that things were going to change, and for the better, in all spheres of life (Hawes, 1979). The search for new systems and policies of education which would serve as tools for the rapid development of the human resources of the new nations became a major concern of African governments. They sought policies that would transform their educational systems into those that can turn out, in the shortest possible time, completely literate working populations for the development of their economies.

Hence before the major mathematics curriculum innovations of the 1960s were launched in Africa, there was already the desire for change. The need to change the traditional school mathematics curriculum, which largely involved mechanical number facts and tables, was urged also by "the realisation of the enormous gaps which were opening between the demands of a computer-based technology and the realities of a curriculum designed in the nineteenth century to serve a nation of shopkeepers" (Hawes 1979:34). Finally, on the African continent, there was a natural development of an anxiety not to be 'left behind', in what was thought of as a general reform, once the changes had begun in certain 'culturally leading' countries. This development, commonly known as the 'band-wagon syndrome' created a powerful pressure for the diffusion of the curricular innovations in school mathematics in countries around the world (van der Blij, *et al.,* 1981).

The search for relevance in education led to a number of conferences of African ministers of education advocating the replacement of the "inherited" colonial system with alternative forms of education and innovations in school curricula (UNESCO, 1961; Ponsiuer, 1971). One of such conferences held in Accra in 1961 led to the inauguration of the African Mathematics Programme (AMP). The AMP spearheaded the major curriculum changes in Africa. The AMP pursued a policy of bringing together African, American and British educators in English speaking African countries to influence mathematics education in Africa. To achieve its objectives, between 1962 and 1969 AMP conducted annual eight-week writing workshops in Entebbe and Mombassa, and produced over 80 volumes of textual materials (dubbed the *Entebbe Math Series)* covering primary school, teacher training, secondary and sixth form mathematics (Lockard, 1968). The AMP schemes were trialed in a small number of experimental schools mainly in the urban areas of the participating African countries. But the

Association of Teachers of Mathematics, made great contributions to mathematical education. A detailed description of the contributions of the Associations can be found in Howson (1973).

full implementation of the Entebbe Modern Mathematics project was delayed for over a decade because it was met with a number of criticisms from the general public.

The first criticism was that the innovators (that is, the early planners and curriculum writers) were largely academics rather than school teachers, and Americans, few of whom had had extensive personal experience in Africa. In view of this, many mathematical problems included in the Entebbe Mathematics textbooks were meaningless to African pupils (particularly to those from rural environments) as they arose in the context of a society quite different from their own. Secondly, the use of the concept of *set* and the *operations on sets* to develop the entire content of school arithmetic presupposes ‘number’ should be presented solely as a property of sets. The undue emphasis on sets makes number work, which involves processes other than enumeration (that is, finding the cardinality of sets), to be given little attention. The third criticism concerns the level of, and complexity of, language of the materials developed. The schemes produced included too many new terminologies that incorporated levels and quantities of language often far in excess of the African pupil’s capacity to absorb them with understanding. Howson (1983) observed that ‘this often reduced most lessons in mathematics in the African classroom to the learning of English words, mainly their pronunciations, instead of their underlying concepts and mathematical significance. That is, symbols and words were mistaken for concepts, means for ends’.

Efforts to change the subject from arithmetic to mathematics at the primary and middle school level increased in the last half of the 1960s. In 1972, ‘*New Mathematics for Primary Schools* (NMPS)’, a new mathematics scheme, which was intended to make “the learning of mathematics by Ghanaian children more interesting and more meaningful to them” (Lockard, 1972:9), was officially introduced into primary schools in the country. Later two more schemes were introduced; these were

a) Modern Mathematics for Elementary Schools, for Book 1 to Book 8, (Armar and Brown, 1970).
b) A West African School Mathematics usually referred to as AWAM; for Middle Forms 3 and 4 (Gibson and Mar dell, 1965)

Around the same period as the AMP schemes were being written, an initiative had began to design new schemes for secondary schools. This was the Joint Schools Project (JSP). The project was originated by Dr. E. M. Hartley (University of Ghana), Miss M. W. L. Harbourn and Mr. B. Raynor (both of Achimota School), and Mr M. C. Mitchelmore (Mfantsipim School). The project was aimed at “producing *new mathematics* course for secondary schools in West Africa, up to school certificate level” (Lockard, 1968). It was funded by three UK agencies - The Nuffield Foundation, London; the Centre for Educational Development Overseas, London; and Overseas Development Administration, London. Associated agencies which also provided support for the project include the Mathematical Association of Ghana (MAG); University of Ghana; and the Ghana Ministry of Education. The Joint Schools Project (JSP) team began the project working as a sub-committee of the MAG, and became self-directing in April 1965 with the appointment of an Executive Committee. In June 1971, when the majority of the experimental work on the JSP books had been completed, the Executive Committee was dissolved. The responsibility for completing and reviewing the JSP books became that of the editors and MAG.

Modern mathematics textbook schemes for Ghanaian schools

In response to the criticisms of the AMP schemes, two regional programmes, the West/East African Regional Mathematics Programmes (WARMP and EARMP), were established from 1970 onwards to modify the schemes for all institutions in the participating countries. William (1976) observed that there was growing demand for the work (in the schemes) to be tailored more specifically to the needs of the countries involved, needs which were not uniform, and which could only be adequately identified by those with extensive experience of African education. The WARMP adapted the AMP mathematics schemes for the three participating countries in West Africa namely, Ghana, Liberia and Sierra Leone. The *Ghana Mathematics Series* (GMS) textbooks and Teacher's Handbooks which were used in the country for three decades were products of the WARMP (CRDD, 1986a, 1987). The series for primary schools and teacher training colleges were published between 1975 and 1977 by the Ghana Ministry of Education. Those for junior secondary schools could not be published until 1988 when funding was obtained as a result of the Educational Reform Programme.

The JSP books were first published in 1970 and had been have been reviewed several times to meet the demands of new challenges and changes in the curriculum. The project originally produced textbooks in mathematics for Secondary Schools Forms 1-5, or age 11-18. It was designed to meet the needs *of "all ability levels commonly found in secondary schools, approximately, top 15% of ability range"* (Lockard, *op cit*). The book was used in a number of African countries and also the Caribbean Islands. The royalties made on the sale of the books had sustained the Mathematical Association of Ghana till this while. By the year 2000, the association had a credit balance of about £53,000 in its royalty accounts in the UK, making it the richest subject association in Ghana (MAG, 2000).

Differences it the modern mathematics textbook schemes: GMS versus JSP

It is necessary to point out here that even though the two curriculum projects were involved in development of mathematics materials, the products of African Mathematics Project which was largely American initiative differed in several ways from those of the Joint School Project which was British initiative. In the former the content and treatment of topics in primary mathematics, as described earlier, was changed completely. The changes that came with the JSP schemes were not so much marked as those described above. Also the JSP team targeted mainly secondary level mathematics, and did not presume the content would change so much at the primary level. Hence the change in content and approach to mathematics was not as drastic as what we saw in the AMP projects. There was therefore a situation where for about two decades the major mathematics schemes used in our primary and secondary schools lacked continuity since they came from two different projects. That is, the Ghana Mathematics Series (GMS) and the Joint School Project (JSP) books were not compatible; the two projects were developed on different philosophies, their contents and style of presentation completely different (Mereku, 1998). It was therefore not a surprise that most Ghanaian students experienced difficulty in switching to the JSP at the secondary level after using the GMS schemes. The result being that only few of the students were really capable of understanding the content prescribed by the senior secondary mathematics syllabuses of the 1987 reforms.

School mathematics during and after the 1987 reforms

The 1987 education reforms in education led to the shortening of the period of pre-tertiary education by five years (i.e. from a possible of 17 to 12 years). New syllabuses were developed for school mathematics under the auspices of the CRDD and published in 1988 for primary, junior and senior secondary mathematics by a panel of mathematics teachers. The revision resulted in a complete re-organisation of the content into what was described as a '*teaching syllabus*'.

At the primary and junior secondary levels, the syllabuses were made to match the content of the Ghana Mathematics Series schemes which were developed a decade earlier (CRDD, 1987). It can be argued in this light that the 1988 JSS syllabus took very little account of the changed educational structure. Furthermore, the scope and complexity of the content of the mathematics curricula for both senior and junior secondary schools were raised over and above the what existed in 'General Certificate of Education ordinary level', and 'Middle School Leaving Certificate', examinations respectively. Besides, all pupils in secondary education (both JSS and SSS) were made to follow similar syllabuses in the heavily loaded curriculum. Mereku (2000) observed this as one of the major factors that influenced the poor students' performance in the subject in the decade which preceded the 1987 educational reforms.

School mathematics in the post 1987 education reform era did not differ significantly from positions adopted in the 70s and the 80s. The traditional approach, which emphasised mainly on basic skills (predominantly computational) was the focus of the basic (i.e. primary and junior secondary) school syllabus. The introduction of the GMS schemes brought several new topics as well as terms into the subject at the primary and junior secondary levels. Examples of the new topics are number bases, sets of numbers, vectors, clock arithmetic, points in a number plane, transformational geometry, probability and statistics; and some of the new terms are addend, commutative, distributive, place value, ray, intersection, line segment, mode, rational numbers, integers, to mention only a few. Sets, relations and modern geometry were seen as unifying concepts across all topics.

Although the spread of modern mathematics was largely due to both the new approaches to learning developed by psychologists and new content areas introduced into mathematics, these approaches were not as easy to adopt as the additional content or topics. A curriculum analysis study conducted by Mereku (1995) revealed that though there was rhetoric in the introduction of the curriculum materials on the use of teaching skills that suggest discovery methods, the learning/teaching activities that would encourage the use of such teaching skills in the materials were not included. The teachers were themselves not aware of the underlying structures of the approaches. Therefore in the JSS, many teachers found it difficult to cope with the teaching of some of the modern mathematics topics that occur in the syllabus for years II and III.

A study commissioned by the Ministry of Education in the first five years into the reforms revealed that achievement of public schools was low in spite of in-service courses organised for teachers to improve the teaching and learning processes in schools, and in spite of the injection of inputs into schools. The study also indicated that mathematics teaching in basic schools focused on computation skills, learning of formulas, rote practice and teaching as telling. The principal investigator in this study, Kraft (1994) argued that

> "the current syllabi, textbooks and teachers' handbooks do not meet the highest international standards, nor the current best thinking on sequence, learning and pedagogy and will not prepare Ghanaian students for the needs of the next century" (Kraft 1994: 2).

Such was the nature of school mathematics curriculum that students entering secondary education in Ghana have received in the last three decades. The implication here is that by the time the majority of pupils began secondary education their foundation in basic school mathematics was woefully low.

At the senior secondary level, the reforms provided the opportunity for Ghanaian authors to develop textbooks that were in consonance with the world-wide new math reform. As pointed out earlier, the JSP textbooks used in secondary schools earlier were not compatible with the GMS textbooks. A set of books for core and elective mathematics were written by the Ghanaian mathematician (Abbiw, Adjei, Adu-Gyamfi, Awuah, Dogbe, Eshun, Folson, Hutchful and Minta, 1992). Later in the reform, a third review of the JSP books was carried out by the Mathematical Association of Ghana (MAG) to abridge the 5-year series to a 3-year series for the senior secondary school system. This was completed before the millennium with the collaboration of SEDCO Publishers and completed and supplied to school in (Macrae, *et. al*., 1998).

Though Ghanaian authored textbooks were available in school, Doku's (2003) analyses found the school curriculum to be one of the contributory factors to the lowering of the quality of mathematics education at the Senior Secondary School level. The over loading of subjects in the school curriculum seem to have affected students' performance in general. He observed that students were lacking basic mathematical skills since there was too much focus on preparing them toward the Senior Secondary School Certificate Examinations without acquiring mathematical skills. Doku (2003) also found that teaching and learning of mathematics at that level was much more competitive than making sure children acquire mathematical knowledge and teachers seem to aim at the brighter students in teaching/learning mathematics rather than helping to bring up the less able ones.

The general underachievement in school mathematics was a major concern of the 26th Biennial National Workshop/Conference of the Mathematical Association of Ghana (MAG) held at the St. James Seminary, Sunyani, from 24th to 28th of August, 1998. That is, before the beginning of the new millennium, mathematics educators in the country were raising the following concerns:

- Poor performance of majority of students in mathematics at the basic and Senior Secondary levels;
- The declining performance level of the girl child as she goes up the ladder;
- Insensitivity of the mathematics curriculum to developments in technology;
- Poor qualification of teacher trainees in mathematics (Mathematical Association of Ghana, 2000).

Mathematics in schools today: Fifty years after independence

In the last decade, the basic school (i.e. primary/JSS) mathematics curriculum had seen two major revisions in 2001 and 2007. The first was in response to the Free Compulsory Universal Basic Education (FCUBE) initiative being pursued by the Ministry of Education which sought to sustain in all basic school pupils educational qualities that would ensure their full participation in the society (MOE, 1996). The second was in view of the Government White Paper based on the Anamuah-Mensah (2002) Committee, which introduced a new universal and continuous basic educational programme from age 4 to 15 and thereafter a re-defined four-year Senior High School system to replace the previous Primary-JSS-SSS structure. In the current reform, the first part of secondary education, hitherto designated JSS, is now the first 3 years of High School (Junior High School), to occupy all of Ghana children from age 4 till age 15 (MOESS, 2004).

Revision of syllabuses and textbooks

At the senior secondary level, the mathematics curriculum had also seen two major revisions in 2003 and 2007. The latter was in view of the current reforms and the former, as indicated earlier, was in response to moves to ensure the curriculum meets the requirements of the changes introduced as a result of Ghana joining the WASSCE. In last three years, attempts have been made by the Ministry of Education and Sports to encourage the development and purchase of textbooks that match the revised syllabuses. Several textbooks are now available for teaching mathematics at the primary and junior high school level, though not adequate (Anamuah-Mensah, *et. al*., 2004; Mereku, *et. al*., 2007). Mathematical Association of Ghana's mathematics textbook series developed from the JSP books are currently under a fourth review to meet the requirements of the changes introduced as a result of the senior high school system and also Ghana joining the WASSCE.

Addressing the needs of students of different abilities

The recent reviews of the syllabuses however gave little attention to the issue of addressing the needs of students of different levels of ability. No provisions have been made in the national mathematics curricula for addressing the issue of students with different levels of ability. That is, there is no differentiation of the content of the mathematics curricula to meet the learning needs of groups of students with different levels of abilities. This is however not so in many parts of the world today. This is because some of the content found in the curricula at this level, in many educational systems, have been found not to be essential knowledge for ALL, but additional (or good to know) knowledge for the few who will continue to study the subjects in their further education after this level (Mullis, *et. al*., (2004).

Approach to learning emphasized in the curriculum

With regard to pedagogy, what one will observe in most mathematics classrooms today will not be significantly different from the traditional approach, which emphasised mainly on basic skills (predominantly computational). The traditional approach presents mathematics as a cut-and-dry proposition, that there is only one way to do everything; the way the teacher says. This is the teaching as transmission model. Fredua-Kwarteng and Ahia (2005) pointed out that fifty years after independence, mathematics teaching in schools in Ghana is still characterized by the ‘transmission’ and ‘command’ models. Some of their observations of the learning culture of mathematics in schools in Ghana are

1. Students learn mathematics by listening to their teacher and copying from the chalkboard rather than asking questions for clarifications and justification, discussing, and negotiating meanings and conjectures. Consequently, students learn mathematics as a body of objective facts rather than a product of human invention.
2. Students could go to the library to read newspapers or novels, not mathematics. Mathematics is learned only in the mathematics classrooms or for examinations, quizzes, or tests.
3. Students could form a small study group outside of their classroom to do home work assignments or prepare for an examination or tests, but not for discussing mathematical concepts that were taught to them in the classrooms.
4. Students learn mathematics by regurgitating facts, theorems or formulas instead of probing for meaning and understanding of mathematical concepts. That is to say, students hardly ask the logic or philosophy underlying those mathematical principles, facts, or formulas.
5. Students accept whatever the teacher teaches them. The teacher is the sole authority of mathematical knowledge in the classroom, while the students are mere receptors of mathematical facts, principles, formulas, and theorems. Thus, if the teacher makes any mistakes the students would also make the same mistakes as the teacher made.
6. Most students do mathematics assignments and exercises not as a way of learning mathematics, but as a way of disposing off those assignments to please the teacher. This implies that mathematics assignments are not construed as an instrument for learning mathematics.
7. Students go to mathematics classes with the object to calculate something. Therefore, if the classes do not involve calculations they do not think that they are learning mathematics. So students learn mathematics with the goal to attain computational fluency, not conceptual understanding or meaning. For a conceptual understanding requires students to think critically and act flexibly with what they know. Students are fond of asking, “How do you calculate that?” instead of asking, why do you calculate it, and in that way?
8. Students learn mathematics with the aim to pass a test or examination. After passing the test or examination mathematics is no longer of importance to the students.
9. It is generally believe that only science-oriented students must learn and master mathematical principles, not so-called arts or business students. Alternatively, most people (including some mathematics teachers) believe that art or business students require a pass in mathematics in their final examinations. Though people believe that artisans or technicians must learn mathematics, they not believe that they have to master as much mathematics as science students; i.e. those who want to study engineering, medicine, architecture, computering, electronics, etc. (Fredua-Kwarteng and Ahia, 2005).

It surprising that in the last four decades when several Ghanaian authors have been involved in curriculum development for schools, teachers continue to teach by merely transmitting mathematical facts, principles and algorithms, and students are commanded to learn them in a passive and fearful manner. One major factor influencing the transmission model relates the inefficiencies within the curriculum materials used in Ghanaian schools. Textbooks in schools are still based on philosophies of teaching which are no more valued globally in school mathematics (Anamuah-Mensah and Mereku, 2005a). Besides, the introductory part of the materials continue to carry rhetoric on the use of teaching/learning skills that suggest discovery and problem solving methods. But a careful look at the materials will indicate that learning/teaching activities that will encourage the use of such pedagogies are not included

(Mereku, 2004). Furthermore, even though textbooks, together with documents for use in classrooms as teaching aids, such as resources for exercises, are very important tools in today's classrooms (Fujita and Jones, 2003), its supply in Ghanaian schools is inadequate (Mereku, et. al., 2007). You hardly find a school where students have one to one access to mathematics textbooks. Seating and writing places are poor and inadequate, while textbooks are in short supply. The result is that students have little opportunity to work and practice mathematics. They do little reading on their own in the subject and are not encouraged to create their own mathematics, that is, pose questions or engage in problem-solving activities in order to attain both conceptual and procedural understanding of what they are being taught. Even though this is what is valued globally today in learning mathematics, in Ghana students are made to copy the algorithms teachers demonstrate and write on chalkboards and simply memorize and regurgitate them during tests or examinations.

Use of Technology in mathematics

One major aim of mathematics education in our schools is to develop mathematical knowledge and skills that pupils will require in their adult life to cope with the mathematical demands of everyday life and employment. Today calculators are used in all walks of life – in business, offices, industry, homes, etc. That is, calculators are gradually becoming part of our culture. But the school mathematics curriculum in Ghana is still silent over its use. Anamuah-Mensah, *et. al*., (2004) found that on the average calculators and computers were not available for 85 percent of students in mathematics classes. How long is it going to take us to come out with a national educational policy on the use of calculators in schools? If pupils are not taught how to use the calculator, they cannot use it effectively in and outside the classroom as well as in examinations.

The non-availability calculators and computers for use in the schools excludes students from using this technology in discovering principles and concepts, practising skills and procedures, looking up information and processing and analysing data. In the TIMSS-2003 study, Anamuah-Mensah and Mereku (2005b) observed that while Singaporean teachers of about 20 per cent of the students reported that calculators were not permitted in their mathematics classes, as large as 61 per cent (about two-thirds) of Ghanaian teachers reported this. This situation prevents most students from making use of calculators for such activities as checking answers, doing routine computations, solving complex and non-routine problems or exploring the number concepts.

In view of the usefulness of technology and the persistent request by the public to use calculators for the school mathematics examinations, the West African Examination Council (WAEC) constituted a National Working Party to analyse the issue and make recommendations to enable the Council to review its position on the issue. The WAEC Working Party recommended that the government should come out with a clear policy that would encourage the use of the calculators in the teaching and learning processes in school mathematics (WAEC, 2005). They further recommended that the policy should ensure that the use of calculators as a tool for carrying out mathematical calculations should be made an integral part of the teaching and learning of mathematics in schools. We are yet to hear any government pronouncement on such a policy.

Conclusion

The writer agrees with the Ghanaian mathematics professor based in Canada that in order to improve mathematics performance in schools in Ghana, we first have to change our mathematics methodology and pedagogy to allow students opportunities for problem-solving, problem-posing, and active participation in mathematics learning in the classroom (Fredua-Kwarteng, 2005). The mathematics classroom should be organized as a learning community (or a community of critical learners). In the learning community environment where problem solving is the major goal of learning mathematics, when students pose mathematics questions they are not necessarily directed at the teacher but to the community. The community members, the students and the teacher, are free to discuss mathematical ideas, question assumptions, ask questions for clarification, and make mistakes without any fear or intimidations from either the teacher or the other community members. In a community of critical mathematics learners, the teacher does not do all the talking while the students passively listen or take notes. Moreover, in such a community the teacher provides rationales, justifications, logic or cultural reasons for mathematical rules, principles, or algorithms; nothing is taken for granted. Besides, in that community the teacher is not necessarily the final arbiter of mathematical disagreements or disputes; bargaining, negotiating, dialogue and research may be used to resolve differences. The teacher also uses local referents and inputs from the students' cultural environment in teaching mathematical concepts.

Besides the learning cultures, curriculum developers must note that in Ghana, where many teachers hardly ever have access to other sources of information and activity, textbooks will continue to play a major role in what goes on in the classroom. Taking account of the power of the textbook in determining what is taught, and how it is taught, it is likely that the textbook and teacher's handbook will remain a major resource that can transform classrooms in Ghana into mathematics learning communities. Textbook writers should therefore ensure their products communicate the methods they really intend teachers to use in the delivery of the content they put in their materials; and this method should be one that will lead to the development of learning community environments in mathematics classrooms.

Finally, it is important to point out that the problem of mathematics learning in Ghanaian schools is not solely that teachers do not teach mathematics well. The crust of the problem is that Ghanaian students are not getting better at mathematics as expected. There is therefore the need for an action plan for the solution of the problem. For instance, when the British government realized that mathematics learning was becoming increasingly a problem in its schools it formulated and implemented National Numeracy Strategy. Accordingly, to solve our national mathematics underachievement, we need a concrete, feasible plan with an enthusiasm to implement the plan and the passion to ensure that the plan is working.

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C o n t e n t s

Mathematics Connection Vol. 8, 2009

An investigation of primary and JHS teachers' attitudes toward mathematics in some selected schools in the Central Region of Ghana 1
Davis, E. K. & Wilmot, E. M. **1**

The effect of behavioural objectives used as advance organizers on senior secondary students' mathematics achievement
Ifamuyiwa, A. S. **11**

The effect of conceptual and procedural learning strategies on the study habit of Nigerian secondary school students in mathematics
Adeleke, M. A. & Oloyede, E. O. **21**

Reaching a National Consensus on the Duration of High School Education in Ghana: A Case for 3-Year Senior High Education
Acquaye, E. **27**

Use of technology for college mathematics instruction: African instructors' experiences
Assuah, C. **41**

Induction of Beginning Teachers in Ghana: Principles and Prospects
Nyoagbe, J. **55**

Ghanaian teacher trainees' perception of the official Social Studies curriculum and the resources available for its implementation
Kankam, B. **61**

Five Decades of School Mathematics in Ghana
Mereku, D. K. **73**

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