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THE APPRAISAL OF MATHEMATICS TEACHERS IN GHANA

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ABSTRACT

Many mathematics teachers in Ghanaian secondary schools have little or no training in the teaching of mathematics, yet they teach the subject because of the shortage of mathematics teachers in Ghana. Such teachers and their trained counterparts, need professional help to enable them guide pupils learn the subject effectively and efficiently especially since the duration for pre-university education in Ghana has been cut by about five years.

This study aimed to:

- 1. Examine the nature of teacher appraisal in Ghana .*
- 2. Examine the validity of existing methods of teacher appraisal in Ghana.*
- 3. Determine which variables influence Ghanaian mathematics teachers' views about teacher appraisal and its ability to help them improve their competence of teaching mathematics.*

Of the 441 secondary mathematics teachers who participated in the study, 193 taught the

subject at the junior secondary level and 248 taught it at the senior secondary level. In addition, 44 Ghana Education Service Officials and six heads of secondary schools who appraise mathematics teachers were sampled. Methods used included questionnaires, interviews and observation of appraisers at work.

Highly significant relationships were found between mathematics teachers' perceived professional support and appraisal experience, mathematics teaching experience and professional status at the senior secondary level, and between received support and appraisal experience at the junior secondary level. The results indicated a dramatic difference between junior secondary and senior secondary mathematics teachers in their perception of the potential of the teacher appraisal system in Ghana to help them to improve their teaching of mathematics. Senior secondary mathematics teachers were generally more pessimistic about

the potential of the appraisal system than their junior secondary counterparts.

The study also showed that many education officials who appraise mathematics teachers have little or no training in secondary school mathematics teaching or its appraisal, yet the appraisal system for both formative and summative purposes require these officers to both "help" mathematics teachers improve their work and make judgements about their performance. These findings led to the conclusion that the teacher appraisal system in the Ghana Education Service is not valid. The implications of the findings are discussed.

Introduction

Teachers constitute the most important (and perhaps the most expensive) resource in education. Therefore there is no gainsaying the fact that any educational system is as good as the teachers in it. Thus, in order to improve the quality of learning that takes place in any educational system, there is the need to improve the quality of teaching in that system. One way of improving the quality of teaching is by providing teachers with the opportunity to develop professionally through the process of appraisal. This paper describes a study which aimed at assessing

the potential of the appraisal system in the Ghana Education Service (GES) with regard to enhancing the competence of mathematics teachers.

Teacher appraisal may be defined as the attempt by oneself and/or others to analyse and assess a range of professional knowledge, skills and attitudes which are relevant to the performance of a teacher's role within an institution or agency. (Anderson, et al. 1987). Teacher appraisal can be both retrospective and prospective, looking back at what has or has not been achieved, taking stock of the present and then planning some pathways which will help the individual teacher's professional development and professional 'accountability'.

Used in the above context, teacher appraisal becomes synonymous with teacher evaluation, which also involves stock-taking and recommendations for improvement. In this paper, the two words (i.e. appraisal and evaluation) are used interchangeably and they mean almost the same thing. The importance of school mathematics in the development of science and technology has been stressed by many governments in both developed and developing worlds.

It is however fair to point out that

as part of the ongoing education reform, changes have been made in the appraisal system to enhance its ability to help teachers improve their work (Gokah, 1993). According to Gokah, the changes are designed to “strengthen the management and supervision of basic education schools at the district and circuit levels” (p.3). These changes include the selection of Circuit Supervisors with higher qualifications and experience to be in charge of supervision of schools at the basic education level. At the senior secondary level too, the selection of supervisors has been streamlined to “ensure that the supervisors have adequate expertise in the teaching (and supervision of teachers) of the various subjects in the senior secondary school programme” (Gokah, 1993, p.3). This paper looks at how the appraisal system was in fact “working” after the above changes were introduced. It concentrates on the appraisal of mathematics teachers in Ghanaian secondary schools where mathematics is found most difficult both to teach and to learn (Boakye and Oxenham, 1982), and where others have done very little research. It examines the validity of the teacher appraisal system and tries to identify some of the factors that are relevant to Ghanaian secondary mathematics teachers’ perceptions of the

potential of the appraisal system to help them improve their teaching of mathematics.

The Problem

Literature on teacher evaluation in Ghana (e.g. Bame, 1991; Fokah, 1992) suggest that a single system of teacher appraisal is used for the two most frequently cited primary purposes of personal appraisal, namely accountability and professional growth. The accountability (or summative) dimension reflects the need to determine whether a professional is competent in order to ensure that services delivered are safe and effective (Stiggins & Duke, 1988), whereas the professional growth (or formative) dimension reflects the need for development of the individual (Wragg, et al. 1996).

Writers like Nuttal (1986) have argued that summative and formative purposes of appraisal can co-exist within the same scheme. Fullan (1991) has also noted that “combining individual and institutional development has its tensions, but the message ... should be abundantly clear. You cannot have one without the other” (p.349). Yet McGreal (1988) argued that multiple purposes of evaluation can be successfully met with a single evaluation system only when the system is viewed as one component of a larger mission: that

of furthering the goals of the organisation. If the dynamic relationship between the individual and the organisation is healthy, then what is good for the organisation must also be good for the individual and vice-versa. Indeed, Getzel and Guba (1957) described this dynamic relationship as one that fuses the prevailing interests of the institution with those of the individual. Such an orientation enhances the ability of both the individual and the institution to achieve desired goals and consequently encourages a satisfying state of affairs within the organisation and among its respective employees (Little, 1993; March & Simons, 1993).

If teacher appraisal is to provide a meaningful solution to the problem of helping teachers to improve on their work, then it is imperative that Ghanaian teachers see the GES in the light described above. This is why the concept of perceived organisational support is central to the present study. It must be emphasised further that in any system of appraisal, even if a single purpose is identified, those involved may see the purpose differently. Senior management, for example, may see it in terms of their need to 'manage' staff whatever the purpose of appraisal is whilst junior staff in their hierarchies may see it more in terms of their own personal

development. These differences may be exacerbated when a single system is used for the dual purposes (of appraisal) as the literature suggests is the case in Ghana.

In such circumstances, and in view of the limited resources available to the GES, it is important to identify which teacher characteristics (and other variables) are significantly related to teachers' perceptions of the appraisal process. Hence the importance of considering teachers' perceived validity of the teacher appraisal system in Ghana. The question then is : how do different categories of mathematics teachers perceive the performance appraisal system in the GES?

Hypotheses

A number of hypotheses were formulated using the relevant teacher characteristics to investigate the perceptions of different categories of teachers of the teacher appraisal system in Ghana. Four hypotheses, which bear somewhat directly on the teaching of mathematics, are discussed in the paper. Perceived support was used as the main dependent variable.

The independent variables are:

1. Experience with appraisal

2. Experience in mathematics teaching
3. Professional status of respondent
4. Gender

The hypotheses which were formulated with the above variables, were based on some of the issues which teacher appraisal ought to address. In other words, they were based on some of the gaps in the literature on teacher appraisal, which need filling. For example, it was considered important to investigate the relationship between mathematics teachers' perceived support and their experience with the appraisal process because any differences between the perceived support of teachers who had been appraised and that of those who had not been appraised could help describe the teacher appraisal system in Ghana.

Another issue which the literature on teacher appraisal in particular has been rather silent on include the influence of teachers' experience and expertise (in both quantitative and qualitative terms) on their perceptions of teacher appraisal system (Berliner 1986). For the purpose of this study, experienced mathematics teachers were those who had taught mathematics at the appropriate level for more than five

years. This is in line with the experienced - inexperienced dichotomy used in studies which have examined the differences between experienced (or expert) and inexperienced (or novice) teachers (Lienhardt Smith 1985; Carter, et al. 1988; Yen, 1991). Any relationship between perceived support and mathematics teaching experience can help shed some light on the appraisal system, and also help determine how experienced and inexperienced mathematics teachers might be helped to improve on their teaching of mathematics.

Finally, the issue of gender differences in mathematics education has attracted much interest both within and outside the mathematics education community (Grouws, 1992). Yet it appears that very little attention has been paid to the relationship between gender and perceptions of appraisal in teacher appraisal studies. The present study therefore attempts to fill this important gap. This is because such a relationship might help explain some of the differences that researchers have found between the sexes in various aspects of mathematics teaching and learning (Hoyles, 1988, 1989; Eshun, in press).

The hypotheses that were tested in

the present study are listed below.

1. Junior and senior secondary mathematics teachers who have been appraised will be more positive about the potential of teacher appraisal in Ghana to help them improve their teaching of mathematics than those who have not been appraised.
2. More experienced mathematics teachers in junior and senior secondary schools will be more positive about the potential of teacher appraisal in Ghana to help them improve their teaching of mathematics than less experienced ones.
3. Junior and senior secondary professional mathematics teachers will be more positive about the potential of teacher appraisal in Ghana to help them improve their teaching of mathematics than will non-professional mathematics teachers.
4. Junior and senior secondary female mathematics teachers will view the potential of teacher appraisal in Ghana to help them improve their teaching of mathematics differently from

male mathematics teachers.

The four hypotheses, formed the basis of teachers' perceived validity of the teacher appraisal system in Ghana. They were based on the "changes" that have been made in the appraisal of teachers in the GES, (Gokah,1993).

Population

The target population for the study consisted of mathematics teachers in the Ashanti, Central, Eastern and Greater Accra regions of Ghana. However, the study was limited to full-time secondary mathematics teachers in public schools, referred to in this paper as "government - schools".

The few private secondary schools in the selected regions were excluded from the study because teachers in these schools are usually hired on temporary or part-time basis, and are also not appraised by the GES for promotion and other purposes like their counterparts in government-assisted schools. Furthermore, most of these part-time teachers are also full time teachers in government secondary schools (Bame, 1991). For these reasons, including private secondary schools in the study

might have led to duplicate listings, whereby some mathematics teachers might have had the chance of being selected more than once, and consequently biasing the results of the study (Kalton, 1983). This is more so because many teachers do not disclose part-time work for various reasons and it is therefore very unlikely that all duplicates (arising from including private schools) could be detected and adjusted for unequal selection chances. For the same reasons, mathematics teachers who teach on part-time basis in government-assisted schools were excluded from the study.

Sample

The sampling frame for the study consisted of the relevant secondary schools in the selected regions. This was done in spite of the fact that secondary mathematics teachers were the units of analysis of the study. In other words, mathematics teachers were sampled by schools. This design was preferred to simple random sampling of individual secondary mathematics teachers because it was to ensure that mathematics teachers in the selected regions were adequately represented, and also to avoid the problem of the huge transportation and other costs involved

in tracing teachers selected through simple random sampling. Stuart (1984) rightly points out that using simple random sampling in such circumstances could lead to high incidence of non-response and increase biases resulting from the latter.

However, in an attempt to preserve the random principle on which statistical inferences depend, while at the same time allowing for a design that would ensure adequate representation of teachers in the sample regions, the study used a stratified cluster sampling method to select participants. Stratification was done by region and type of school (i.e. whether junior or senior secondary).

At the senior secondary school level, mathematics teachers were sampled by schools selected at random from a list of schools in each region. Fifteen schools were selected in each of the Ashanti and Eastern regions whereas 10 schools each were selected from the Central and Greater Accra regions. The number of schools selected in each region reflected the number of schools in the region. In all, 50 senior secondary schools were involved in the study, and all the mathematics teachers in these schools were sampled.

Unlike the senior secondary schools, junior secondary schools in Ghana are scattered throughout the country. Nearly every single town or village with a primary school has a junior secondary school. Because of this, the method of sampling mathematics teachers by schools (selected at random from a list of schools in each region) proved extremely difficult and almost impossible to use. Two districts were therefore selected at random from each of the 4 regions. In each district, 4 circuit supervisors were selected at random and all the mathematics teachers in the selected circuits were sampled. In all 129 junior secondary schools participated in the study.

The sample sizes for the junior and senior secondary were 193 (with 12 absentees) and 248 (with 46 absentees) respectively. Thus the study involved 441 junior secondary and senior secondary mathematics teachers. With regard to the appraiser, 44 GES officials and 6 heads of senior secondary schools who appraise mathematics teachers took part in the study. The constitution of the appraisers who were sampled is as follows: the circuit supervisors of the 8 selected circuits in each region were sampled. In addition, 2 inspectors were sampled from each of the four regions and all the inspectors

at the headquarters of the Inspectorate Division of the GES were sampled. In all, out of the 50 supervisors/appraisers sampled, 44 responded, giving an overall response rate of 88%.

Instruments

Preparations towards the pilot as well as the main study involved a number of steps. Preparations began with the study of similar studies and the materials used in them. This was followed by training in the construction of questionnaire and interview items. The author attended a number of seminars and workshops on the construction of survey instruments. The training received at these seminars and workshops helped the author to select and modify the items with which the teacher and appraisal questionnaires used in the present study were constructed. For example, in order to identify the appropriate items to include in both the mathematics teacher appraisal questionnaire (referred to in this paper as the teacher questionnaire) and the appraiser questionnaire, a number of existing instruments were examined. With regard to the teacher questionnaire, these were instruments which aimed at assessing teachers' attitude towards the teaching and learning of mathematics and those

assessing their attitude towards teacher appraisal generally. As no study involving the appraisal of mathematics teacher had come to the notice of the researcher, most of the items used in the study were modifications of those used in mathematics education studies which were somewhat related to the present study (e.g. Kouba, 1992). Other items used were from instruments used in teacher appraisal studies generally. Specifically, some of the items on Ghanaian teachers' attitude towards GES officials' supervisory activities were adapted from the items used in the teacher motivation study described by Bame (1991). Those items regarding teachers' attitude towards mathematics teaching and learning were adapted from studies investigating mathematics teachers' attitude towards the teaching and learning of the subject (e.g. Raymond 1993). Some of the items used in the appraiser questionnaire were similar to those used in the teacher questionnaire. Such items were derived from the same instruments as those on which the teacher questionnaire were based. Other items were derived from Ghanaian teachers' expressed opinions about the supervisory activities of GES officials in similar studies.

Preparations towards the interviewing exercise involved much the same steps undertaken to develop the two questionnaires. They involved the development of interview 'blue print' specifying the areas to be covered and the questions to be asked. The preparation began with the study of materials describing the process of interviewing (e.g. Anastasi, 1986; Oppenheim, 1990). These materials included manuals, descriptive articles and transcripts of interviews carried out using the "critical incident" technique (Hoyles, 1986). These initial exercises provided a sense of the form the interviews in the present study should take, the appropriate questions to ask and the probes and prompts to use.

The Pilot Study

The instruments were tested in a pilot study which was conducted from October to December 1998. Thus the purpose of the pilot was to gain insight into the relative strengths and weaknesses of the research instruments in order to make possible improvements prior to the main study. The sample for the pilot study consisted of 50 secondary mathematics teachers and 10 appraisers selected from two

districts in the regions selected for the real study.

Administration of Instruments in the Main Study

The main study was conducted from February to May 1999. Having been granted permission by the directors of education in the districts and regions involved in the study, the researcher then personally administered the teacher questionnaire. At the junior secondary level, circuit supervisors in some of the districts were directed by the district directors to inform all mathematics teachers in their circuits about the research and to arrange a meeting of all mathematics teachers at specified venues. In all the districts sampled, the author met with the teachers at specified venues to administer the questionnaires. The meeting usually took the form of a workshop: the first part of which was used for the administration of the questionnaires and the second part for the discussion of some general issues on the problems facing mathematics teachers generally and those in the junior secondary schools in particular. This was done after questionnaires had been collected from the respondents. No discussion took place among the respondents whilst they were

completing the questionnaires. The author went round after the questionnaires had been completed to ensure that all sections were completed before collecting the completed questionnaires. The "workshop" lasted about 3 hours.

The method used to administer questionnaires at the senior secondary level was different from the one used at the junior level. At the former level, the author visited the individual selected schools to administer the questionnaires. The heads quickly arranged for the author to meet with the heads of mathematics departments who then informed their colleagues about the study. The questionnaires were usually administered to groups of mathematics teachers available in the school at the time of the visit. In some cases, especially where some of the mathematics teachers could not join the groups because they were engaged in the classroom or elsewhere, the questionnaire was administered on one-to-one basis. No questionnaires were left behind for the 46 teachers who were not available. Therefore although nearly all the teachers who were available in the schools at the time of the visits completed the questionnaires, the response rate came to about 85%. The

questionnaires for the appraisers at the junior secondary level were left with the Assistant Director (AD) at the Inspectorate Division at each district office, who in turn distributed them to the selected circuit officers. Appraisers returned the completed questionnaires to the AD for collection later. A similar procedure was used at the senior secondary level except that at this level, the questionnaires were left with the Director in charge of the Inspectorate Division at the regional office or at the headquarters. The completed questionnaires were picked up a week later.

Interviews

In addition to the questionnaires, 20 senior secondary and 17 junior secondary school mathematics teachers were interviewed in detail about their responses to the questionnaire items, their experience with the appraisal process, their teaching of mathematics and how they think the former affect the latter. These interviewees were selected on the basis of their responses to the questionnaire items. Specifically, after an initial 'analysis' of the completed questionnaires, the responses were categorised using the main independent variables. Individuals from these categories were selected

at random for the interviews. Using the proportions of senior and junior secondary respondents in the sample for the study, 22 senior secondary and 18 junior secondary mathematics teachers were selected for the interviews. One junior secondary and two senior secondary mathematics teachers who had completed the questionnaires were not available for the interviews. Thus 37 (92.5%) out of the 40 teachers selected were interviewed. Also 10 appraisers selected from the districts headquarters of the GES as well as 6 secondary heads were interviewed in detail about their views regarding the appraisal process. The appraisers were also selected on the basis of their responses to the appraiser questionnaire. Factors taken into account in the selection of the appraisers included subject specialisation, experience as an appraiser and the level of education at which appraiser worked (i.e. either JSS or SSS). The heads were selected from the senior secondary schools where at least two teachers were selected for the interview. All the heads and appraisers selected for interviewing were interviewed.

Apart from the questionnaire and the interviews, some appraisers were observed while at work. The purpose of the field observation

was both to gather data to enable conclusions to be drawn about the validity of the appraisal system and to cross-validate the responses from the interviews and information from other sources. The researcher observed three inspectors whilst they were on inspection duties in two senior secondary schools in the selected regions. Nine circuit supervisors who were on supervision and promotion inspection duties in the selected districts were also observed.

Analysis

First, descriptive statistics were run on all the individual items in the teachers' questionnaires to both make sense of the data and to examine any differences between the various regions. This initial examination revealed no significant differences between the regions with regard to the measure used in the study. Nor was there any reason or theory to suggest any differences between the regions in terms of the data collected. However, there were significant differences between junior and secondary 'scores' within each region which reflected the fact that the two levels constitute different stages in the Ghanaian education system.

The data were therefore analysed separately for junior and senior and

the results compared. Chi-square analysis were initially conducted to test the significance of any relationships between the variables employed in the study. This initial analysis was followed by multivariate analysis - particularly discriminate analysis - to throw more light on the relationships that had been revealed by the use of chi-square analyses. Responses from appraisers' questionnaires were subjected to exploratory and bivariate analyses in the same way as described above.

All interviews conducted in the study were tape recorded and fully transcribed. The interviews were reduced to manageable proportions by creating summary sheets for each interviewee (see Moriere, 1992). On each summary sheet, there were portions corresponding to the main variables of interest of the study. These sheets offered a quick and useful reference to respondents' perceptions of the appraisal system and helped make comparisons between teachers' and appraisers' perceptions much easier. The actual transcripts were used as references for quoting particular representative observations.

Results

The findings of the study are reported separately for junior and

senior secondary levels because the initial analysis revealed significant differences between the levels of "score" obtained at these levels. This was expected because the junior and senior secondary levels constitute different stages in the GES. The junior secondary school level forms part of the basic education level which, in theory is free and compulsory for all Ghanaian children. The senior secondary level, on the other hand, is neither free nor compulsory, and admission to this level is determined by students' performance at the Basic Education Certificate Examination (BECE) as well as their parents' or guardians' ability to afford the fees charged at this level.

Besides, the appraisal of mathematics teachers at the two levels is done by different sets of officers in the GES. Whereas junior secondary mathematics teachers are generally appraised by circuit officers from the district offices of the GES, the appraisal of mathematics teachers at the senior secondary level is done mainly by officers from the regional offices as well as those from the headquarters of the Service.

The main dependent variable (i.e. perceived support) was taken from section II of the mathematics

teacher appraisal questionnaire (MATAQ) which dealt with mathematics teaching. Respondents were presented with the following item: "*Please state three ways in which you personally can improve your teaching of mathematics*". Each respondent stated three ways in which he or she could improve his or her teaching of mathematics. Three separate items were used to gather respondents' views about the potential of Teacher Appraisal in Ghana (TAG) to help them to do what they had stated they would to improve their teaching of mathematics. The three items were:

- a. Can the way teacher appraisal is done presently in this country help you to do the first (1st) thing you have stated in the item above?
- b. Can the way teacher appraisal is done presently in this country help you to do the second (2nd) thing you have stated in the item above?
- c. Can the way teacher appraisal is done presently in this country help you to do the third (3rd) thing you have stated in item above?

Respondents were required to answer "yes" or "no" to each item "Yes" was coded 1 and "No" was coded 0. Each respondent's score-

measuring his or her perceived potential of TAG to help or him or her to improve his or her teaching of mathematics (i.e. Perceived Support from GES) - was arrived at by adding the codes for their three responses. Thus, respondents' score ranged from 0 (i.e. 3 "nos") to 3 (i.e. 3 "yesses"). Table 1 shows the frequencies of the perceived support scores for both junior and senior secondary level respondents.

At the first stage in the analysis of the data, the 4-point scale in the table was dichotomised into two categories. Scores of 2 and 3 were put into one category, and those of zero and one were put into the second category. The former category was designated the positive category and the category with scores of 0 and 1 was taken as the negative category.

It may be noted from Table 1 that at the junior secondary level, 137(71.0%) out of the 193 respondents were positive about the potential of TAG to help them to improve their teaching of mathematics, and 56(29.0%) had negative perception of TAG to help them to improve their teaching of mathematics. The corresponding figures at the senior secondary level were 126(50.8%) positive, and 122(49.2%) negative.

In order to identify probable two-way relationships between the dependent and the independent variables, the various multinomial scales of measurement of some of the independent variables were also collapsed into two categories. Table 2 shows the frequency counts of perceived support 'scores' in the form of contingency tables

Table 1

Frequencies of perceived support scores for respondents at the junior and senior secondary levels.

Number of "Yesses"	JSS Frequency	SSS Frequency
0	20(10.4%)	57(23.0%)
1	36(18.7%)	65(26.2%)
2	62(32.0%)	62(25.0%)
3	75(38.9%)	64(25.8%)
Total	193(100.0%)	248(100.0%)

involving the main independent variables in the study, and the dependent variable at the junior and secondary levels respectively.

1. The totals in Table 2 are not row totals. They refer to the total number of respondents in each of the two (positive/negative) categories.

professional status correlated significantly with perceived support.

Appraisal Experience

The first hypothesis tested was the one formulated to examine the relationship between appraisal experience and perceived support.

Table 2

Examining the relationship between teacher characteristics and perceived (professional) support

JUNIOR SECONDARY LEVEL

	Number of respondents in specified category		Chi-square	P
	Positive (Total n = 137) ¹	Negative (Total n = 56)		
1. Teachers who have been appraised	113	35	7.7994	p<.01***
2. Taught maths for over 5 years	50	18	0.1669	—
3. Professional maths teachers	15	7	0.0030	—
4. Female teachers	16	8	0.0501	—

SENIOR SECONDARY LEVEL

1. Teachers who have been appraised	64	91	13.9778	p<.001***
2. Taught maths for over 5 years	59	89	16.5128	p<.001***
3. Professional maths teachers	51	89	25.2854	p<.001***
4. Female teachers	13	11	0.2056	—

* Significant at 5%

*** Significant at 1%

It may be inferred from the table that at the junior secondary level, only appraisal experience correlated significantly with perceived support. At the senior secondary level, however, three variables, namely, appraisal experience, mathematics teaching experience and

The prediction was that at both junior and senior secondary levels, mathematics teachers who had been appraised would be more positive about the potential of TAG to help them improve their teaching of mathematics than those who had not been appraised. At both levels,

appraisal experiences was significantly related to perceived support at the 1% alpha level. At the junior secondary level, 113(76.4%) out of the 148 respondents who had been appraised were positive about TAG as compared to 24(53.3%) of the 45 who had not been appraised, $X^2(1, N=193)=7.7944, p<.01$.

At the senior secondary level, 64(41.3%) out of the 155 respondents who had taught mathematics for more than five years were positive about the potential of TAG, while 62 (66.7%) out of the 93 non-appraised respondents were negative about TAG, $X^2(1, N = 248) = 13.9778, p <.01$.

Mathematics Teaching Experience

The second hypothesis tested in the present study concerned the relationship between experience in mathematics teaching and perceived support. It was predicted that teachers who had taught mathematics for longer periods would be positive about the potential of TAG to help them to improve their teaching of mathematics. At the junior secondary level 50 (73.5%) out of the 68 teachers who had taught mathematics for more than five years were positive about

the potential of TAG to help them to improve their teaching of mathematics whilst 87 (69.6%) of the 125 teachers with five years or less experience in mathematics teaching viewed TAG positively. It may be noted that, on the face of it, the difference between "experienced" mathematics teachers in terms of perceived support was not statistically significant even at the 50% alpha level, $X^2(1) = 0.1669, P > .50$.

The situation looked different at the senior secondary level. At that level, 59 (39.9%) out of 148 of "experienced" maths teachers as opposed to 67 (67%) out of the 100 "inexperienced" teachers - nearly double the former percentage - viewed TAG in a positive light. Thus, at this level, there was an apparently strong relationship between mathematics teaching experience and perceived support in the direction predicted, $X^2(1) = 16.5128, P <.001$.

Professional Status

Hypothesis 3 predicted that at both levels, professional mathematics teacher would be more positive about the potential of TAG to help them to improve their teaching of mathematics. The initial findings, as far as professional status is concerned, were that hypothesis 3 was not supported at either levels. Null results were obtained at the

junior level but at the senior level, the relationship between professional status and perceived support was, on the face of it, very strong and in the opposite direction.

At the junior level, 15(68.2%) out of the 22 'professional' respondents were positive about TAG whereas 122 (71.3%) out of the 169 non-professionals were positive, $X^2(1, N=193)=0.003, p>.95$. The situation at the senior level was, as mentioned above, very different. At that level, only 51(36.4%) out of the 140 professionals were positive about TAG as compared to 75 (69.4%) out of the 180 non-professionals, resulting in an apparently strong association between professional status and perceived support, $X^2(1, N=248) = 25.3854, p<.001$.

Gender

The fourth hypothesis tested in the study was about gender differences in perceived professional support. It predicted that at both junior and senior secondary levels, female mathematics teachers would view the potential of TAG to help them improve their teaching of mathematics differently from male mathematics teachers. The results obtained were apparently unresponsive of this hypothesis for, at both levels, no significant differences were found between males and females about their views about TAG. At the junior secondary

level, 16(67%) out of the 24 female mathematics teachers and 121(71.6%) out of the 169 male mathematics teachers were positive about TAG. As mentioned above, the difference between female and male respondents with regard to their views about TAG was not significant, $X^2(1, N=193) = 0.2056, p>.50$.

At the senior secondary level, the corresponding figures (indicating positiveness towards TAG) were 13(54.2%) out of the 24 females and 113(50.4%) out of the 224 male respondents. Here too, the difference between males and females in terms of their views about TAG was not significant, $X^2(1, N=248) = 0.2056, p>.50$

Further Analysis

In the chi-square analyses presented above, no more than two of the independent variables were used at a time. This means that the chi-square analyses provided no means of examining the combined 'effect' of the independent variables on the dependent variable. It also means that they provide no means of disentangling the web of correlations that appeared to exist between the independent variables in order to find the effect each of them had on the dependent variables 'on its own'. It therefore seemed necessary to re-examine the variables discussed above using procedures that would take into account not only the relationships

between the various independent variables, but also those between a combination of the latter and the dependent variable. Thus, in an attempt to throw more light on the relationships between the main (dependent and independent) variables discussed above, and to find out how the independent variables affect the dependent variable directly or indirectly, linear discriminant function analyses were done.

Each of the variables was examined to see how best it can, on its own, discriminate between the above groups of teachers on the basis of their scores on the dependent variable. Put differently, the discriminant power of each variable was calculated for each of the three sets of data (i.e. junior secondary, senior secondary, and the combined sets). The discriminant power of each variable was arrived at by finding the percentage of "grouped"

cases correctly classified by the variable on its own, using the "stepwise" procedure on the SPSS discriminant analysis programme. Table 3 gives the discriminant power of each of the variables of interest.

The table shows that, at the junior secondary level, appraisal experience could, on its own, correctly classify 71 percent of the respondents into two groups - positive and negative - in terms of their actual 'scores' on the dependent variable. None of the remaining three variables namely, mathematics teaching experience, gender and professional status could, on its own, classify any of the respondents. In other words, they were too weakly related to the dependent variable to classify any of the respondents - an observation which appears to confirm the results reported in the last section.

Table 3

Discriminant power of the main independent variables

Variable	Junior Secondary % classified correctly	Senior Secondary % classified correctly	Combined Data % classified correctly
Appraisal experience	70.98	61.69	-
Maths teaching experience	-	62.90	59.64
Professional status	-	66.13	66.44
Gender	-	-	-

At the senior secondary level, and in much the same way, each of the three variables that correlated significantly with the dependent variable at that level (when chi-square values were used) could, on its own, assign respondents to the two groups with some degree of success. For the combined data, the variables, mathematics teaching experience and professional status were the only ones that qualified for analysis, with professional status emerging as the best single variable for correctly classifying 66 percent of all the 441 respondents. In fact, the linear discriminant function analysis confirmed the results obtained from the chi-square analysis.

Discussion

It is interesting to note that at both levels and in both analyses, gender was not significantly related to the dependent variable and both mathematics teaching and professional status at the junior secondary level need to be explained. Also to be explained is the fact that contrary to the prediction that at both junior and senior secondary levels, mathematics teachers who had been appraised would be more positive about the potential of TAG to help them improve their teaching mathematics than those who had not been appraised, the relationship between the two variables were in

different directions at the two levels. Whereas the relationship between appraisal experience and perceived support was in the predicted direction at the junior secondary level, the direction of the relationship between the variables was reversed at the senior secondary level.

Explaining first the apparent difference between the groups in the direction of the relationship between the dependent variable and appraisal experience, one major reason why the results at the senior secondary level showed a deviation from the prediction is the type of appraisal experience the respondents get at the two levels. As mentioned above, 44 Ghana Education Service Officials (GESOs) who appraised mathematics teachers at either the JSS level or SSS level took part in the study. Of these 29 were circuit supervisors who appraise mainly junior secondary mathematics teachers as well as teachers of other subjects. The remaining 15 appraisers were responsible for appraising teachers at the secondary level. Although at the latter level, emphasis is placed on subject specialisation and that where possible, GESOs are supposed to appraise teachers who teach the appraisers' specialist subjects, most of the officials who had appraised mathematics teachers were not mathematics specialists.

In fact, only eight (18.8%) of the appraisers who had appraised mathematics teachers were mathematics specialists. Of the eight, three appraised mathematics teachers at the junior secondary level and five appraised mathematics teachers at the senior secondary level. What is more, not all the non-mathematics specialists had been trained in the appraisal of mathematics teaching. As many as 15 (41.6%) of the 36 non-specialists had not been trained. Eight of these were operating at the junior secondary level whereas seven of the untrained non-specialists operated at the secondary level.

Thus of the 15 appraisers who appraised mathematics teachers at the senior secondary level, seven (47.0%) were either non-specialists or not trained. The corresponding percentage at the junior secondary level was about 17%. Thus whereas 27% of the appraisers at the junior secondary level lacked the expertise in mathematics teaching or its appraisal, as high as 47% lacked such expertise at the senior secondary level. As Ball (1988) points out, "knowledge of mathematics is obviously fundamental to being able to help someone else learn it" (p.12). Many of the appraisers at the senior secondary level were not in the position to help mathematics

teachers improve their performance. In other words, the feedback most of the mathematics teachers, especially those at the senior secondary level, got from the appraisers could affect their perceptions of the appraisal system negatively. The suggestion is that mathematics teachers who doubt the expertise of their appraisers would not be satisfied with the appraisal feedback from such appraisers (Larson & Callan, 1990; Raymond, 1993).

It can be inferred from Table 2 that, apart from appraisal experience, the relationship between perceived support and each of the variables, mathematics teaching experience and professional status was the reverse of the one predicted at the senior secondary level. At the junior secondary level, no significant relationship was found between the dependent variable and either of the variables under discussion.

The leader-member exchange model describes the process by which members in an organisation evolve their roles through interactions with their supervisors. As a result of this process, quality of exchange ranging from low to high develops between the teacher and the supervisor. Early research examining the model indicated that a superior develops different quality exchange relationships with

subordinates and these relationships are relatively stable over time (Dansereau et al. 1975; Graen and Cashman, 1975). Later studies (eg. Kingstrom and Mainstone, 1985) were focused on the relationship between exchange quality and supervisor and subordinate attitudes and behaviours. Results suggested that, in comparison with a low quality exchange relationship, a high quality exchange relationship is related to more supervisor support and guidance, higher subordinate satisfaction and performance, greater subordinate influence in decisions and lower subordinate turn over.

The relationship between Ghanaian teachers, particularly the experienced ones, and their supervisors has been far from anything that can promote a high quality exchange behaviour between the two groups. The rather depressing relationship that has existed between teachers and their supervisors is well documented (e.g. Bame, 1991). It would appear that in spite of the changes that the reform is purported to have brought in the supervision of teaching, the relationship between teachers and their supervisors does not seem to have changed for the better.

Thus following Graen and Cashman's (1975) observation about the relative stability of superior-subordinate relationships

over time, it is reasonable to expect more experienced teachers especially at the senior secondary level to make "on-line" judgements in the negative direction about the supervisory activities of GES officials. This could be more so in the case of mathematics teachers, considering that most of the supervisors might not have the requisite knowledge in mathematics or its teaching to enable them offer any help to these teachers.

It may be recalled that the hypothesis concerning professional status stated that at both junior and senior secondary levels, professional mathematics teachers will be more positive about the potential of TAG to help them improve their teaching of mathematics. At both levels, there was a deviation from the prediction. Whereas no significant relationship was found between professional status and perceived support at the junior secondary level, the predicted direction of the relationship between professional status and perceived support was reversed at the senior secondary level. Both results need to be explained.

Firstly, the difference between junior secondary and senior secondary mathematics teachers with regard to the relationship being examined may be due to the difference between the proportion of professionals at the two levels.

Indeed the tiny proportion (11.4%) of professional respondents at the junior level makes any conclusion about relationship between professional status and perceived support at the junior secondary level appear unsafe. The tentative conclusion therefore is that there were insufficient data at the junior level to enable safe conclusions to be drawn, notwithstanding any claim that the data were representative of the proportion of professional mathematics teachers at the two levels.

Secondly, considering that most of the appraisers at both junior and senior secondary levels were found to lack expertise in mathematics, it is no exaggeration to suggest that the difference between the two groups of teachers may be due to the possible differences in the levels of competence and self-concept in mathematics between the two groups. Indeed, Grouws (1992) has cited a number of studies (e.g. Byrne, 1984; Marsh, 1986) on the individual's self-concept in mathematics which findings suggest that the relationship between self-concept and achievement is consistently positive. If these findings are anything to go by, then teachers who have low achievement levels in mathematics and as a result poor self-concept in the subject, would be more likely to accept feedback from an external source than those with high self-

concept in the subject. It is suggested that the professional teachers at the junior secondary level differ from their counterparts in the senior secondary schools in terms of self-concept in mathematics. This view was supported by the interviews conducted during the study.

The fourth hypothesis tested was about gender difference in perceived professional support. It predicted that at both junior and senior secondary levels, female mathematics teachers would view the potential of TAG to help them improve their teaching of mathematics differently from male mathematics teachers. The results obtained were apparently unsupportive of this hypothesis, for at both levels, no significant differences were found between males and females about their views.

In as much as one would wish to explain the above "deviation" from the hypothesis, one would also have to point out the difficulties involved in explaining the null results involving gender in the present study, considering the small number of female mathematics teachers who took part in the study. At either levels, 24 females took part in the study. This figure represents 12.4% and 9.7% at the junior and senior secondary levels respectively. Consequently, no further discussion

of the data on gender can be justified. Nevertheless, the data may be the starting point of further research, looking, for example, at gender differences in performance appraisal ratings.

Other Findings

In addition to the findings resulting from the testing of the hypotheses, the study made other findings through the interview and observation data. For example, the study found that in line with the Ministry of Education's stand on appraisal, the system was, at the time of the study, being used for both staff development and the assessment of performance for promotion and other related purposes. In fact, the appraisal system used for both accountability and professional development purposes and the same set of officers were used for both purposes! The lack of expertise among these officers clearly invalidated the appraisal system (Yen, 1991; Brown and Borko, 1992).

Besides, the dual use of an appraisal system often creates confusion as teachers are most of the time not aware of what purpose they are being appraised for. This confusion appears to confirm the fears of writers like Powney (1991) who hold the view that no appraisal

system can serve both purposes. Bame (1991), for example, comments on the dilemma the dual role poses in the Ghanaian educational setting:

“We noted that (the) majority of both the teachers and headteachers acknowledge the usefulness of some aspects of the supervision carried out by officials, in that it helped teachers to improve their teaching. But at the same time, they indicated that ... the officials always tried to find fault with ... teacher's work” (Bame, 1991, pp. 114-115). The study also confirmed Gokah's (1993) observation that only the managerial appraisal method was being used in the appraisal of mathematics teachers in Ghana. Classroom observation was found to be the main instrument for the collection of data for teachers' work for both formative and summative appraisals, particularly at the junior secondary level. It was found that classroom observation when it was used to collect data about teachers' work, for either purpose was used once or twice, not more. It is worth pointing out that the scanty samples of teachers' work used in summative evaluations weakened the validity of classroom observations in the present study.

The only other instrument used to appraise mathematics teachers for summative purposes was the

promotion interview. Here too, the study concluded that the nature of questions mathematics teacher were asked at such interviews invalidated the interviews. This is because the interviewers did not ask enough questions about teachers' classroom practice. Far too many of the questions were on issues that bore no relevance to mathematics teaching. Asked why general knowledge questions dominated the interviews, an officer who served on one of the interview panels rightly argued that although academic qualifications are important in the teaching profession, they are not enough to make one a good teacher and that the GES was committed to rewarding good teachers. Other factors, he argued, had to be taken into account. Nevertheless, not asking a mathematics teacher or indeed any teacher enough questions about their classroom practice leaves one in doubt as to what the purpose of the promotion interview is.

Conclusion

The findings of the present study lead to the conclusion that the teacher appraisal system in the GES is far from valid. It must be emphasised, however, that knowing (rightly) that the system of teacher appraisal in Ghana is not valid, and improving one's teaching are two different things. Professional mathematics teachers may be

aware of the lack of mathematical expertise among their appraisers but this knowledge cannot, on its own, help them to improve their work. In fact, such knowledge can even lead to complacency. It appears the main way of helping teachers to improve their working through the teacher appraisal system in Ghana is, in view of the findings of the present study, to make changes to the present system of appraisal of teachers in Ghanaian schools generally and that of the appraisal of mathematics teachers in Ghanaian secondary schools in particular. Indeed, both Nyoagbe (1993) and Bame (1991) recommended that there should be restructuring of the supervisory relationship between officials and teachers. They both urged officials to show educational leadership by suggesting new ideas to teachers and by practical demonstrations which will help the teachers discover alternative means of improving their work. This view was shared by nearly all the mathematics teachers who took part in the study, especially those at the senior secondary level. They all expressed the need for professional support through formative appraisal processes conducted by competent officials who would be capable of raising their confidence in the teaching of the subject.

Thus, in addition to Nyoagbe's (1993) recommendation that "the

GES should appoint a good corps of supervisors to infuse professional consciousness in teachers and guide them to improve (their) performance” (p. 15), teachers must perceive the supervisory activities of present and future officials in a positive light.

These officials should be conversant with the teaching of mathematics at the pre-tertiary level of the education system. Admittedly, it would be extremely expensive to appoint supervisors subject by subject, yet if the emphasis the government is putting on mathematics, science and technology is to translate into real gains in these fields, then there is the need to train professionals who would help teachers in these areas. Such professionals when appointed should go through a period of intensive training during which time they would be exposed to different uses of appraisal and how they can be applied to suit local conditions. In addition to the pre-service training, they must be given the opportunity to attend international courses and conferences on appraisal. Another important observation is that, the findings of the present study call for the reintroduction of mathematics and science organisers at the district offices. These organisers were redeployed as part of the reform programme. Many of them are now in charge of Basic

Education Certificate Examinations, serving as links between the district offices and the West African Examinations Council. This redeployment has clearly led to waste of vital “resources”. These specialist officers ought to be responsible for the professional development of junior and senior secondary mathematics and science teachers whereas the present supervisors would concentrate on the general running of the schools by heads and deal with matters relating to allocation and uses of educational facilities. This means that the organisers must be very well qualified and experienced teachers some of whom may even be drawn from the universities. Should the circuit supervisors need information about mathematics teachers’ professional needs, they should collect such information from the mathematics organisers, who will only give such information with the teachers’ consent.

With regard to appraisal for promotion and other summative purposes, the GES should train officers who would be able to ‘assess’ teachers’ performance accurately if such assessment would be needed for such summative purposes. Most importantly, the promotion interview should reflect the type of work teachers do in their classrooms as such a move could encourage teachers to learn more

about what is expected of them as mathematics teachers. It appears that one of the reasons why appraisers at promotion interviews do not attempt to ask mathematics teachers any question about the subject is their lack of confidence in the subject. This means that if the promotion interview is to reflect mathematics teachers' classroom work, then those who interview them must be mathematics specialists who would understand the various problems facing mathematics teachers in the secondary schools.

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