PRESERVICE TRAINING FOR SCIENCE TEACHING AND THE SUBSEQUENT CLASSROOM PRACTICES OF TEACHER-GRADUATES

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ABSTRACT

This study has investigated the effects of a massed and a spaced preservice programme of science training on the subsequent classroom practices of the graduates of these programmes after they had spent 6 months as year-one teachers.

The investigation was conducted in 2 phases. Phase 1 entailed an examination of the training presented to the preservice teachers and the instructional behaviours used by the science lecturers during the presentation of training. Phase 2 involved an examination of the classroom practices of the teacher-graduates.

The sample for the first phase of the study comprised 5 science lecturers and 120 preservice teachers. For Phase 2 the sample comprised 20 volunteer teachers from the earlier sample, 7 of whom had received spaced curriculum training over a period of 2 years (group 1) and 13 of whom had received massed curriculum training over a period of 6 weeks (group 2).

Information gathering techniques included direct observation and audiorecording of the curriculum training sessions and the subsequent science lessons of the 2 groups of teachers, as well as structured interviews and a questionnaire. A system developed by Adams (1965) was used for the analysis of the teaching patterns of both science lecturers and teacher-graduates.

The results of the study revealed that both groups of teachers:

(i) indicated that they were using 47 competencies presented during preservice training with a "high" mean level of success;

(ii) attributed their capability to use such competencies to preservice training, and

(iii) reported that the use of these competencies had a "<u>high</u>" mean level of influence on their overall level of success as science teachers.

The results also revealed that of the 6 teaching patterns with which they were compared, the averaged teaching patterns of both groups of teachers resembled mostly the <u>actual teaching patterns of their respective lecturers</u>. Moreover, on an individual basis:

(i) the (averaged) functional patterns of <u>15 of the 20 teachers</u> resembled the averaged <u>functional patterns of their respective lecturers</u>; and

(ii) the (averaged) structural patterns of <u>18 of the 20 teachers</u> resembled the averaged <u>structural patterns of their respective lecturers</u>.

From this it was concluded that the teachers <u>modelled the teaching patterns of their lecturers</u>.

In addition to such findings the following conclusions were drawn from the study:

(i) Both massed and spaced enquiry-oriented, science curriculum training did appear to be effective means for ensuring teacher-use of competencies provided during preservice training.

(ii) Positive transfer of training did appear to have resulted from programmes of training with the same objectives of the syllabus which the graduates of these programmes subsequently used.

(iii) Preservice training in science teaching <u>did</u> effect positive teacher attitudes towards the teaching of science.

(iv) Preservice training in science teaching <u>did</u> appear to influence the teachers' own perceptions of how elementary science <u>should</u> be taught.

(v) Role modelling did appear to be an effective means of promoting specific teaching behaviours in teachers.

(vi) Although teacher-perceptions of the recommendations of their lecturers did appear to influence their own concepts of how science <u>should</u> be taught more than the actual behaviours of their lecturers, the <u>behaviours of their lecturers</u> did appear to have influenced their own teaching patterns <u>more</u> than their <u>own recommendations</u>.

(vii) The teachers' ability to <u>control</u> pupils during science classes did appear to have <u>the highest</u> level of influence on their overall level of success as science teachers.

(viii) The teachers' own <u>knowledge</u> and <u>understanding</u> of science did appear to be less influential on their science teaching success than was their own <u>ability to teach whatever science they knew</u>.

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CONTENTS

Page

LIST OF TABLES

Table		Page
8	Competencies for which the Averaged Scores of Group 2 yielded Higher Attribution Ratings than those of Group 1	108
9	Competencies for which the Averaged scores of Group 2 yielded higher Success Ratings than those of Group 1 but in which the Averaged Scores of Group 1 yielded higher Attribution Ratings than those of Group 2	109
10a	Lecturers: Recommended Functional Time	124
10b	Lecturers: Recommended Structural Time	125
11a	Lecturers: Actual Functional Time	134
11b	Lecturers: Actual Structural Time	135
12a	Teacher-perceptions of Lecturers' Functional Recommendations	163
12b	Teacher-perceptions of Lectuers' Structural Recommendations	164
13a	Teacher-perceptions of Lecturers' Functional Transactions	178
13b	Teacher-perceptions of Lecturers' Structural Transactions	179
14a	Teacher-perceptions of "Pre-College" Teachers' Functional Transactions	197
14b	Teacher-perceptions of "Pre-College" Teachers' Structural Transactions	198
15a	Teachers: Recommended Functional Time	207

LIST OF FIGURES

Figure		Page
24	Lecturer-transactions: Range and Mean	133
25	Science Lecturers: Actual Transactional Patterns	138
26	Lecturer-transactions: Actual and Recommended	142
27	Actual Transactional Pattern versus Recommendations: Lecturer 1	145
28	Actual Transactional Pattern versus Recommendations: Lecturer 2	149
29	Actual Transactional Pattern versus Recommendations: Lecturer 3	152
30	Actual Transactional Pattern versus Recommendations: Lecturer 4	155
31	Actual Transactional Pattern versus Recommendations: Lecturer 5	158
32	Teacher-perceptions of Lecturer-recommendations: Range and Mean	166
33	Perceived lecturer-recommendations: Group 1	168
34	Perceived lecturer-recommendations: Group 2	170
35	Perceived versus Actual Lecturer-recommendations: All Teachers	172
36	Perceived versus Actual Lecturer-recommendations: Group 1	174

Figure		Page
37	Perceived versus Actual Lecturer-recommendations: Group 2	176
38	Teacher-perceptions of Lecturer-transactions: Range and Mean	181
39	Perceived Lecturer-transactions: Group 1	183
40	Perceived Lecturer-transactions: Group 2	185
41	Perceived versus Actual Lecturer-transactions: All Teachers	187
42	Perceived versus Actual Lecturer-transactions: Group 1	191
43	Perceived versus Actual Lecturer-transactions. Group 2	194
44	Teacher-perceptions of School Teachers' Transactions: Range and Mean	199
45	Perceived School Teachers' Transactions: Group 1	201
46.1	Perceived School Teachers' Transactions: Group 2	203
46.2	Perceived School Teachers' Transactions: Groups 1 and 2	205
47	Teacher-recommendations: Range and Mean	210
48	Recommended Transactions: Group 1	212
49	Recommended Transactions: Group 2	214

Figure		Page

INTRODUCTION

Science curriculum courses have now become a familiar component of many teacher-training programmes. The presupposition which undergirds all such programmes is that whatever is taught will:

(i) be learned by the trainees, and
(ii) be subsequently employed by them in the context of the classroom.

Numerous studies have examined the effects of various aspects of science curriculum training on the subsequent practices of teachers, and many have yielded favourable results. However, most studies, whether preservice or inservice in focus, have been set largely within the confines of the training period itself and have been concerned with immediate or very short-term effects. Consequently, whether or not science teachers persist in "using" their training is generally unknown. The need for studies focusing on the effects of training on the subsequent behaviours of science teachers has been emphasized by Parish (1968), Brown (1977), and Campbell and Okey (1977).

The present study attempts to bridge the gap between "short-term" and "long-term" studies by examining the relationship between preservice training in elementary science teaching and subsequent classroom practices of the programme's graduates after a period of 6 months as year-one teachers.

However, interwoven in any presage/process investigation are a number of "hidden" variables. Whether a teacher uses competencies gained, or taught, during preservice training could be due to a number of factors other than training - including for example, the training received in <u>other</u> curriculum courses, or results of trials and errors within the classroom. They could also be due to the models of teaching behaviours observed in other teachers (prior, during or after training) and to perceptions of the teaching strategies that should be employed.

Accordingly, the study not only investigates the correspondence between the competencies learned and teaching strategies used by the year-one teachers and those taught during preservice training, but it also seeks to establish:

(i) the extent to which the year-one teachers perceive their capabiity to use such competencies and teaching strategies to be directly attributable to training, and

(ii) the relevance of preservice training to the teaching situation as reflected in the year-one teachers' belief that science curriculum training enhanced their overall level of success as science teachers.

In other words, the study sets out to test, in a relatively modest fashion, the way in which a specific programme of science teacher-training affected the subsequent classroom practices of the teachers who had graduated from it. Necessarily, it also attempts to arrive at some explanation of the results achieved.

The study itself is organised into 6 chapters. The first chapter examines the problem in broad perspective, incorporating a review of the relevant literature. Chapter 2 deals with the problem specific including certain theoretical implications and research findings related to the problem. Chapter 3 on methodology, describes the procedures of sampling, data collection, and data analyses. The findings of the study are presented in Chapters 4 and 5, while chapter 6 deals with a discussion of the findings and conclusions of the study.

CHAPTER 1

REVIEW OF THE LITERATURE

The purpose of this chapter is to present a review of the literature pertinent to the study. The study itself deals mainly with the contents of "process oriented" training of preservice elementary science teachers and the students' subsequent application of this training after a period of 6 months as year-one teachers. It also investigates the effects of observational learning on the teaching patterns of the teacher-graduates. Accordingly, the chapter focuses mainly on research into the effects of various aspects of process oriented training on the ensuing competencies and teaching behaviours of elementary science teachers. It also covers some of the relevant research into the effects of observational learning and microteaching on the teaching behaviours of science teachers - primarily at the elementary school level.

To date, the vast majority of research dealing with the effects of process oriented training for elementary science teaching on subsequent teacher-practice has emphasized either:

(i) specific skills,
(ii) competencies, or
(iii) teaching behaviours.

It has also tended to have been confined to either pre-service or inservice teachers. The findings of these studies, though generally encouraging, leave open the question whether the skills, competencies, and teaching behaviours that teachers initially employ as a result of training will persist over a substantial period of time or not.

The existing research has reported increases in the knowledge of process skills gained from process training (Wilson 1967; Breit and Butts, 1969; Sabulao, 1973; and Campbell and Okey, 1977). Further, Jaus (1975); Brown (1977); Campbell and Okey (1977); and Bluhm (1979) also reported that training with "hands-on" activities designed to teach science process skills, led to substantial improvement in the preservice teacher's ability to use such skills. However, the increase in the use of process skills is not restricted to hands-on instruction. For example Riley (1979) found that preservice teachers' competence in selected process skills could be improved by either a "hands-on" or a "non-manipulative" approach to training.

Fletcher (1969), and Menzel (1968) also found no significant differences in the performance of teachers trained by different instructional methods. Fletcher compared "student-centred" versus "teacher-centered" instruction in elementary science methods classes. Menzel, on the other hand, compared the effects of four alternative procedures: -

(1) "active instruction,"
(2) "passive instruction involving a reading situation"
(3) "alternating active instruction with passive instruction" and
(4) "combined active and passive instruction" all concerned with teaching the processes of classifying and measuring.

In the study no significant differences were found between the groups for classifying while any differences that were found for measuring were restricted to the groups which received "alternating active and passive instruction."

Other research showed that teacher subjects not only acquired the process skills for which training was provided but they were also more willing to use these skills in the classroom than those who were not so trained (Wilson, 1967; Jaus, 1975 and Cotten *et al.*, 1978). Jaus found that "few teachers were willing to provide instruction to children in areas in which they had very little competence." However, "prospective elementary teachers" who had participated in training in "integrated process skills" "wrote significantly more instructional objectives designed to teach [such] skills to children" than did teachers who were untrained in these skills. These same trained teachers also "designed instructional materials" to bring about integrated skill acquisition in the children they taught. (These findings also parallel those of Campbell and Okey 1977). The untrained teachers in the study although they desired to teach integrated process skills were unable to either plan for it or do it. Jaus concluded, not altogether surprisingly, that the teaching of process skills requires both "will and skill".

Zeitler (1981) used both microteaching and model viewing for the teaching of process skills. The results showed that not only did the teachers taught by both methods show "significant gains" in the acquisition of these skills but they also "incorporated these skills in their lesson plans."

In addition to such findings, science methods classes have been shown to increase significantly preservice teachers' ability to use in class "background information"; child group experiments; and "children's observations, conclusions, and verification of conclusions" (Harris *et al.*, 1970).

The findings of research on the training of elementary science teachers and their subsequent teaching behaviours reveal that training generally results in positive changes in teaching behaviour. For example, Masla (1968) studied "the effects of instruction in interaction analysis on the verbal inquiry patterns of elementary science methods students." He found that teachers trained in interaction analysis asked more "open-ended questions" and engaged in "a significantly greater proportion of unpredictable responses" than those who were not. In addition to this, research alied to Flanders Interaction Analysis generally found that teachers trained in interaction analysis:

(i) used more praise (Simon, 1966; Hough *et al*, 1969; Bondi, 1970);

(ii) were more indirect in their teaching (Finske, 1967; Kirk, 1967; Hough *et al*., 1969; Simon, 1966; Parish, 1968; and Bondi, 1970);

(iii) encouraged more pupil talk (Finske, 1967; Masla, 1968; Hough *et al*., 1969; Parish, 1968; and Bondi 1970).

(iv) were more flexible in their teaching (Finske, 1967);

(v) used less criticism (Simon, 1966; Hough *et al*., 1969; and Bondi, 1970).

In addition, Parish (1968) found that the pupils of such teachers "interjected their ideas more freely into discussions than did the pupils of teachers not trained in interaction analysis". These findings coincide with those of Hough *et al*. (1969) and Bondi (1970), where it was also found that interaction analysis trained teachers used less lecturing than those who were not so trained.

Despite the popularity of Flanders Interaction Analysis, predictably, not all research on the effects of training on the teaching behaviours of elementary science teachers involved training in interaction analysis. Kondo (1968), and Porterfield (1969), using learning materials from "Science Curriculum Improvement Studies" (SCIS), studied the effects of training on the questioning behaviours of science teachers. Kondo first found that individual teachers showed "differences in the complexity of questioning patterns". He also found that the <u>manner</u> in which a teacher approached a lesson influenced the kinds of questions that were used more than the type of lesson itself. Porterfield, on the other hand, found that teachers trained in the SCIS programme used more "translation, interpretation, analysis, synthesis and attitude or value questions" than the untrained group. Although both groups used a high proportion of recall questions, the trained group used proportionally fewer - 34% as opposed to 44% by the untrained group.

Schmidt (1969) also studied the questioning behaviours of teachers. After an enquiry-centred course of "new science" his teachers used more divergent questions, and asked fewer recall and convergent questions than before.

Using a somewhat different approach, Simmons (1973) used a programme "designed to be compatible to the objectives and philosphy of the Science Curriculum Improvement Study" (SCIS). Simmons found that the teachers so trained "practiced more of the desired behaviours" than did the untrained ones . Berkely (1968) studied the effects of training in the OScAR technique on prospective teachers and found that it had a "positive effect" on their verbal behaviours. Sunal (1980) used a field experience to effect desirable teaching behaviours in his preservice teachers.

The effects of training on the subsequent teaching behaviours of science teachers have also been investigated using video, audio, and written models as media for conveying specific teaching behaviours. Yeany (1977) found that the "teaching styles" of preservice elementary science teachers changed after training that employed a combination of the "viewing of videotaped model lessons" and training in "teaching strategy analysis and planning". Based on the results of this study Yeany recommended a curriculum which would include:-

(i) the "viewing of model science lessons" and
(ii) "systematic teaching strategy analyses".

Santiesteban and Koran (1977) used both video and audio models for the training of preservice teachers in science teaching skills. The results showed that both models were "effective in producing the types of behaviours displayed by the models". Newport and McNeill (1970); Bruce (1971); and Moon (1971); all used written models as a means of promoting specific enquiry behaviours in elementary science teachers. Rezba (1971) and Rezba and Anderson (1976), however, used a "written model" in conjunction with a "perceptual model" to convey desirable verbal behaviours to preservice teachers. After exposure to these models the preservice teachers displayed "significant changes" in their verbal behaviours.

It would also appear that teachers may unconciously model the teaching behaviours to which they are exposed. According to Bandura (1977): -

> *Observational learning relies mainly upon two representational systems - imaginal and verbal. Some behaviour is retained in imagery. Sensory stimulation activates sensations that give rise to perceptions of the external events. As a result of repeated exposure, modeling stimuli eventually produce enduring, retrievable images of modeled performances. On later occasions, images (centrally aroused perceptions) can be summoned up of events that are physically absent.* (p. 25)

This phenomenon was confirmed by Freyberg *et al* (1974). In their study of "the vicarious learning of skills in a microteaching programme" they reported changes in the teaching behaviours of "participants" "even when they were only observers and did not practice the skills concerned".

Not only has model viewing been reportedly effective in changing the teaching behaviours of preservice elementary science teachers but so also has been the use of microteaching. De Marte (1971) used microteaching along with videotaped models to change the verbal behaviours of second and third grade science teachers. Steinbach and Butts (1969) compared the behaviours of preservice teachers during micro-teaching practice sessions involving on the one hand, peer teachers and on the other, children. The results showed that, with small exceptions, the teachers who taught peers "developed competencies and attitudes similar to those who taught children". Those who taught children however, tended to teach in a "more indirect" manner, used "more questions", and "more clarifying of pupil responses". Those who taught peers displayed more "overt silent activity" and tended to focus more on "student talk" and "clarification of ideas."

Wright *et al.* (1969) studied the effects of microteaching on the verbal behaviours of preservice teachers. In the words of the authors: -

> *The microteachers advanced considerably in their ability to conceptualize their own and other teaching behaviour and this might provide for them their greatest long term gain. This led them towards an increasing facility in stating specific objectives, predetermining teacher strategy congruent with these, and evaluating their teaching towards such objectives. It seemed that their teaching showed a more business-like approach and a growing economy of presentation. There was a noticeable shift of concern from content to teaching strategy.*
>
> Wright, Nuthall and Lawrence, 1969 pp 72-73).

Admittedly, most of these studies have been relatively short-termed and most have been specifically aimed at either the pre-service or inservice teacher. Nevertheless the findings indicate that teachers do practice (at least initially) comp-etencies and teaching behaviours for which they have been trained.

Whether or not these behaviours persist after a substantial period of time in the natural classroom is generally unknown at the moment. Parish (1968), Brown (1977), Campbell and Okey (1977) and Yeany (1977) have mentioned the need for research in this area.

The present study, recognizing the latter point, seeks to wed the two issues of training, and the persistence of the effects of training. Accordingly, it investigates first the training and second, the classroom practices of elementary science teachers after a period of six months as year-one teachers. Third, it seeks to discover whether or not the teaching behaviours of the first-year teachers are affected by: -

(i) the science teaching behaviours to which they were exposed at Teachers College or prior to Teachers College; or

(ii) their own perceptions of the manner in which elementary science should be taught.

Fourthly, it seeks to ascertain the extent to which the first-year teachers attribute their skills, competencies, and teaching patterns to preservice training for science teaching.

A detailed description and general discussion of the problem follow in Chapter 2.

CHAPTER 2

STATEMENT AND DISCUSSION OF THE PROBLEM

This chapter is concerned with the statement and general discussion of the research problem. The first part of the chapter presents an outline of the issues with which the problem deals. In the second part of the chapter these issues are discussed in relation to certain theoretical implications and research findings which have a direct bearing on the problem.

The problem itself is multidimensional. At heart it is concerned with the correspondence between science curriculum training and first-year teacher-practice. However, the connection between teacher-training and first-year teacher-practice is a complex one. The underlying logic however, is straightforward: If training is to be utilized by teachers it must first be learned, presumably then, whatever is learned ought to correspond, in some way, to what was taught. If so, a number of questions follow.

Firstly, having completed a programme of training, will first-year teachers necessarily employ the competencies for which provisions were made during training?. Secondly, if these competencies <u>are</u> employed, to what extent is this due to the actual process of training?. Furthermore, and thirdly, how will the employment of these competencies influence the overall level of competence required by the first-year teachers in their respective teaching situations?. Fourthly, are the teaching patterns of the first-year teachers those that were <u>recommended</u> by the lecturers during training or are they the result of some other factor?. Are they, for example, the result of the learning that was <u>received</u> by the teachers during the process of training?, or sixthly, are they the result of the teaching patterns which the teachers <u>observed</u> in their past instructors (either at Teachers College or prior to Teachers College)?. Seventhly, to what extent are the teaching patterns of the first-year teachers attributable to the actual process of training?. Eighthly, to what extent are the teaching patterns of the teachers attributable to the teaching patterns that they observed in their instructors either at Teachers College or prior to Teachers College?. Ninthly, and finally, what part does the first-year teacher's own concept of the manner in which he or she <u>should</u> teach play in determining his or her particular style of teaching?.

These are the main issues with which the study deals. The following part of this chapter covers a general discussion of these issues in the light of certain pertinent theoretical considerations and research findings.

The general assumptions which lie behind the provision of Teachers Colleges is that learning will occur and that this learning will be employed subsequently by teachers in the classroom situation. However, the failure of teachers to use the training given at Teachers Colleges has been mentioned repeatedly. Wallen and Travers (1963), and Hoyle (1970) have each reported disparities between training and the subsequent teaching patterns of teachers. Hilliard (1968) Morris (1969), and Tibble (1972) have also noted disparities between educational theory and teacher - practice. This discrepancy between training and subsequent practice is not new. As early as 1949, Ryle distinguished between "knowing <u>how</u>" and "knowing <u>that</u>". To Ryle, "knowing <u>that</u>" is referred to as "the stocks of truths [which one] acquires and retains", whereas "knowing <u>how</u>" entails the operationalization or "application" of the "truths that are learned."

Concerning the same issue Gage (1978) asserts that "knowledge <u>how</u>" does not necessarily follow from "knowledge <u>that</u>" and gives the following example: -

> *We may know <u>that</u> reinforcers strengthen responses but not know <u>how</u> to reinforce a pupil so as to strengthen the child's tendency to participate in class discuss-ions. Similarly, we may know <u>that</u> criticism in very small amounts may be good for the achievement of more academic-ally oriented pupils but not know <u>how</u> to limit our criticism to those small amounts for that kind of pupil .*
>
> (Gage, 1978, p. 44).

In addition to the hiatus that seems to exist between teacher-training and teacher-practice, Principals and Heads of Depart-ment's frequently complain that novice teachers often fail to use many of the skills and competencies necessary for effective teaching. As a result, the general level of their success as teachers is thought to be reduced. The salient issue here is whether or not the skills and competencies presented during training coincide with those required by the teachers in their respective teaching situations.

But beyond the expectations of teacher-educators that learning will result from training lies another - that the mechanisms used for teaching will bring about that learning. The working of these mechanisms however, is a matter of contention even among theorists.

For example, Bruner (1961 and 1966*), takes a cognitivistic approach to instruction where learning is viewed as leading to "the achievement of knowledge or skills" and "<u>discovery learning</u>" is the desired medium. To Bruner efficient instruc-tion is characterised by learning experiences which:

(i) provide individuals with appropriate motivation to learn within the learning environment;

(ii) "are structured so that they can be most readily grasped by the learners;"

(iii) are sequenced in such a way that learning is facilit-ated; and

---

* entire book

(iv) provide the learners with "intrinsic rewards inherent in solving complex problems for themselves".

According to Bruner, the benefits which may be derived from "discovery learning" are: -

(i) an "increase in intellectual potency",
(ii) a "shift from extrinsic to intrinsic rewards",
(iii) "learning the heuristics of discovery," and
(iv) an "aid to memory processing".

But not all proponents of the cognitive approach to instruction are in total agreement. Ausubel (1968) has expressed some reservations about "independent discovery" and advocates the use of other instructional procedures including the "expository" method. Others like Hunt (1966) and Torrance (1966), have openly opposed "pure discovery" as a form of instruction and are more in favour of "guided learning".

Unlike cognitive theorists, advocates of Behaviour Modification such as Skinner (1968), and Bandura (1969) are more concerned with the behaviours that are exhibited by individuals.

Skinner views effective instruction as entailing a situation where: -

(i) tasks within the programme are analysed into manageable steps each of which adequately prepares the student for a subsequent learning task;

(ii) learning experiences allow students to work at their own pace; and

(iii) each correct response is immediately followed by positive reinforcement which could be either intrinsic or extrinsic.

By contrast, Rogers (1969), and Maslow (1968) take a Humanistic position with respect to instruction. They emphasize self-initiated learning that is relevant to the learner, and which takes into account affect as well as cognition. The emphasis is always on the learner who is free to choose his own learning task and to decide when and how it should be learned.

Gagné (1970), a proponent of "hierarchical learning", sees effective instruction as necessitating "a systematic plan". His system of instruction demands the taking into account of conditions "within" the learner such as "the developmental readiness" of the learner, and "previously learned intellectual skills", as well as conditions "external" to the learner, for example the "arrangement" and "timing" of learning events. To Gagné, the 9 steps of instruction are as follows: -

> 1. *Gaining and controlling attention.* An external stimulus arouses the appropriate attentional set.
> 2. *Informing the learner of expected outcomes.* Communication, usually verbal, tells the learner about the kind of performance he will be able to do after he has learned.
> 3. *Stimulating recall of relevant prerequisite capabilities.* The learner is reminded of the relevant intellectual skills, and also verbal knowledge, he has previously learned.
> 4. *Presenting the stimuli inherent to the learning task.* The particular stimuli to which the newly learned performance will be directed are displayed.
> 5. *Offering guidance for learning.* Usually by verbal communications the learner's thinking is directed by prompts or hints until the essential performance is achieved.
> 6. *Providing feedback.* The learner is informed of the correctness of his newly attained performance.
> 7. *Appraising performance.* Opportunity is provided for the learner to verify his achievement in one or more situations.
> 8. *Making provisions for transferability.* Additional examples are used to establish increased generalizability of the newly acquired capability.
> 9. *Insuring retention.* Provisions are also made for practice and use of the new capability so that it will be remembered.
>
> (Gagné, 1970, p. 304).

It is certainly not uncommon to find the "discovery learning" of Bruner, the "experiential learning" of Rogers, the reinforcement principles of Skinner, the "hierarchical learning types" of Gagné, and other instructional theories (in part or in their entirety) incorporated into teacher-training programmes. However, whether the instructional procedures employed by teacher-educators themselves conform to any one instructional position is an empirical question. On face value, it appears that a common practice of teacher-educators is to provide teacher-trainees with a theoretical knowledge of teaching - i.e. strategies of instruction; techniques of questioning; methods of class motivation, management and control; factors and conditions which facilitate learning, and so on - and intersperse these theories with: -

(i) periods of practical activities such as simulated classroom interactions; peer-teaching; films; videotapes and direct observation of aspects of teaching processes; microteaching; and the like; and

(ii) actual periods of classroom practice. The goal of the entire process being that the competencies and teaching strategies presented during training will be employed by the graduates of these training programmes in the classroom situation.

But using a particular style of instruction for the presentation of training is one thing. Whether or not this style of instruction is effective in producing the intended learning is another. Similarly, the exposure of teacher-trainees to specific competencies, and teaching strategies is no guarantee that all of these competencies, and strategies will be subsequently employed by them, or that, as teachers they will persist in using these competencies and teaching strategies in their subsequent teaching. In other words, there is no guarantee that any lasting transfer of training will occur. Some of the earlier studies on transfer of training have produced considerable experimental evidence to show that positive transfer of training can occur (Baker and Wylie, 1950; Gagné and Baker, 1950; Rossman and Goss, 1951; and McAllister 1953) but other studies have shown that positive transfer of training does not always occur (Hilgard *et al.*, 1954; Battig, 1956; Burack and Moos, 1956; Battig *et al.*, 1957; and Hoffeld, 1957).

While the teaching practices of first-year teachers may be a direct outcome of the training given, there are a number of other logical possibilities to which they may be due. Firstly, the skills and teaching competencies that year-one teachers employ, although similar to those for which provisions were made during teacher training, may have been developed by trial and error within the classroom.

Secondly, the teaching behaviours of the teachers may be in accordance with their own concepts of the course of action appropriate for a teacher to employ. There are a number of reasons why this could be the case. Although the teacher may set out to practice the teaching behaviours that he was taught to use, the actual nature of the classroom interactions themselves could influence his teaching behaviours to the disadvantage of the original intention.

After studying the teaching processes of preservice elementary science teachers, Irwin and Butts (1972) concluded that the teaching behaviours of their teachers were "influenced more by the children taught than by the actual instructional task". Apart from this, the rapid pace* of classroom transactions often leaves little room for reflection about prescribed teaching behaviours. According to Jackson (1968):

> *At the simplest level it seems the teacher is just too busy to be bothered with the intellectual and pedagogical frills of learning theory and precisely defined objectives. Faced with twenty or thirty restless students he has enough to do without worrying about whether*

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* Adams (1965), and Rowe (1974) have also observed this rapid pace of classroom interactions.

> *his behaviour is in accord with the pronouncements of the theorists....* (P. 166).

The tendency of the teacher, at first, is to use behaviours appropriate for meeting the needs of the situation as it exists at the time. Later, when the class is better known, behaviours that evoke desired responses, or achieve desired objectives, are used and those that do not are avoided.

Thirdly, the year-one teachers may be practicing the teaching behaviours that they received from the teacher-training process but these behaviours may not necessarily be the learning that was intended by the teacher-educators. There are two possible causes for this "unintended learning". Firstly, the content of the training that is transmitted by the teacher-educators may differ from that which is received by the teacher-trainees because whatever learning is received by the teacher-trainees will depend on their own perceptions of what is being transmitted. Secondly, the style of presentation of training may effect in the teacher-trainees a totally different type of learning than that which was intended by the teacher-educators, namely, observational learning. In the course of presenting instruction, the teacher-educators themselves are exhibiting particular patterns of teaching on which the teacher-trainees can model their own teaching behaviours. According to Good and Brophy (1973) "the potential for modelling effects exists at all times". Concerning the same phenomenon Bandura (1969) has deduced from some of his earlier studies that an individual's "exposure to modelling influences" may result in his acquisition of "new response patterns which did not previously exist in his behavioural repertoire". Further, Bronfenbrenner (1970) has reported that: -

> *the potency of the model is enhanced when the behaviour exhibited is a salient feature in the actions of a group of which the [observer] already is or aspires to be a member.* (P. 134).

Certainly this factor could be operative in the case of the teacher-trainees. Further, the possibility of teacher-trainees modelling the teaching behaviours of the teacher-educators is credible in light of the fact that knowledge of how to perform a task is no guarantee that one will be able to practice this task in a practical situation. Gagné (1970) has stipulated that knowledge of a concept could mean "nothing more than the use of a new entity as a concept". This, coupled with the fact that students generally tend to follow a set of actions rather than a set of ideas (Bryan and Walbek, 1970) could provide explanatory power to the argument that trainee teachers may model the teaching patterns of their teacher-educators. Subsequently the teachers though equipped with a knowledge of the instructional behaviours that are prescribed for use in the schools, when faced with the reality of teaching, may resort to instructional strategies which they have actually seen in operation.

Bronfenbrenner (1970) has reported a "two-phase process" of "acquisition and performance" whereby behaviours may be "acquired" by observing a model but may not be used until a later time when conditions are suitable for their use. This same phenomenon has been reported by Bandura and Walters (1970) and Bandura (1977). Because of this, another issue arises - that of year-one teachers' modelling the teaching behaviours of teachers to which they were exposed prior to Teachers College. If acquired observational learning can be stored and used at a later period of time, it can be reasonably assumed that the teaching behaviours of year-one teachers could either be based on the styles of instruction they observed at Teachers College, or prior to Teachers College.

*McGoech (1942) however, has theorised that new learning can actually contribute to the process of forgetting. According-

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* From: Bugelski, B.R., The Psychology of Learning, Henry Holt and Company, New York, 1956, pp. 303-337.

ing to his "Theory of Interference", forgetting results because of the interference of subsequent learning on previously learned responses. In light of this theory it would seem that the odds are in favour of the year-one teachers' modelling the instructional behaviours of their teacher-educators, since exposure to them is more recent. But, as early as 1927 Pavlov noticed that learning or responses which had been forgotten or extinguished by subsequent learning, "spontaneously" recurred at some future date.

Later, a study by Hall (1955) showed that after 21 days, interpolated learning materials had no significant inhibition on the recall of earlier learning. Also, Ausubel and Blake (1958) have found that learning materials interpolated immediately after (or given immediately before) a specific learning task had no significant impairment on the retention scores of the experimental subjects. It follows then that although there is a likelihood that year-one teachers could model the instructional behaviours of their teacher-educators, the possibility remains that they could also model the general patterns of teaching to which they were exposed prior to Teachers College.

To sum up, the main points of the problem are as follows: Firstly, to establish:

(i) the extent to which first-year teachers employ the teaching competencies that they were instructed to use during science curriculum training;

(ii) the extent to which capability to use these competencies is attributed to training for science teaching; and

(iii) the extent to which the employment of these competencies influences the overall level of competence required by the first-year teachers in their actual teaching situations.

Secondly, to establish the relationship between the actual teaching patterns of the first-year teachers and: -

(i) the teaching patterns that they were instructed to use during science curriculum training;

(ii) their own perceptions of the teaching patterns that they were instructed to use during science curriculum training;

(iii) the teaching patterns to which they were exposed during science curriculum training;

(iv) their own perceptions of the teaching patterns to which they were exposed during science curriculum training;

(v) their own perceptions of the science teaching patterns to which they were exposed prior to Teachers College; and

(vi) their own concepts of the course of action appropriate for a science teacher to use.

Thirdly, to ascertain the extent to which first-year science teachers attribute their own teaching patterns to:

(i) the teaching patterns that they were instructed to use during science curriculum training;

(ii) the teaching patterns of their science instructors at Teachers College;

(iii) the teaching patterns of their science teachers prior to Teachers College; and

(iv) some other factor.

However, because of the programme operating at the Teachers College that is to be used, a further dimention is added to the research problem. Some trainee teachers receive a more concentrated form of curriculum training than others. Because of this, another question arises: What effect does the spacing or massing of training have on the first-year teachers' use of instruction given during training?. Several theories convey the idea that learning is promoted more by massed practice than by spaced practice. Two such theories are the *Principles of Frequency and Recency formulated by Watson (1878-1958). According to the Principle of Frequency - 'the more frequently a given response is made to a given stimulus the more likely it would be for that response to be made to that stimulus again'. According to the Principle of Recency 'the more recently a given response is made to a given stimulus the more likely it would be for that response be made again'. Thus long spaces between learning sessions would tend to decrease the likelihood of continuity of the same response from session to session.

Thorndike (1932)** contended that frequency of practice was "inadequate" as an explanation of the "cause of learning". In one of his experiments, blindfolded subjects were told to draw lines six inches in length and were given no reinforcement. After many such trials with no improvement Thorndike begun to reinforce responses by saying "Right" when responses were within 1/4 of an inch of the correct length. Thereupon, responses began to improve. The conclusion that Thorndike drew from this and other experiments was that "the repeated occurrence of a situation, in and of itself, does not produce adaptive learning".

The preceeding experiment was one of a series of tests to which Thorndike subjected his Law of Exercise which asserts that, "other things being equal, the oftener a situation connects with or evokes or leads to or is followed by a certain response, the stronger becomes the tendency for it to do so in the future". (Thorndike 1971, page 6).

The Law of Exercise subsumes two other laws,*** the Law of

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* Definitions based on an account by Hill, Winfred, F., Learning A Survey of Psychological Interpretations, revised edition, Chandler Publishing Company,Scranton/Toronto/London, 1971, p. 37.

** Thorndike, E.L., The Fundamentals of Learning, First AMS edition, AMS Press Inc. New York N.Y. 10003, 1971, pp. 170-206.

*** Thorndike, E.L., Educational Psychology, Vol 2, Greenwood Press Publishers, Westport, Connecticut, 1970, pp. 2-4.

Use and the Law of Disuse. The Law of Use states that "when a modifiable connection is made between a situation and a response, that connection's strength is, all things being equal, increased". This would suggest that, in a given situation, frequency of practice is beneficial for continuity in the learning of a specific task. The Law of Disuse states that "when a modifiable connection is not made between a situation and a response during a length of time, that connection's strength is decreased". The implication here is that shortly-spaced practice sessions are beneficial for continuity in the learning of a specific task.

Despite the controversy between the two theorists, Watson's Principles of Frequency and Recency, and Thorndike's Law of Exercise, each predict an increase in learning when practice is massed rather than spaced. The present research does not take any particular position as to the efficiency of the one type of practice in promoting learning over the other, but is rather concerned with the type of teaching performance which results from both situations. The real efficacy of massed training and spaced training will be determined by the correspondence between the competencies and teaching behaviours that each group of year-one teachers display in the classroom, and those that were presented to them during the process of science curriculum training.

In its investigation of the many questions surrounding the research problem, this study deviates from the general procedure of the formulation and testing of hypotheses. Instead, it maintains a purely exploratory position and seeks answers to the issues outlined in the previous part of this chapter.

The procedures by which these issues were investigated are presented in the following chapter.

CHAPTER 3

PROCEDURES OF DATA COLLECTION AND ANALYSIS

This chapter describes the procedures by which the issues outlined in Chapter 2 were investigated. They include sampling, data collection, coding and data analysis.

The study entailed the use of 1 Teachers College and 19 schools in the North Island of New Zealand. In common with all institutions, the Teachers College and the schools possessed their own peculiar organizational structures and practices. Accordingly, the investigation of the research problem was constrained by the existing realities of the institutions in which the study was conducted. The salient operational problem thus became: "How, within the existing organizational structures of the College and schools, could the broad research problem be tested?"

The investigation of the relationship between preservice training in science teaching and subsequent teacher-practice required the acquisition of a variety of information. Firstly, knowledge had to be gained about the nature of the science curriculum training given to preservice teachers, and the manner in which this training was presented. This would not only entail an examination of the contents of the science courses taught, and the interviewing of lecturers responsible for training, but also direct observation of training sessions. In addition, verification of the specific types of teaching behaviours recommended by each science lecturer for the teaching of elementary science would have to be obtained, probably by a series of interviews. With the nature of the science training process and instructional methods determined, the subsequent task would be to establish correspondence between training processes and methods and first-year teacher-practice. This second step would probably entail the observation of first-year science teachers in their individual teaching situations, as well as the administration of a series of interviews and a questionnaire. Necessarily the investigation of these two phases of the study would entail a number of administrative decisions as well as require the co-operation of the educational personnel involved in the study. It is the purpose of this chapter to outline how the existing conditions in the Teachers College and the schools were used to provide a basis for answering the research questions.

Phase 1 - Teacher Training

This section of the chapter indicates the information needed for the first phase of the study and outlines how it was obtained. It also includes a description of: -

(i) the procedures preliminary to the entry of the researcher into the Teachers College;

(ii) the sample of science lecturers and preservice teachers; and

(iii) the scope that the researcher was allowed after entry to the Teachers College.

The information required for the first phase of the study was:

(i) the instructional methods used "on" the preservice teachers;

(ii) the teaching competencies featuring in the science curriculum programme; and

(iii) the teaching behaviours recommended as appropriate for elementary teachers by the science teaching staff.

Before any of these data could be collected however, permission to undertake the study was obtained from the authorities. Thereupon the collaboration of the science staff themselves was sought and gained. The first phase of the study commenced in July, 1979 and continued through December, 1979.

On the entry to the Teachers College, the researcher was allowed free access to all science curriculum classes and was at liberty to hold informal talks with both staff and students during or after curriculum training sessions. She was also invited to attend the weekly planning sessions of the science staff. During these planning sessions, problems encountered in the teaching of science curriculum units were discussed and plans were made regarding strategies of teaching to be employed and the contents to be covered during the following week. This planning procedure was to ensure that all groups of teacher-trainees covering the same curriculum units, but being taught by different staff, would be exposed to the full variety of instructional strategies.

For this first phase of the study the sample comprised 5 science staff and 120 final-year students. The students were divided into 7 groups of between 15 and 19 members. Six of these groups consisted of non-science-specialists -- students specialising in subjects other than science but pursuing a course in science teaching as a compulsory part of their training. The remaining group comprised science-specialists - students specialising in science as a major teaching subject. All groups were exposed to science curriculum courses that had the same basic objectives but the schedules of training were different. The science-specialist course (group 1) extended over a period of 2 years (interspersed with science content courses), while the non-specialists received a version of the same course condensed into six weeks.

With 7 groups of students involved, there was, of necessity, some overlap in class timetables. The sessions for the 6 groups of non-science-specialists occurred within 2 six-week time blocks. During the first 6 weeks, 3 groups (of non-science-specialists) were scheduled, all receiving training during the same period of time. There followed another 6 weeks period in which the remaining 3 groups of non-science-specialists received their training (during the same time periods). The training sessions of the science-specialists were not so intensely scheduled and occurred at times which did not overlap with the training sessions of the non-science-specialists. Nevertheless there were always 3 groups of students receiving science curriculum training at the same time. Because of the scheduling, a major dilemma at the time was to distribute the data collection sessions so as to obtain a realistic representation of the nature of the science training given to each group. Since it was impossible to observe all training sessions for any given group of students, three procedures were used to obtain the necessary information:

(i) direct observation and recording of training sessions
- in order to establish the instructional procedures by which science curriculum training was presented;

(ii) examination of:
a) course outlines of the science curriculum programme and
b) curriculum training sessions
- in order to determine the teaching competencies intended to be acquired by students during science curriculum training;

(iii) interviews with College lecturers - in order to verify:
a) the types of teaching behaviours recommended by them for the teaching of elementary science, and
b) the teaching behaviours used "on" the science-specialists.

The details of each step* follows.

Investigation of Training Procedures

Verification of the instructional behaviours of the science

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* It must be mentioned that although these three procedures are dealt with sequentially within the text, during actual investigations the three tasks overlapped to a considerable degree.

staff necessitated devising: -

(i) a method for recording classroom events, and

(ii) a systematic basis for the description of these events (detail provided later under "Coding and Analysis of Training Sessions").

There were three principle ways in which the events of the training sessions could be recorded. Firstly, they could have been observed on a firsthand basis and directly recorded as they occurred. This method however, had one major limitation: In any given classroom situation the observer is confronted with more information than can be assimilated at any one time. Consequently, attention must be confined to a few select events to the negation of whatever else is happening at the time. In compensation, the observer is actually experiencing the events as they occur and can gain a 'holistic' preview of the situation.

Secondly, videotaping could be employed. Although providing the most comprehensive form for recording classroom events, in the present case, cost and logistic considerations precluded its use.

Thirdly, audio-recording could be used. Although lacking the visual discrimination afforded by videotape, audio-recording can produce a reasonably accurate record of verbal exchanges taking place. Other advantages include economy; unobstrusiveness; portability; ease of replay, transcribing and coding.

Direct observation coupled with the audio-recording of classroom events was chosen as the most practical and inexpensive means of obtaining as complete a record as possible. A total of 7 training sessions were observed and audio-recorded for each group of teacher-trainees. Observational records consisted of audiotapes, class "handouts" (Appendix O), and a few notes.

Having obtained a record of science curriculum training two other aspects of training remained to be investigated:

(i) the teaching competencies intended by the lecturers to be acquired by the preservice teachers as a result of science curriculum training;

(ii) the teaching patterns recommended by the lecturers for the teaching of elementary science. Description follows.

Recommended teaching competencies

The teaching competencies were to be identified by examining the science curriculum course outlines and science training sessions. The course outlines used highly structured forėmats that could easily be followed during any given session. Not only did each training programme possess the overall course objectives but the course content of each programme was subdivided into lesson units. In turn, each of these lesson units carried specifications of its own specific objectives and also included a brief description of the instructional procedures by which these objectives were to be achieved (i.e. lecture, seminar, field trip, school visit and the like).

An examination of the lesson units and training sessions of the preservice teachers (science-specialists and non-science-specialists) revealed a number of common competencies. They could be divided into two broad categories as follows: -

(i) Competencies dealing with general aspects of science teaching: -

a) selection and appropriate use of science resource books and materials;

b) modifying materials to suit specific class needs or science activities;

c) programme and lesson planning;

d) class motivation, management, safety and control;

e) the teaching of science process skills;

f) use of a science teaching kit;

g) extending the science programme beyond the classroom;

h) programme and lesson evaluation;

i) evaluation of pupils' progress in science; and

j) collaborating with Science Resource Teachers and Heads of Science Departments.

(ii) Competencies dealing with personal teaching attributes of the preservice teachers themselves: -

The teachers' own:

a) knowledge and understanding of science as taught in the elementary schools;

b) motivation and ability to teach science;

c) attitude toward the teaching of science; and

d) skills and confidence in the teaching of science.

Recommended teaching patterns

The present study required specific information about the amounts of lesson time the science lecturers intended for preservice teachers to spend on both functional and structural aspects of classroom interaction. Accordingly, the lecturers were to be interviewed using a structured interview requiring specification of the proportion of lesson time that first-year teachers were expected to spend on 18 specific functional and structural transactions. They were:

(a) "Functional transactions"

(i) giving information about science;
(ii) giving information about sociation;
(iii) giving information about organization;

(iv) promoting understanding about science;
(v) promoting understanding about sociation;
(vi) promoting understanding about organization;
(vii) doing science activities;
(viii) doing sociation activities;
(ix) doing organization activities.

(b) "Structural transactions"

(i) teacher working with individual pupils and taking a leading role (emitter);

(ii) teacher working with individual pupils and taking an attending role (target);

(iii) teacher as audience to individual pupils;

(iv) teacher working with small groups and taking a leading role (emitter);

(v) teacher working with small groups and taking an attending role (target);

(vi) teacher as audience to small groups;

(vii) teacher working with the whole class and taking a leading role (emitter);

(viii) teacher working with the whole class and taking an attending role (target);

(ix) teacher as audience to the whole class. (See Appendix A for interview foremat).

The science lecturers were interviewed at times that were most convenient for them. During the interview each lecturer was first reminded that the purpose of the interview was to collect information about the types of instructional behaviours that he recommended for teachers of elementary science. The researcher introduced each task to the lecturer, explaining any terms that were not fully understood. Thereupon the researcher and lecturer worked through each task in detail with the interviewee writing answers for each question in the appropriate spaces provided on the inteview sheet. No time limit was set for the interview, and subjects were free to ask for clarifications on any points.

After the administration of the interviews the results were transferred from the interview sheets to tables prepared for this purpose (Tables 10a and 10b, Chapter 5). Graphs were then constructed showing the amounts of lesson time recommended by each lecturer.

Having obtained samples of the instructional behaviours used "on" the preservice teachers, and having ascertained:

(i) the teaching competencies featuring in the science curriculum programme, and

(ii) the teaching patterns recommended as appropriate for elementary science teachers by the science teaching staff the next step was the coding and analysis of the training sessions.

Coding and Analyis of training sessions

The coding and analysis of the events of the training sessions necessitated a systematic means for describing these events.

Given the nature and thrust of the study the procedure developed by Adams (1965) and subsequently used by Adams and Biddle (1970) was selected. A detailed description of this instrument, coding procedures, and analysis of coded material follow.

The Adams' Instrument for the analysis of Classroom Transactions

In his system for the description of classroom events Adams (1965) conceptualized the classroom as a "social system" where "communication" is "an essential element". He divided communication processes into a number of categories into which classroom events could be classified. The follow_ ing account, lengthy because of its significance to the study, is taken directly from the original work of Adams (1965).

> *The classroom can be classified readily enough as a social system: social in the sense that it involves interacting individuals, and systematic in the sense that it is organised. However, it is severely prescribed in its manifestation of both aspects. Within it, organisation is uniquely patterned and interaction is characteristically (and even more uniquely) circumscribed.*
>
> *To the extent that classrooms in general as social-behavioural settings can be identified consistently, there must be something that gives them identity as classrooms. This identity is not vested solely in the material phenomena involved, nor solely in the personnel. Rather, it derives in large degree from the characteristic activities and the prevailing behaviours that repeatedly occur there. These behaviours comprise the "teaching-learning" process. Irrespective of what is taught or learned, irrespective of how it is taught or learned, behaviour concerned with teaching and behaviour concerned with learning will be manifested there. Whether or not one chooses to conceptualise this twin-like element as the objective of the system is unimportant. The point being made is that "teaching-learning" is an observable behavioural characteristic of the classroom social situation. It defines the essential character of the setting and may be assumed to be omnipresent.*
>
> *Given the teaching-learning function of the classroom, then necessarily "communication" must be an essential element. In order that teaching-learning may proceed, communication among the personnel or between the personnel and the artifacts must exist. Without communication (defined in its broadest terms), teaching-learning is impossible.*
>
> *The communication process requires, in its turn, "interactions" among the*

personnel. There are admittedly, communication situations that do not involve interpersonal interaction (e.g. reading a book, viewing a film, etc.). However, sufficient evidence exists to support the contention that such interaction (admittedly mostly verbal) exists among the members of the classroom group (Withall and Lewis, 1963).

On the assumptions contained in the preceding paragraphs a conceptual model of the nature of the classroom setting has been devised . . . .

In the model the classroom is envisaged as a system of communication behaviours: that is, a boundary-maintaining set of inter-dependent sub-units of communication behaviours. These behaviours involve the personnel in interaction with each other. The behaviours have identifiable characteristics and occur sequentially in diverse ways.

As a first step in interpreting the behavioural character of classroom settings workable definitions of the basic concepts of communication and interaction should be undertaken.

. . . Interaction will be regarded as a set of behaviours which bring about, or can be legitimately interpreted as attempting to bring about, communication between individuals. Communication here may be verbal, physical, or by signs or signals. Thus the following kinds of situations are among those encompassed: conversations, discussions, arguments, fighting, shaking hands, letter writing, waving, and saluting. It is also regarded as an interaction when an attempt is being made by one person to communicate, unknown to another. Similarly, an "accidental" comment, signal or touch received by one person unknown to the initiator is also regarded as an interaction, provided there is behavioural evidence registered by the recipient. The position taken here is justified mainly on the grounds that it delimits the term in a manner that is not inconsistent with common usage and that it is empirically viable.

The interpretation of both interaction and communication is based (as the definition would demand) on an observational frame of reference. The focus in the main is placed upon readily observable behaviours that can be classified in terms of their manifested features. Classifying behaviour in this way provides the justification of the use of the phrase, communication/interaction "system".

Classroom Structure

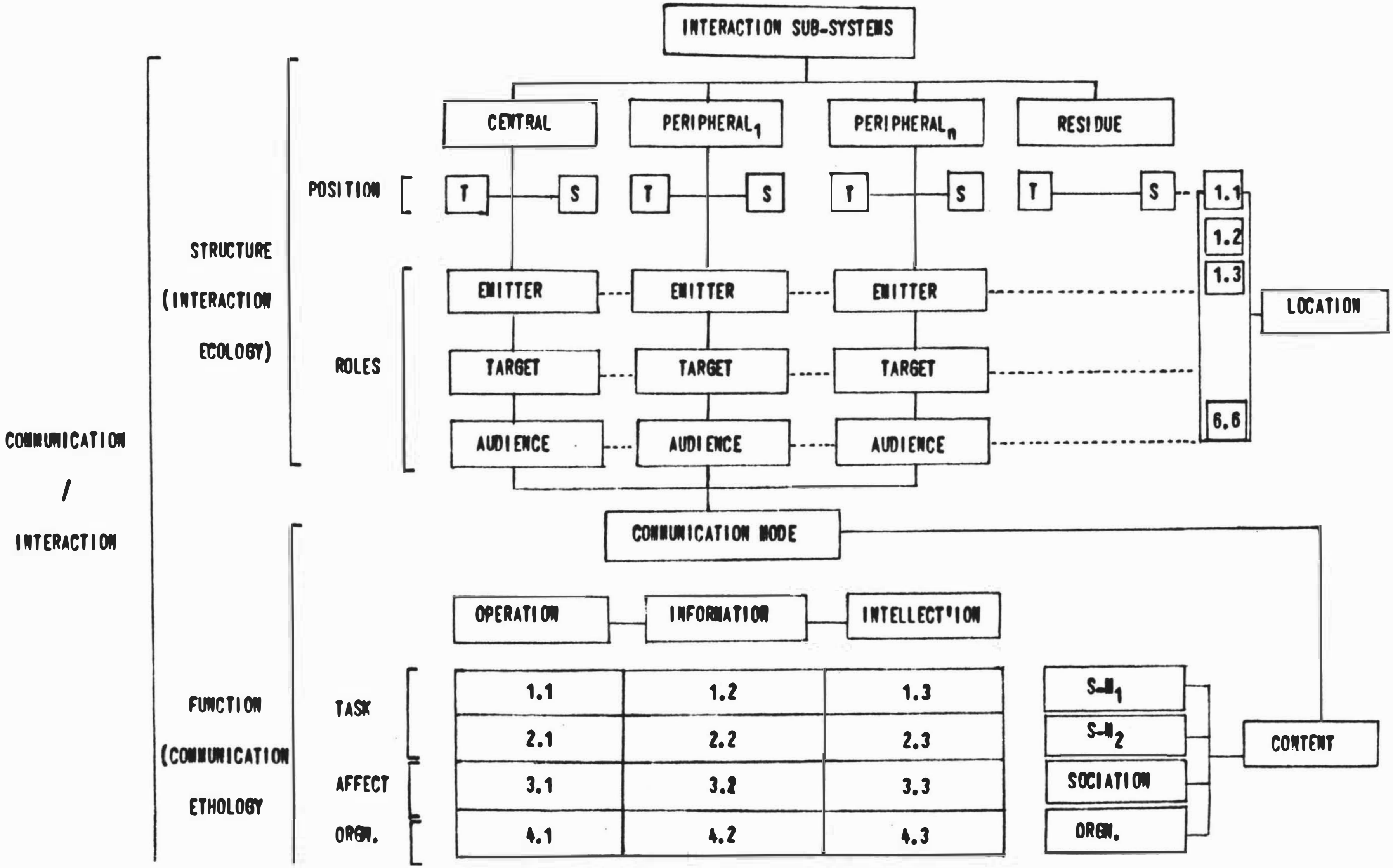
In order to provide a measure of coordination in the model, one segment has been designated Structure. As the term has been used here Structure means an order that is observed to persist among the communicating members in the system. Theoretically, the number of classroom members involved in any one communication exchange could range from two to the total number in the group. During certain kinds of exchanges, however, some members may not be involved in the communication network at all. At other times communication of any kind may be completely absent. These different contingencies have been accommodated in the model by the postulation of different communication sub-systems. . . .

Communication/interaction patterns occur over time; they also occur through the individuals who are in the classroom setting. Each of these individuals at any one time must occupy a particular location; a point in classroom space. Structure, then, may also be viewed as a geographical distribution of the personnel. There is a likelihood that the distributions will also show evidence of change and variation. This Structural interpretation of the classroom constitutes the spacial structure of the setting.

The personnel involved in the communication/interaction systems have been identified in two other ways, first according to the positions they hold, and second according to the roles they play. Each will be dealt with in turn. Two "positions" have been specified viz. teacher and student positions (T and S in Figure 3). . . .

FIGURE 3

THE COMMUNICATION/INTERACTION SYSTEM OF THE CLASSROOM



Three different communicating roles are also employed in Figure 3. They have been designated (1) Emitter, (2) Target, (3) Audience. They are integral to the Structural conception of the communication/interaction system in that they are identified when there are changes in the composition of the communication sub-systems. The Emitter is the person communicating at the inception of the communication/interaction sub-system. The Target is the person or group to whom the communication is driected. The Audience consists of those members who are attending to the communication/interaction. A one role system comprises an audience only (class watches film). A two role system usually consists of an emitter and an audience (teacher lectures students). A three role system involves an emitter, a target and an audience (teacher disciplines single pupil, others watch). Any Central or Peripheral sub-system during its existence <u>must</u> manifest at least one of the roles; it may on the other hand, manifest two or all of them.

Both role and position, as they have been conceptualised here, are complementary. Any role can be identified according to whether incumbents of the teacher or student position occupy it. Members of any position can be identified according to the roles they play.

In the model, the phrase "interaction ecology" has been coined to designate all the Structural aspects selected for consideration. "Interaction" refers to the feature that defines the phenomena under consideration. "Ecology" indicates that it is the latter characteristic disposition that is being emphasised.

Structure with its temporal and spatial contextual components may perhaps be envisaged as the web on which the tapestry of the teaching-learning picture is to be woven. It limits the extent of the picture, dictates the degree of fineness of work and provides the foundational framework that will determine the durability of the finished product. Nonetheless, the appeal and beauty of the work will owe little to it. Rather, will elegance be derived from the woven pattern, the blending of forms, the balance of colour, the overall design. The sources of potential elegance in the classroom are to be found in the actual teaching-learning process itself. They are delineated in Figure 3 by the heading, Function.

Classroom Function

At the risk of grossly over-simplifying a complex process, Function has been taken to mean what goes on within the system boundaries, or more specifically, what characteristic forms of behaviour are manifested in the system. This interpretation of Function rests on the assumption that the classroom is an artificially contrived and sustained teaching-learning situation. The interpretation also owes its form and substance to the contention that communication has "content" (is concerned with some topic or other) and that communication occurs in a characteristic manner or mode.

. . . The Functional interpretation contained in the model and described below represents one way in which the kaleidoscope of classroom behaviours may be resolved and systematised. Because function is of central significance in determining the character of each classroom, "communication ethology" has been used, in the model, to designate the total Functional configuration. "Communication" nominates the phenomenon under consideration, "ethology" indicates that focus is being placed on interpreting its essential character.

Communication Content

It is assumed that the Content of classroom communication is concerned with three principal kinds of meanings. These are designated in the model as: Subject-matter (S.M.), Sociation and Organisation. Subject-matter meanings are concerned with "task" elements which are derived mainly but not exclusively from syllabus and curriculum prescriptions. Sociation meanings relate to inter-personal exchanges concerned with affective, social-emotional behaviours. Organisation meanings are identified in those communications which are directed towards the maintaining and perpetuating of the classroom as a functioning system. They are essentially administrative in character.

I. Subject-Matter

Two kinds of subject matters are featured in the model. Subject-matter 1 refers to contents of communications that can be legitimately interpreted as directly relating to the kind of lesson specified at the time. For example, in an "arithmetic lesson" subject-matter 1 content means the content of communicatin that refers directly to arithmetic. However, many communications in classrooms, though concerned with areas of legitimate educational interest, do not always bear on the subject ostensibly being taught. Thus, even an arithmetic lesson can be punctuated by excursions into social studies, biology, literature and so on. Such digressions are classified under the heading, subject-matter 2, which subsumes all subject matter not related to the subject matter specified for the class at that time.

II. Sociation

. . . "Sociation" is used to denote communication contents that either focus deliberately on the process of being sociable (negative or positive) or that clearly represent recognised social conventions. Thus, "good morning class", "how do you do", "did you have a pleasant holiday" are communications of the latter kind. In the case of the former, exhortations to "be good citizens", "be tidy workers", "stop fighting", "consider the importance of good manners" are all appropriate examples. Such communications have affinity with (but are not to be regarded as identical with) aspects of behaviour that are recognised by psychologists as "affect".

III. Organisation

Whenever the content of any communication is devoted to matters that directly involve the administration of the classroom, the appropriate content category is "Organisation". Under this heading fall communications that are concerned with controlling and directing all or any of the personnel or artifacts in the setting. It thus covers the numerous teacher directives that facilitate (sic) the functioning of the classroom. It also covers any communications concerned with similar matters which emanate from the students. The effectiveness of such communications is not under review at this stage.

Communication Mode

The Mode concept is less easy to illustrate in that it represents a relatively novel way of interpreting the implications of the content of communications. There follows a consideration of each element taken in turn.

I. Information Dissemination

Information Dissemination refers to all communication-transactions devoted to the conveying of information. Statements concerned with providing facts, or clarify-facts, comments, questions or assertions, illustrations or demonstrations performing the express function of exhibiting (or purporting to exhibit) substantial evidence, are regarded as falling under this heading. A brief reflection on the nature of examination scripts and upon the average textbook may provide more than an adequate testimony to the fact that acquisition of information is of prime importance to the system. Factual knowledge is regarded as particularly important. Necessarily then, factual information features prominently in the teaching-learing intercourse. Facts are presented, interpreted, explained, elaborated, illustrated and repeated with monotonous inevitability. In them is to be found the essence of "information dissemination".

II. Intellectualisation

Intellectualisation refers to all communications devoted expressly to the procedures involved in considering, reasoning, and indulging in deductive and inductive thought. It also includes those non-logical procedures such as attitude expression, opinion giving, judgment making, interpretation making, assessing and evaluating. It should be noted that the focus is on the procedure itself. As such intellectualisation is quite distinct from the "intellectualising" that is usually (sometimes optimistically) inferred as lying behind communications made by individuals.

One of the conceits that many teachers at all levels permit themselves is that they teach their students "to think". Furthermore, whether it is due to their agency or not, it is abundantly clear that children do learn how to think, at least in some fashion. It is contended here, that a proportion of the communcation-transactions occurring in classroms focusses on the actual procedure by means of which the members become familiar with the processes of thinking, reasoning, forming opinions and so on.

. . . It has been decided to include as well, those untidy, illogical and frequently unsystematic but nonetheless intellectual communication behaviours which give evidence of opinions, prejudices, interpretations and so on, irrespective of the quality of the opinion, judgment, or evaluation itself. Again, what distinguishes this component of Intellectualisation from Information Dissemination is its emphasis on the nature of the procedure rather than the "facts" that might contribute to the procedure.

III. Operation

The third sub-category designated Operation in Figure 3 refers to those teaching-learning behaviours which cannot be classified under the other two headings and which appear to exist merely for the sake of the experience itself. Thus, group singing may find an appropriate classification under this heading. Any student practice activities (reciting arithmetic tables, practising a motor skill, doing writing drills, etc) are also included. So too, are creative activities such as painting (without technical instruction) and dancing. Group quizzes, tests, and examinations, are also located under this heading. Such activities are often ritualised in classrooms. They persist over time often with little variation. They carry their own momentum in that once they are started and their rules become established, they clearly circumscribe and prescribe behaviour. At such times, group behaviour is more overtly homogeneous than at most others. These are the occasions when uniformity reigns and conformity is the norm.

There are two incompletely resolved issues that need attention at this stage. They both revolve round the question of the relationship between the Content and Mode elements described. The second is whether or not they collectively exhaust the universe of classroom behaviours. Each of these points will be taken in turn.

The Mode categories have been so constructed that each is independent of the others. By definition any communication-interaction can be identified as either Information Dissemination, Intellectualisation, or Operation.

In support of this position it has been found that different judges observing the same behaviour <u>can</u> consistently categorise it according to this system. It is in other words, procedurally possible to identify behaviour according to this threefold criteria.

It is the sociological orientation of the study that permits this to occur. By contrast, if a psychological frame of reference were adopted instead and the focus were placed on the individuals in this setting, then it can be claimed that inevitably the dissemination of information and intellectualising must go hand in hand. Clearly, it would be argued, it is not possible to assimilate information without intellectualising about it. Indeed intellectualising must occur if any communication, be it concerned with Information, Organisation or Operation is to be comprehended. All this is correct. But it is only correct if one argues from the point of view of the individual, and with, it should be added, the assurance that from observable behaviour, may be inferred certain mental (psychological) characteristics.

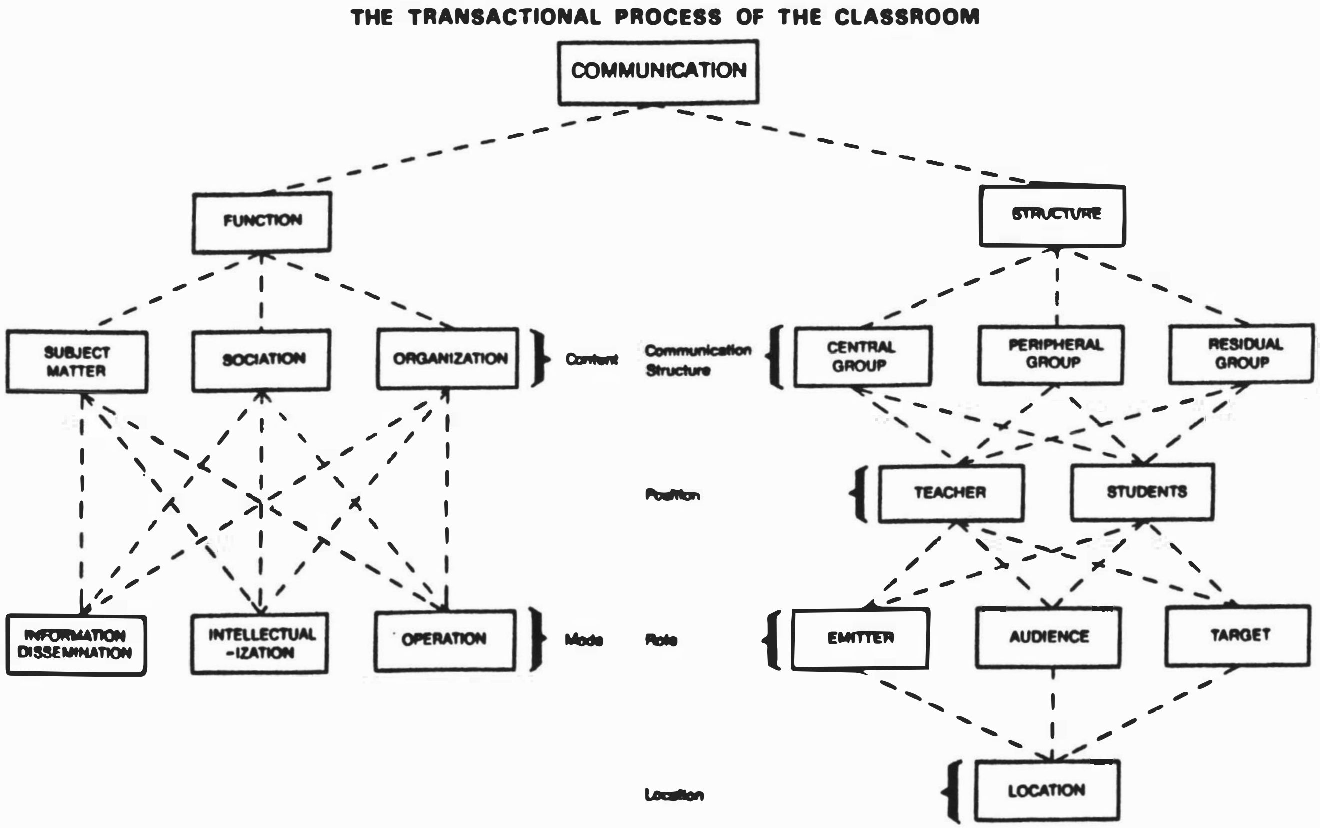
The differentiation of the three Content categories, Subject matter, Sociation and Organisation, does not pose quite the same *problem. Admittedly if Sociation is regarded as equivalent to psychology's "affect" then difficulties arise in that tone of voice, smiles, frowns, etc., can be taken as cues. However, when attention is focussed on the subject of discourse and not on individual acts such difficulties are diminished. It is possible consequently to classify all communication exchanges in terms of the four broad Content classifications postulated.*

. . . The Content categories are mutually exclusive. The Mode categories are also mutually exclusive. However, Mode and Content are not independent of each other. Any communication in a given Mode must also have a given Content. Any communication with a given Content must also be in a given Mode. Consequently, there are twelve distinguishable function forms that are to be derived from cross-relating the three Mode elements with the four Content ones. These are illustrated in the Functional matrix in the model.

It is contended then, that the two major Functional categories, Content and Mode, . . . can be empirically identified, and that together they can be taken as exhausting the universe of communication behaviour. Whatever communication occurs within the classroom can be classified under one of the headings. It should be apparent that the categories are basically very broad and that many things have been rather roughly bundled into each of the twelve baskets (Adams, 1965).

The Adams' Instrument is summarised in Figure 1. In Figure 1 there are 6 functional and 9 structural categories according to which classroom events could be classified. For the purposes of the present study all of the functional categories of the Adam's Instrument were employed. So also were all of the structural categories with the exception of location (since videotape was not used). Some changes in terminology were made. Instead of "central group", "peripheral group", and "residue", the categories of "whole class", "multiple pupil", and "individual pupil"

*Figure 1



*From: Adams, R.S., and Biddle, B.J., Realities of Teaching Explorations With Video Tape; Holt, Rinehart and Winston, Inc. New York, 1970; p. 20. Used by permission of CBS COLLEGE PUBLISHING, 383 Madison Avenue, New york 10017.

were used. "Multiple pupil" was taken as any group of pupils who could not be classified as the whole class or as an individual pupil. These categories were more suitable for the purposes of this study because, during the playback of recorded teaching sessions, it was impossible to "see" whether fifty percent, or less than fifty percent, of the class was involved at any given time but it was generally possible to "hear" when the whole class, multiple pupils, or individual pupils were either targets, emitters, or the audience.

Coding

In order to code the observational audio-records a coding form was devised. It appears in Table 1 (page 52). It was designed to permit the identification of each episode and its duration (the two left hand columns) and the classification of each episode according to the type of Communication Mode (next 3 columns), Communication Content (next 4 columns) and Teacher's Role (next 2 columns). The final column provided space for a general description of the lesson.

Coding procedures entailed, first identifying an episode and second, classifying it appropriately. A number of conventions were followed for both tasks - which though conceptually separate were often in fact operationally intertwined. Explanation follows: -

Episoding:

An episode was taken to mean any given period of time in which a single functional/structural transaction occurred. The determining factors in each case were: -

(i) the mode of the transaction;

(ii) the content of the transaction; and

(iii) the role of the teacher as defined by the conceptual framework used. In effect this meant that a transaction had to be identified as, and accordingly confined to a specific functional/structural type.

In order to determine the functional type of an episode it was first necessary to ascertain:

(i) its Mode* (i.e. "how the communication was given"), and

(ii) its Content ("what the communication was about").

In this study the Mode of an episode could be one of 3 types: -

(i) "Information dissemination Mode" - "communications devoted to the conveying information".

(ii) "Intellectualization Mode" - communications concerned with "considering, reasoning, indulging in deductive thought, expressing attitude, opinion giving, judgment making, interpretation making, assessing, and evaluating".

(iii) "Operation Mode" - classroom processes which included such activities as written work, experimentation, preparation of teaching aids, and the like .

Similarly, the Content of an episode could be one of 3 types: -

(i) "Subject matter Content". Here the subject matter could either be about science, about science teaching, or irrelevant.

(ii) "Sociation Content" - communications representing either "affective" or social aspects of behaviour for example "How do you do", "I'm sorry", and the like.

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* Definitions based on an account by Adams and Biddle (1970), pp 6-20.

(iii) "Organization Content" - "communications concerned with directing personnel or property within the setting".

Hence the functional type of an episode could be one of 15 types: -

(i) Information dissemination about Science.
(ii) Information dissemination about Science Teaching.
(iii) Information dissemination about irrelevant subject matter.
(iv) Information dissemination about sociation.
(v) Information dissemination about organization.
(vi) Intellectualization about Science.
(vii) Intellectualization about Science Teaching.
(viii) Intellectualization about irrelevant subject matter.
(ix) Intellectualization about sociation.
(x) Intellectualization about organization.
(xi) Operation pertaining to Science.
(xii) Operation pertaining to Science Teaching.
(xiii) Operation pertaining to irrelevant subject matter.
(xiv) Operation pertaining to sociation.
(xv) Operation pertaining to organization.

In order to determine the structural type of an episode it was necessary to ascertain who was speaking to whom and in whose audience. In other words it was necessary to determine: -

(i) the <u>emitter</u>: - "the person who spoke first when a communication group was set up";

(ii) the <u>target</u>: - "a person or group to whom the emitter addressed himself";

(iii) the <u>audience</u>: - "those members who were attending to the communication". (Definitions from Adams and Biddle; 1970).

Emitters could either be the teacher, an individual pupil, the whole class or multiple pupils (any group of pupils which could not be classified as the whole class or as an individual pupil).

Similarly the target or the audience could either be the teacher, an individual pupil, multiple pupils, or the whole class.

The structural type of an episode could be one of 9 types (outlined previously on page 31).

To facilitate the coding of structural types of episodes a grid (Figure 2) was constructed which provided an easy means of designating combinations of teacher/pupil interactions in the communication process.

FIGURE 2: CATEGORIES FOR DESIGNATING COMBINATIONS OF TEACHER/PUPIL INVOLVEMENT IN THE COMMUNICATION PROCESS

	EMITTER	TARGET	AUDIENCE
TEACHER	a	d	g
INDIVIDUAL PUPIL	b	e	h
MULTIPLE PUPIL	c	f	i
WHOLE CLASS	w	x	y

The following is an example of how an excerpt from an actual science lesson was divided into episodes.

<u>Excerpt:</u>

Student to lecturer: *"Maybe it's just the way the paper is cut".*

Lecturer to student: *"So you think it's just the way the paper is cut?"*

Student to lecturer: *"Well, that will make it curl".*

(Class works for 3 seconds).

Lecturer to student: "Here's a piece of paper, try your ideas out!"

From this excerpt 5 different episodes were identified each with a particular functional/structural type.

Episode 1:

Student to lecturer: *"Maybe it's just the way the paper is cut".*

Functional classification: intellectualization (reasoning) about science.

Functional classification: "bdi" (Figure 2) - an individual pupil is emitting to the teacher (the target) with the rest of the class (multiple pupils) as audience.

Episode 2:

Lecturer to student: *"So you think it's just the way the paper is cut?"*

Functional classification - intellectualization about science.

Structural classification "aei" - teacher emitting to an individual pupil with multiple pupils as audience.

Episode 3:

Student to lecturer: *"Well, that will make it curl".*

Functional classification: intellectualization about science.

Structural classification: "bdi" - individual pupil emitting to the teacher with multiple pupils as audience.

<u>Episode 4:</u>

Class works for 3 seconds.

Functional classification: <u>operation about science.</u>

Structural classification: "Silent" episode* - no emitters and no targets.

<u>Episode 5</u>:

Lecturer to student: *"Here's a piece of paper, try your ideas out!"*

Functional classification: <u>information dissemination about organization.</u>

Structural classification: "<u>aei</u>" - teacher emitting to an individual pupil with multiple pupils as audience.

Having determined the functional/structural classification of episodes the next step was to record them. There were 7 steps in the coding and recording of any particular episode: -

(i) the number of the episode had to be entered on the coding sheet (first column);

(ii) the duration of the episode had to be recorded (column 2);

(iii) the duration of the episode had to be entered on the coding sheet according to the <u>Mode</u> of the episode (columns 3, 4, or 5);

(iv) the duration of the episode had to be recorded according to the <u>Content</u> of the episode (columns 6, 7, 8, or 9);

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* Whenever there was a "silent" episode in this study the teacher's role was taken as "<u>audience to the whole class.</u>"

(v) Whether the teacher was the emitter (E), the target (T), or the audience (A) had to be recorded in column 10;

(vi) the teacher/class involvement in the communication process ("aei", "bdi", "cdi" etc) had to be recorded in column 11; and

(vii) a brief description of what was taking place in the lesson during the episode had to be recorded in column 12.

An example of the coding of the 5 episodes outlined previously is to be found in Table 1.

In the interest of manageability three lessons of each lecturer were selected for coding and subsequent analysis. They were the first, middle, and last sessions.

Coding was done directly from the playback of audio-recorded classroom sessions and an Olympic Stopwatch was used for the timing of episodes.*

After the coding of each lesson the coded sheets were analysed to determine the proportion of lesson time that was spent on the functional and structural transactions which occurred during the lesson.

Data Analysis

Generally data analysis entailed: -

(i) calculating the proportion of lesson time spent on the 15 functional and 9 structural transactions (outlined previously) for the 3 sessions of each lecturer; and

---

* Coding proved to be a very time-consuming process - 40 minutes of classroom transactions taking up to 24 hours.

TABLE 1

SAMPLE CODING OF CLASSROOM EVENTS

EPISODE		COMMUNICATION MODE			COMMUNICATION CONTENT				TEACHER'S ROLE		*LESSON DESCRIPT.
					SUB. MAT.						
NO	TIME	INFO. DISSEM.	INTEL.	OPERAT.	SC.	SC. TCH.	SOCIAT.	ORGAN.	E T A	CLASS INVOL.	
1	1.5		1.5		1.5				T	bdi	Maybe it's just the way the paper...
2	1.6		1.6		1.6				E	aei	So you think it's just the way the...
3	1.3		1.3		1.3				T	bdi	Well, that will make it curl.
4				3.0	3.0				A		Class works
5	2.1	2.1						2.1	E	aei	Here's a piece of paper, try...

* In the "Lesson Description" column notes were made to describe what the focus of each episode was. Sometimes "key phrases" were selected as descriptors.

(ii) constructing linear profiles of the means and ranges of variations in the amounts of lesson time spent by each lecturer on the functional and structural transactions.

Functional Analysis:

The time spent on each functional transaction was calculated as a percentage of the total lesson time (the sum total of the times of all episodes for a given lesson).

To ensure accuracy the tally of separate episodes was calculated against the total time elapsed. Where initial errors occurred the record was re-examined until the errors were eliminated.

The calculations when completed were tabulated (Appendix B.1) and converted into a linear profile. An example is to be found in Figure 3 where the highest amount of lesson time for functional transactions (34.3%) was spent on - operation about the subject matter of science teaching, followed by: -

(i) information dissemination about the subject matter of science teaching - 29.9%;

(ii) information dissemination about organization - 24.1%;

(iii) intellectualization about the subject matter of science teaching - 6.6%;

(iv) information dissemination about sociation - 4.5%;

(v) intellectualization about organization - 0.4%; and

(vi) other irrelevant functional transactions - 0.2%.

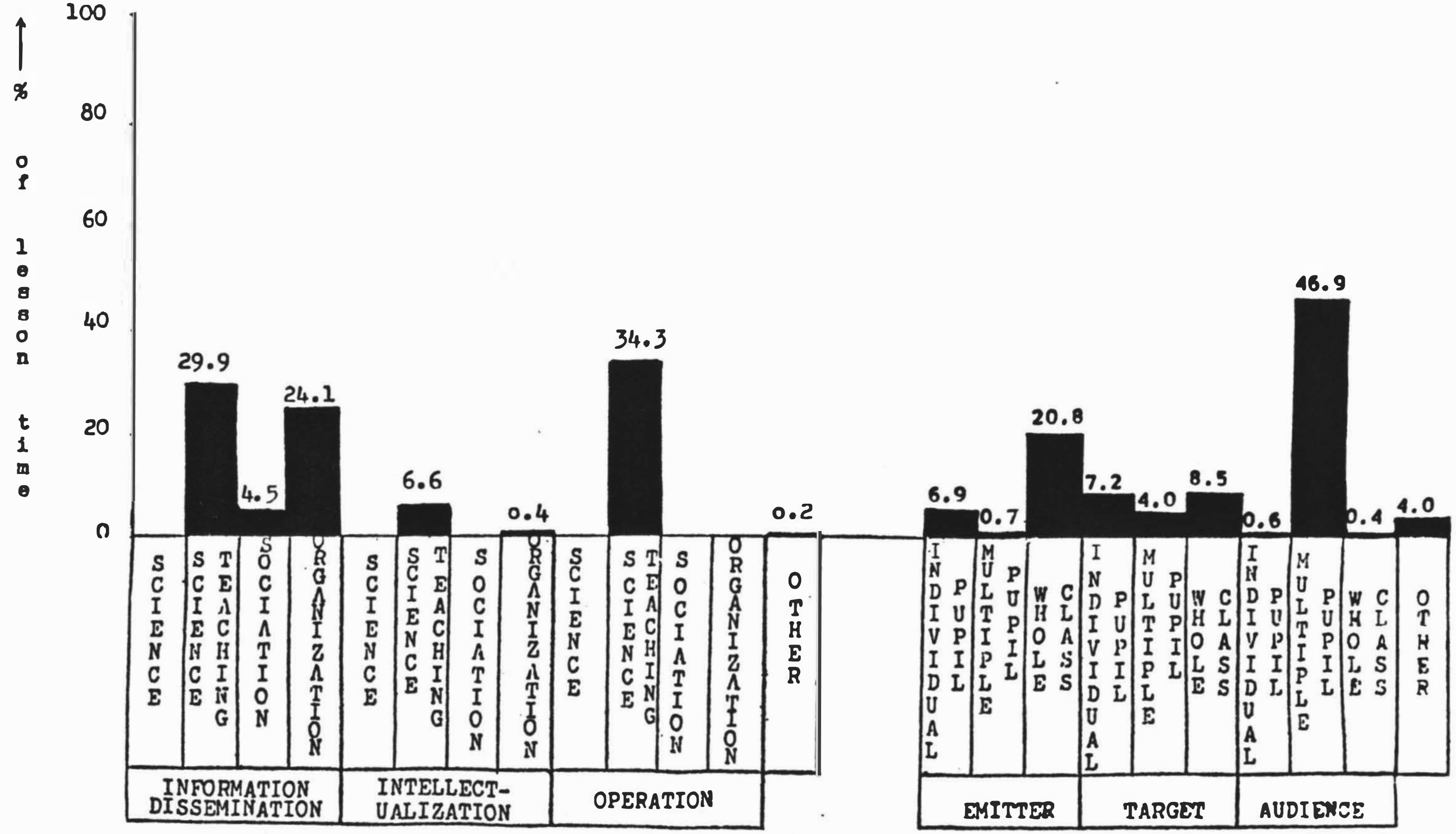
Taken together the times of all of these transactions comprise 100% of the lesson time.

Figure 3

Typical Lesson Profiles for Functional and Structural Transactions

a. Functional Transactions

b. Structural Transactions



When the 3 lessons of each lecturer had been subjected to this process of analyses the lesson profiles were used to produce a composite graph showing the mean and range of variation (Appendix C).

After the amount of lesson time spent on functional transactions had been determined, a similar structural analyses was undertaken.

Structural Analysis

As in the case of functional transactions, the percentage of lesson time spent on each structural transaction was calculated against the total lesson time. These percentages were then tabulated (Appendix B.2) and used to construct linear profiles showing the amount of teacher/pupil involvement in the communication process for each given lesson. See Figure 3 as an example where the highest amount of lesson time for Structural transactions (46.9%) was spent by the teacher as audience to multiple pupils, followed by the teacher: -

(i) emitting to the whole class - 20.8%;
(ii) as the target of the whole class - 8.5%;
(iii) as the target of individual pupils - 7.2%;
(iv) emitting to individual pupils - 6.9%;
(v) as the target of multiple pupils - 4%;
(vi) emitting to multiple pupils - 0.7%;
(vii) as audience to individual pupils - 0.6%;
(viii) as audience to the whole class - 0.4%.

Irrelevant structural transactions occupied 4% of the total lesson time.

Data from the 3 lessons of each lecturer were then used to produce a composite graph showing the mean and variation in teacher/pupil involvement in the communication process (Appendix C).

With the analysis of functional and structural aspects of the science training sessions completed Phase 1 of the study was brought to a close.

Phase 2 of the study was concerned with the actual teaching processes of the previous students as new, year-one teachers. Data gathering procedures, though to some extent similar to those of Phase 1, did have some notable differences. Explanation follows.

Phase 2 - The Field Study

The purpose of this aspect of the study was to investigate the correspondence between the training (teaching competencies and instructinal strategies) given to students and their subsequent use of these Competencies and teaching strategies after a period of 6 months as novice teachers. Information was to be sought about: -

(i) the levels of success perceived in using the competencies previously taught;

(ii) actual teaching patterns of the year-one teachers;

(iii) their own perceptions of the teaching patterns that should be employed in teaching elementary science;

(iv) their perceptions of the instructional patterns to which they were exposed during their own science training;

(v) their perceptions of the instructional patterns recommended by their lecturers for the teaching of elementary science; and

(vi) the instructional patterns of their own science teachers at school.

In addition to these issues, answers to 3 other questions raised in Chapter 2 were to be sought: -

(i) The extent to which the year-one teachers attributed their teaching patterns to science curriculum training.

(ii) The extent to which the use of the teaching competencies taught them was thought to:

a) have enhanced the overall level of competence they achieved in the first year's teaching; and

b) be due to the actual process of training.

(iii) Whether the two methods of organization used at College (massed curriculum training and spaced curriculum training) influenced teaching performance.

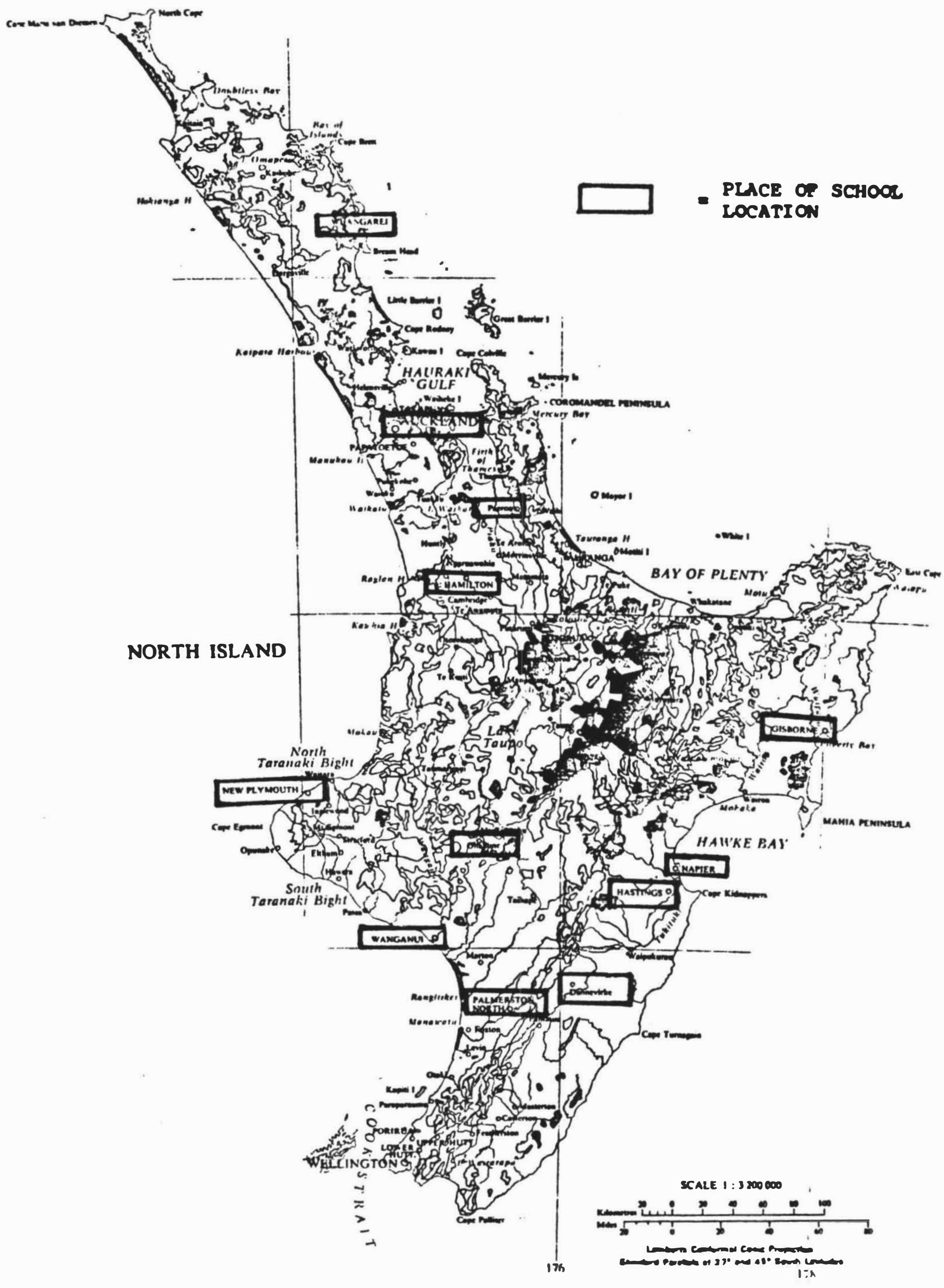
Before the commencement of the second phase of the study it was necessary to select a sample of first-year teachers (from the earlier sample). Letters were therefore given to all final-year students requesting their continued participation in the study the next year (See Appendix D).

Of the 34 teachers-to-be who initially indicated a willingness to participate, 11 subsequently went to University instead and 1 other sought, and obtained, deferment from teaching. Two further students, posted to South Island schools, were excluded because of travel costs. The remaining 20 first-year teachers then constituted the sample of first-year teachers for the second phase. Of these, 7 were science-specialists and 13 were not. They were located in 19 schools ranging from the home base in the south (where the Teachers College was located) to Whangarei, in the north (see Figure 4). There were 3 schools in Gisborne, 3 in Palmerston North, 2 each in Wanganui, Hastings and Napier, and 1 each in the other 7 locations. Of the 19 schools 17 were Primary schools and 2 were Intermediate schools, the latter located in Napier and Hamilton.

The classes to which the first-year teachers were posted ranged from new-entry and infants (equivalent grade 1) to standard 4 (equivalent grade 6) in the Primary schools, and form 2 (equivalent grade 8) in the Intermediate schools.

Figure 4

*Map showing locations of schools used in the study



*New Zealand Atlas, Ian Wards (Ed.), Government Printing Office, Wellington, New Zealand, p. 106.

Three teachers were appointed to composite (multigraded) classes. Of these, one had a combined standard 3 and 4; one a combined junior 1 and 2; and 1 a combination of New-entry through Junior 1 and 2 (See Table 2). The pupil/teacher ratio ranged from 26 to 36 pupils per teacher with the average number of pupils per teacher, 29.

Permission was sought (and obtained) from the appropriate Education Boards and school principals for undertaking school visits. Visits began in late August, 1980 and continued through to the end of November, 1980.

During school visits the types of information outlined at the beginning of the chapter were obtained from everyone. The method by which each type of information was collected, however, varied. Instructional patterns were observed in a manner similar to that employed with the College lecturers - direct observation and audio-recording. The extent to which first-year teachers attributed their own teaching patterns to training was collected by a questionnaire. Perceptions of the manner in which elementary science should be taught were obtained through a structured interview. So also were the teachers' perceptions of:

(i) the actual instructional patterns of their lecturers,
(ii) those recommended by their lecturers, and
(iii) those of their own school teachers.

Information about (i) perceived levels of success in practicing acquired competencies,
(ii) the influence of these levels of success on the overall level of success of the first-year teachers and
(iii) the attribution of these success levels to training, were all collected by questionnaire. Detail follows.

First-year Teacher Observations - Recording and analysis of teaching sessions.

TABLE 2

CLASS LEVELS FOR FIRST-YEAR TEACHERS

ELEMENTARY GRADE LEVEL	GROUP 1		GROUP 2	
	Teachers assigned	Number of pupils	Teachers assigned	Number of pupils
New- entry and Infants	T 5	28	T 11	30
New-entry/Junior 1/Junior 2	T 3	32		
Junior 1			T 10	30
			T 19	30
Junior 1/Junior 2			T 14	28
Junior 2			T 13	28
Standard 1	T 1	28	T 8	26
Standard 2	T 4	30	T 17	29
Standard 3	T 6	29	T 9	30
	T 7	30	T 16	30
			T 18	28
Standard 3/Standard 4			T 15	29
Standard 4			T 12	30
Form 1	T 2	30		
Form 2			T 20	29

T - Teacher

A total of 2 lessons* were analysed for each first-year teacher in the sample with the exception of 1 teacher - teacher 16 where a third was also used in order to obtain a more 'holistic' picture of his teaching pattern. In his case, each of the 3 lessons involved a different instructional procedure -

(i) discussion,

(ii) recording, and

(iii) group-presentation of the events of a previous bush walk.

The coding and analysis procedures that were employed were identical to those used for the College lecturers' classes. Briefly, each audi-recorded lesson was coded onto the coding sheet (see Table 1). In this case however, coding structural transactions became slightly more complex - as unexpected exigencies occurred and unanticipated emitters and targets surfaced.

For example: -

(i) A visitor brought a litter of kittens into the classroom during a science lesson on "Mammals". A category 'V' was invented for the visitor. When the teacher spoke to the visitor this was recorded as 'aVy' i.e. the teacher emitting to a visitor with the whole class as audience (See Figure 2). When the visitor replied to the teacher this was recorded as 'Vdy' - where the visitor was the emitter, the teacher was the target, and the whole class was audience.

(ii) A teacher spoke to an animal. During the course of the science lesson on "Mammals" the teacher tried to encourage a kitten to walk by moving a string across the floor, clicking her fingers and saying "Come on..., come on.."

---

* The classes of the first-year teachers did not always consist of science as a separate subject. Very often science was found coupled with Story, Social Studies, Art and Craft, or Mathematics.

Category 'K' was invented for the kitten and the episode was recorded as 'aKy' where the teacher was the emitter, the kitten the target, and the whole class the audience.*

(iii) Other teachers became involved in the lesson.
When other teachers came into the classroom and spoke to the class teacher, or when other team-teachers spoke to the teacher in charge of the particular science lesson that was being coded, categories were also invented to designate their involvement. For example: 'T' for another class teacher; 'H' for the Head Teacher; and 'R' for the researcher (to whom some teachers spoke during their lessons).

There were also some episodes to which translation-equivalents had to be ascribed. These included: -

(i) Silent episodes. Silent episodes were not necessarily "empty" time periods in the communication process. Sometimes genuine pauses (during which no communications were given and no operation was being done) accounted for these 'silent episodes' but more often than not, "silent operations" were in progress. These silent operations could either be operations pertaining to science, organization, or sociation. (No silent operations of sociation were recorded, however). Silent operations pertaining to science included such activities as seat work and experimentation. Silent operations pertaining to organization included finger-play (used to 'settle' a class) and hand raising. Hand raising was an activity that was directed at the teacher and was taken to mean "please call on me!" and coded as "information dissemination about organization".

---

* Kitten emitters were not coded.

(ii) Vocal and non-vocal 'noises'. The 'on-the-spot' observations justified specific interpretations. For example, a sudden, prolonged intake of breath after a teacher's question (always accompanied by the raising of hands) was taken to mean "Please call on me". So also did finger clickings, hand flappings, and sounds such as "Ooh ... ooh!" Other sounds for which translation equivalents were ascribed included hand-clapping and bell-ringing. When a teacher suddenly started clapping or ringing a bell during a lesson it usually meant "Stop what you are doing and listen to me", but sometimes it meant "There is too much noise in this class!" If the bell ringing or hand clapping was followed by an address from the teacher the former was used, if not, the latter.

To test the reliability of coding and analysis of lessons a complete science lesson was re-coded and re-analysed some time after the first coding and analysis were done. The graphs showing the lesson profiles for functional and structural transactions of the re-analysed lesson were compared with the corresponding ones from the pre-analysed lessons. Although not identical, the two sets of graphs showed a very close resemblance to each other (Figure 5).

In addition, code/re-code reliability was calculated according to the formula:

$$R = \frac{A-(\frac{1}{N-1}\cdot D)}{A+D} \quad \text{where -}$$

R = reliability
A = sum of time in agreement
D = sum of time in disagreement
A + D = total time coded
N = number of tolerated coding categories

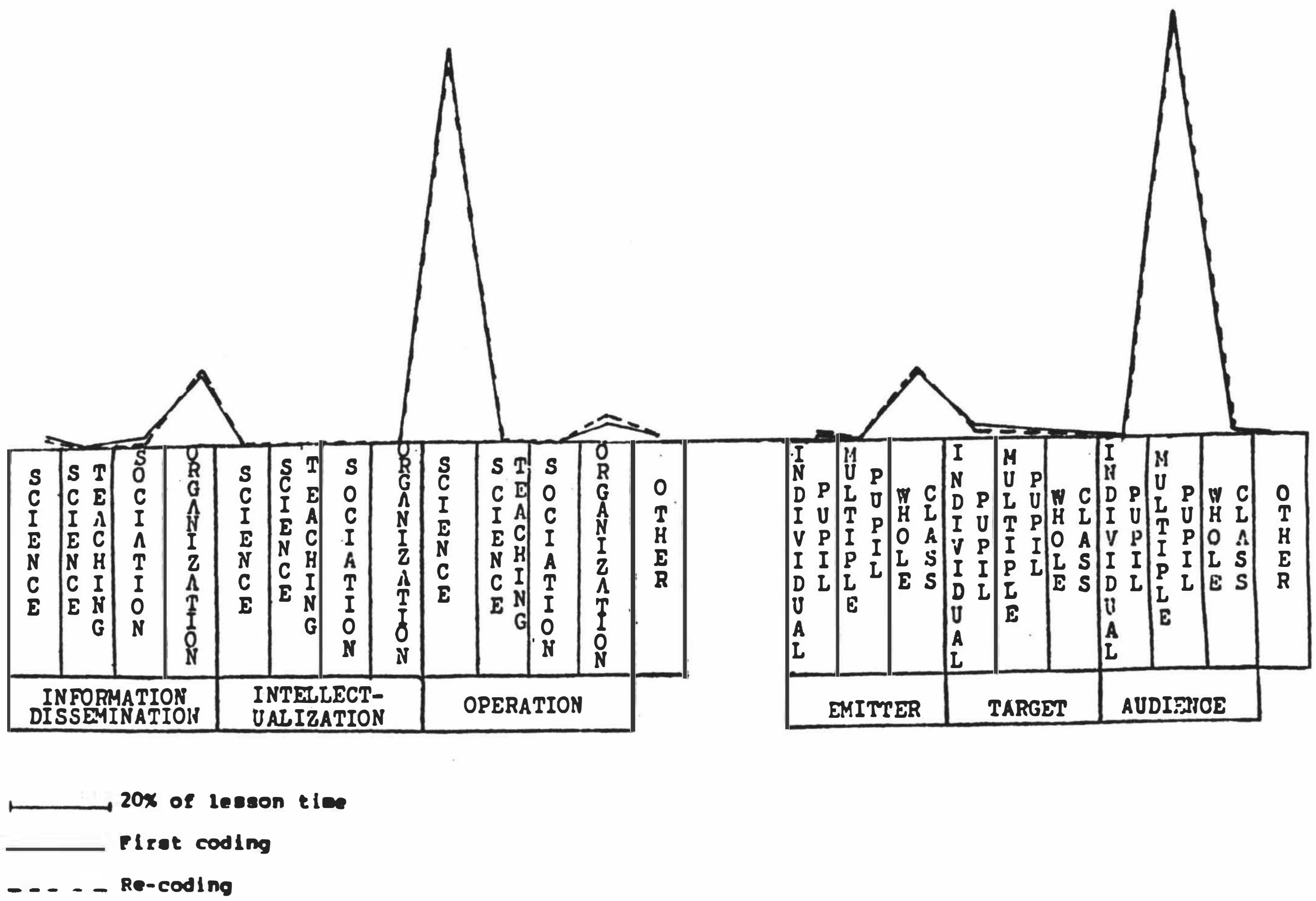
(Adams, 1965)

Figure 5

Code/re-code Reliability

a. Functional Transactions

b. Structural Transactions



This formula determined for what proportion of the total number of coded observations the two sets of codes were in agreement.

The results were as follows: -

(i) Functional transactions:

$$R = \frac{72 - (\frac{1}{9-1} \times 12)}{72 + 12} = 0.839$$

(ii) Structural transactions:

$$R = \frac{75 - (\frac{1}{9-1} \times 9)}{75 + 9} = 0.879$$

After coding was completed each first-year teacher's protocol was then analysed to determine the amount of time spent on the various functional and structural categories and the results were recorded (see Appendix E.1 for the individual functional analyses. Appendix E.2 for structural analyses). Thereupon graphs were drawn showing the range and mean for both functional and structural transactions for each first-year teacher (Appendix F).

The second task for Phase 2 was to determine the extent to which the first-year teachers attributed their own teaching patterns to science curriculum training.

Attribution of teaching patterns to training

Information about the extent to which the first-year teachers attributed their own teaching patterns to science curriculum training was collected by questionnaire (Appendix H, Section C).

Teachers were asked to indicate the extent to which their own particular method of teaching was thought to be due to: -

(i) the way they were taught science at Teachers College;
(ii) the way they were told to teach science at College;
(iii) the way they were taught science at Primary School;
(iv) the way they were taught science at Intermediate school;
(v) the way they were taught science at High School, or
(vi) *Some other influence.

Responses were required on the following 5-point scale:

5 - a great deal
4 - much
3 - a moderate amount
2 - not very much
1 - little or none

Results for this section are to be found in Table 17, Chapter 5.

The third task for Phase 2 was to determine the first-year teachers' perceptions of:

(i) the manner in which elementary science "should" be taught,
(ii) the teaching patterns of their school science teachers,
(iii) those of their College lecturers, and
(iv) those recommended by their College lecturers.

Structured Interviews

A total of 4 structured interviews were undertaken with each first-year teacher. In keeping with the first phase of the study the questions centered around the 9 structural and 9 functional transactions in Appendix A. For Interview

* For this category teachers were also asked to submit written comments in the spaces provided on the questionnaires.

1, teachers were asked to indicate the percentages of lesson time that they believed an elementary science teacher "should" spend on these 9 functional and 9 structural transactions. For Interview 2 they were required to indicate the percentages of lesson time spent by their science school teachers on these transactions. For Interview 3, the percentages of lesson time recommended by their College lecturers, and for Interview 4 the percentages of lesson time spent by their College lecturers on these transactions (Appendix G).

The first-year teachers were interviewed individually at times when most convenient for them. Places of interviews ranged from staff rooms, to empty offices and classrooms, to a store room for musical equipment. Initially, for each separate interview, the researcher went through each task with the teacher, explaining any terms not fully understood. Then the researcher and teacher worked through each task in detail with the teacher writing his/her answer to each question in the appropriate spaces on the answer sheet. No time limit was set and teachers were free to ask for clarification on any points at any time during the interviews.

The results were then tabulated. They appear as the following Tables in Chapter 5:

Tables 12a and 12b - perceptions of the proportion of lesson time recommended by science lecturers to be spent on functional and structural transactions.

Tables 13a and 13b - perceptions of the proportion of lesson time spent by science lecturers on functional and structural transactions.

Tables 14a and 14b - perceptions of the proportion of lesson time spent by "pre-college" science teachers on functional and structural transactions.

Tables 15a and 15b - perceptions of the proportion of lesson time that <u>should</u> be spent on functional and structural transactions.

The final steps in the collection of information for Phase 2 were to determine: -

(i) the levels of success that each first-year teacher believed he or she was experiencing in the use of the teaching competencies for which provisions had been made during training;

(ii) the extent to which the practising of these competencies was thought to have influenced their overall level of success as science teachers; and

(iii) the extent to which capability in practising these competencies was attributed to training.

First-year teachers - teaching competencies

According to the science curriculum programmes there were 47 different teaching competencies available for acquisition by the students. Of these, 40 related to the general aspects of science teaching and 7 to the personal attributes of science teachers. They are listed on pages 73, 74 , and 75 , Chapter 4.

Based on these 47 competencies, a two-section questionnaire was constructed. Section A covered the fourty general competencies, Section B the seven teacher-attributes.

Each of the 47 items of the questionnaire consisted of three parts or sub-questions. For every item the respondent was required to indicate:

(i) a level of proficiency in a particular competency,
(ii) the extent to which this level of proficiency influenced his/her overall level of success as a science

teacher, and

(iii) the extent to which this level of proficiency was thought to be due to training for science teaching. (see Appendix H).

Responses were required on five-point scales. Viz: -

1. Part (a)

   Levels of success in practicing competencies:

   5 - extremely high
   4 - high
   3 - average
   2 - low
   1 - extremely low

2. Part (b)

   Influence of success levels on overall level of science teaching:

   5 - extremely high
   4 - high
   3 - average
   2 - low
   1 - extremely low

3. Part (c)

   Attribution of success to training:

   5 - entirely
   4 - very much
   3 - partly
   2 - not very much
   1 - extremely little

Most answers were put in the numbered spaces provided. Some however, were placed inbetween. In such cases the ratings were taken to be the mid-point between the two ratings e.g. between 2 and 3 was taken as 2.5.

The ratings given to the questionnaire items were tabulated (Appendix I). Respondents were numbered. Numbers 1 through 7 were allocated to those who had received spaced curriculum training (group 1) and 8 through 20 to those who had received massed curriculum training (group 2).

From these individual teacher-ratings of questionnaire items group-ratings (for each item) were formulated for:

(i) group 1,

(ii) group 2, and

(iii) the entire sample of first-year teachers.

The group-rating for each questionnaire item was determined by adding the ratings of each group member for a particular item and dividing this sum by the total number of respondents in the group. Take for example item 1a in Appendix I, Section A. For group 1 the sum of all teacher-ratings for this item was 20. Since there were 7 respondents in this group the group-rating for this particular item was 20/7 or 2.857. Similarly, the sum of all teacher-ratings for this item by group 2 was 42. Since there were 13 respondents in this group the group-rating for this item (for group 2) was 42/13 or 3.23. This in effect established a group scale scored on 'average' position. Where individual teachers did not rate particular competencies these teachers were omitted from the group when the group-ratings were calculated.

When all group-ratings for each questionnaire item had been established, the results were tabulated in Tables. (Tables 4, 5 and 6 in Chapter 4).

Since each item of the questionnaire consisted of three parts (a, b and c), the tables for group-ratings of questionnaire items also employed 3 columns, each corresponding to an item part (See Table 3 as an example).

TABLE 3

COMPETENCE QUESTIONNAIRE: CATEGORIES FOR GROUP RATINGS

Item No	Competence Level	Effect of Competence Level on Overall Success	Attribution of Competence Level to Training

The graphs that were subsequently drawn represented: -

(i) the reported levels of success that the various groups of teachers were experiencing in each competency and the effects of these success levels on their overall level of science teaching success, and

(ii) the reported levels of success that the various groups of teachers were experiencing in practicing each competency and attribution of these success levels to training.

With the completion of this final step Phase 2 of the study was brought to a close. The findings of the study follow in Chapters 4 and 5.

CHAPTER 4

FINDINGS - TEACHING COMPETENCIES

This study of the relationship between preservice training in science teaching and subsequent teacher-practice is based on a number of questions raised in Chapter 2 and whose investigation was described in Chapter 3. It is the purpose of the present chapter to present the findings for preservice training and the subsequent teaching competencies of the first-year teachers.

Based on the issues discussed in Chapter 2, the findings for 7 questions are presented in this chapter.

What are the teaching competencies for which provisions were made during science curriculum training? (Question 1)

Investigation of the course outlines and science training sessions undergone by the students revealed 47 competencies implicit. These, it may reasonably be concluded, were intended to be gained and subsequently used!. Of these, 40 pertained to the general aspects of science teaching and 7 to the personal attributes of science teachers. They were respectively: -

(i) General teaching competencies:

To enable the preservice teachers to: -

1. Use the prescribed science syllabus
2. Exercise his/her own judgement over how to use the science syllabus
3. get access to science resource books
4. use science resource books
5. get access to science equipment
6. use science equipment
7. benefit from collaborating with Science Resource Teachers

8. benefit from collaborating with Heads of Science Departments (if present)
9. adapt the classroom environment in the interest of science teaching
10. organize pupils during science lessons
11. control pupils during science lessons
12. get pupils to observe safety rules during science lessons
13. plan a science programme
14. extend the science programme beyond the classroom
15. devise objectives for science lessons
16. prepare science activities
17. devise open-ended problems for science classes
18. modify materials to fit specific class needs or science activities
19. integrate science with other subjects
20. exercise own judgement over how to teach science
21. use a science teaching kit (prepared at Teachers College)
22. motivate pupils to learn science
23. increase pupils' knowledge of science
24. help pupils to develop concepts in science
25. develop pupils' communication skills in science
26. teach pupils to observe
27. teach pupils to measure
28. teach pupils to classify
29. teach pupils to infer
30. teach pupils to predict results
31. teach pupils to hypothesize
32. teach pupils to experiment
33. increase pupils' understanding of science
34. develop desirable attitudes in pupils during science classes
35. prepare testing and evaluation instruments for pupils
36. evaluate pupils' acquisition of process skills
37. evaluate the increase of knowledge and under-

standing of science in pupils

38. evaluate the increase of communication skills in pupils of science classes
39. evaluate the increase of desirable attitudes in pupils of science classes
40. write progress reports for members of science classes.

(ii) Personal (teacher) attributes:

Development of the preservice teacher's own:

1. knowledge of science (as taught in the elementary schools)
2. understanding of science (as taught in the elementary schools)
3. positiveness of attitude toward the teaching of science
4. motivation to teach science
5. ability to teach science
6. skills in teaching science
7. confidence in teaching science.

Having completed a course in science curriculum training, after a period of six months, do first-year teachers necessarily employ the competencies for which provisions were made during training? (Question 2)

The questionnaire administered during the first-year teacher observations in Phase 2 provided the basis for conclusions relevant to question 2. (See Appendix H). Items in Section A of the questionnaire required teachers to indicate the levels of success they considered they were experiencing in the 40 general competencies. Items in Section B with the 7 personal (teacher) attributes.

Results from Section A are given in column 2 of Table 4a and from Section B in column 2 of Table 4b. Figure 6 is a graphic representation of the results from column 2 of Table 4a (general competencies).

TABLE 4a

REPORTED GENERAL COMPETENCY LEVELS, EFFECTS ON SUCCESS AND ATTRIBUTION TO TRAINING (GROUPS 1 AND 2 COMBINED)

Item #	Competence Level	Effect of Competence level on Overall Success	Attribution of Competence Level to training
1	3.1	2.8	2.8
2	3.6	3.5	2.8
3	3.4	3.3	2.4
4	3.3	3.4	2.8
5	3.3	3.5	2.6
6	3.5	3.6	2.8
7	2.9	2.9	1.9
8	2.4	2.7	1.9
9	3.1	3.3	2.5
10	3.4	4.0	2.8
11	3.7	4.1	2.3
12	3.7	3.6	2.7
13	3.4	4.0	3.1
14	3.6	3.5	3.0
15	3.3	3.8	3.1
16	3.6	4.0	3.3
17	3.1	3.1	3.0
18	3.4	3.5	2.6
19	3.8	3.8	2.6
20	3.5	3.4	2.5
21	2.1	1.9	2.2
22	3.4	3.7	3.0
23	3.4	3.5	3.0
24	3.2	3.4	3.0
25	3.2	3.4	3.2
26	3.9	4.0	3.4
27	3.0	3.1	2.9
28	3.5	3.6	3.4
29	3.1	3.5	3.2
30	3.3	3.4	3.2
31	2.7	3.0	3.0
32	3.6	3.5	3.1
33	3.3	3.4	2.9
34	3.5	3.8	3.0
35	2.6	3.0	2.7
36	3.1	3.3	3.4
37	3.1	3.3	3.0
38	3.1	3.3	2.8
39	3.1	3.3	2.8
40	2.7	2.7	2.2
Mean:	3.3	3.4	2.8

Figure 6

General Competencies: Reported Success Levels (All Teachers)

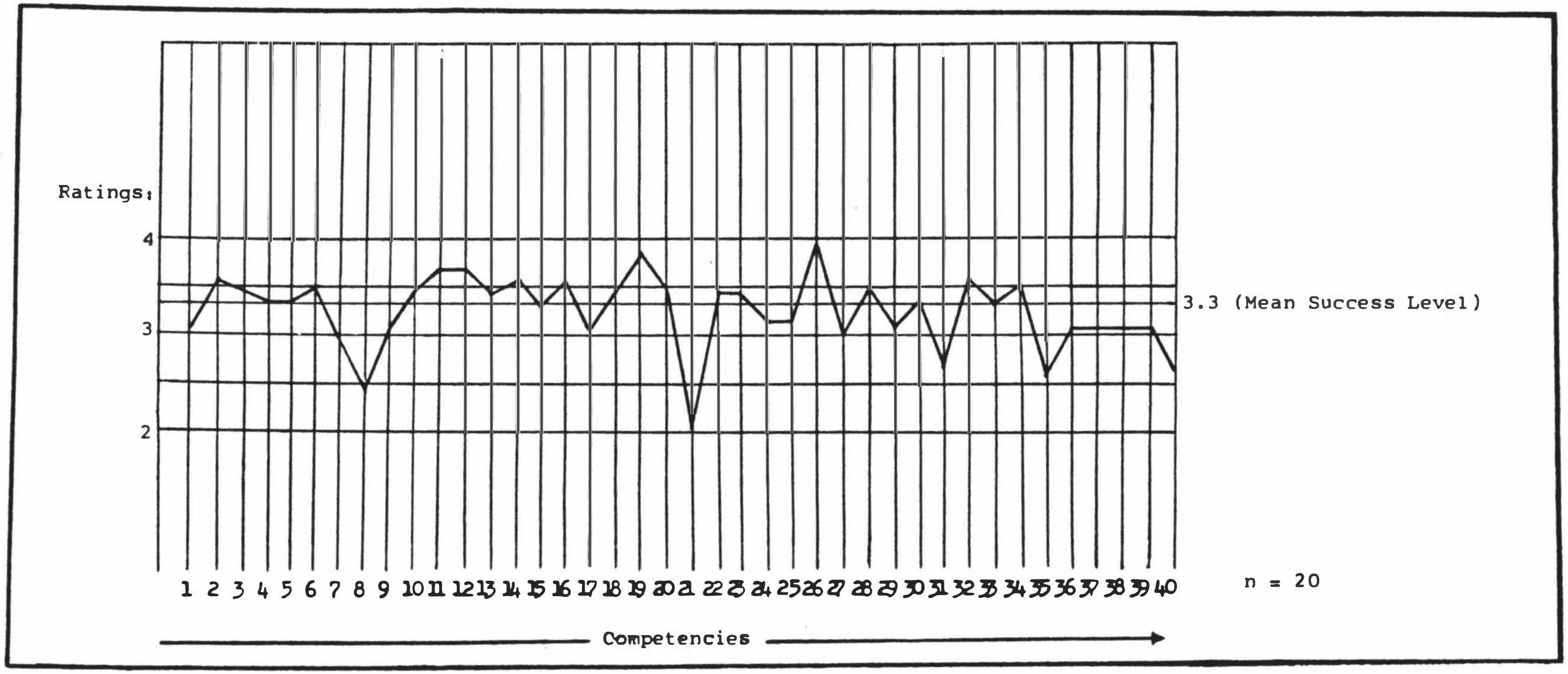


Table 4a contains three sets of data - from the separate questionnaire item parts. Each set has a column devoted to it - columns 2, 3 and 4 for averaged success, influence, and attribution ratings respectively.

The 3 rating scales for the questionnaire item parts are to be found in Chapter 3. These scales were all 5 point scales to accomodate individual teacher ratings from 1 to 5. However, averaged group ratings of questionnaire item parts were seldom in the form of whole numbers. It was felt that the the retention of the group scores in decimal form would present a clearer graphic picture of variations in averaged group responses. Therefore, based on the scales in Chapter 3, the following success, influence, and attribution scales were devised to accommodate the decimalized scores:

(i) Success Scale for the rating of part a of questionnaire items (perceived levels of success in teaching competencies): -

4.1 - 5 = Extremely high
3.1 - 4 = High
2.1 - 3 = Average
1.1 - 2 = Low
0 - 1 = Extremely low or not at all

(ii) Influence Scale for the rating of part b of questionnaire items (influence of success levels on overall level of science teaching): -

4.1 - 5 = Extremely high
3.1 - 4 = High
2.1 - 3 = Average
1.1 - 2 = Low
0 - 1 = Extremely low or not at all

(iii) Attribution Scale for the rating of part c of questionnaire items (attribution of success levels to training for science teaching): -

4.1 - 5 = Entirely
3.1 - 4 = Very much

2.1 - 3 = Partly
1.1 - 2 = Not very much
0 - 1 = Extremely little or not at all.

Figure 6 and column 2 of Table 4a reveal that: -

(i) The success* ratings derived from the aggregated (or group) scores for the separate general competencies ranged from 2.1 to 3.9 with the mean falling at 3.3. This means that the lowest success rating is equivalent to the response of "an average level of success" and the highest to the response of "a high level of success." A mean of 3.3 would be located at a point on the scale that means "a high level of success."

(ii) 33 of the fourty general competencies were rated above success ratings of 3.0, or above "average".

(iii) The four items with the highest success ratings were:

- teaching pupils to observe (item 26) - success rating - 3.9;
- integrating science with other subjects (item 19) - success rating - 3.8;
- controlling pupils during science lessons (item 11) - success rating - 3.7; and
- getting pupils to observe safety rules during science lessons (item 12) - success rating - 3.7;

(iv) The five items with the lowest success ratings were:

- teaching pupils to hypothesize (item 31) - success rating - 2.7;
- writing progress reports for members of science classes (item 40) - success rating-2.7;
- preparing testing and evaluation instruments for pupils in science classes (item 35) - success rating - 2.6;

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* Throughout the study, 'success' whether related to competencies or science teaching is always perceived success.

- benefitting from collaborating with the Heads of Science Departments (item 8) - success rating - 2.4,
- using the science teaching kit prepared at Teachers College (item 21) - success rating - 2.1.

Success levels in all of these 5 competencies were equivalent to the response of "an average amount of success" on the Success Scale.

The general picture that emerges is that for the averaged responses: -

(i) Success levels in 82.5% (33) of the 40 general teaching competencies were rated above 3.0. On the Success Scale these scores are equivalent to the response of "a high level of success".

(ii) Success levels in 17.5% (7) of the general teaching competencies were reportedly "average".

(iii) Success levels in none of the general teaching competencies were reportedly low.

Attention now turns to the 7 personal (teacher) attributes as they relate to the same question - question 2. Teacher-ratings for these competencies are recorded in column 2 of Table 4b and are represented in Figure 7 which shows: -

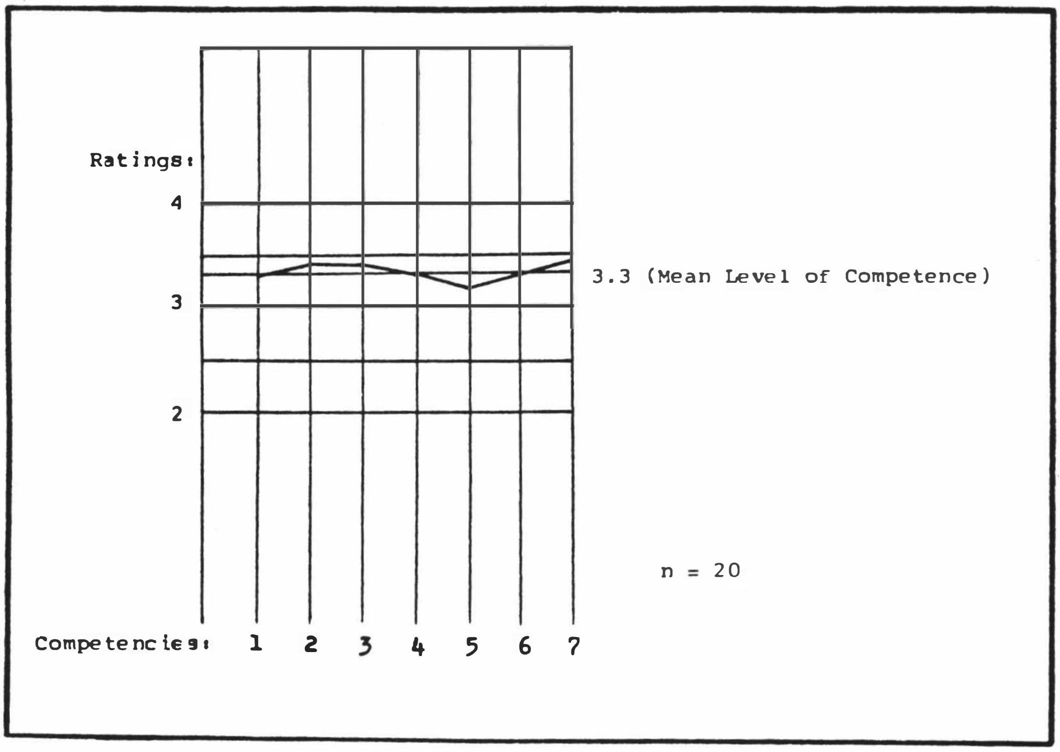
(i) the mean level of competence reported in the 7 teacher-attributes; and

(ii) deviations from the mean competence level.

From Figure 7 it can be seen that the mean competence level over the 7 personal (teacher) attributes yielded a success rating of 3.3 and that all of the averaged ratings were closely clustered around the mean. The averaged ratings

Figure 7

Personal (teacher) Attributes: Reported Competence Levels (All Teachrrs)



ranged from 3.2 to 3.4 (see Table 4b). For <u>all</u> of the personal (teacher) attributes the averaged competence levels were reportedly "high".

<u>If the competencies for which provisions were made during science curriculum training are employed by first-year teachers to what extent is this attributed to the actual process of training for science teaching?</u> (Question 3)

Findings for this question were derived from part c of the questionnaire items which required the teachers to indicate the extent to which the levels of success they indicated for the specified teaching competencies were thought to be due to the training they had received. Results are to be found in column 4 of Tables 4a, and 4b for general competencies and personal attributes respectively.

The results for the general teaching competencies will be considered first. A figurative representation of the combined results reflecting the relationship between success in the general competencies and attribution to training is to be found in Figure 8.

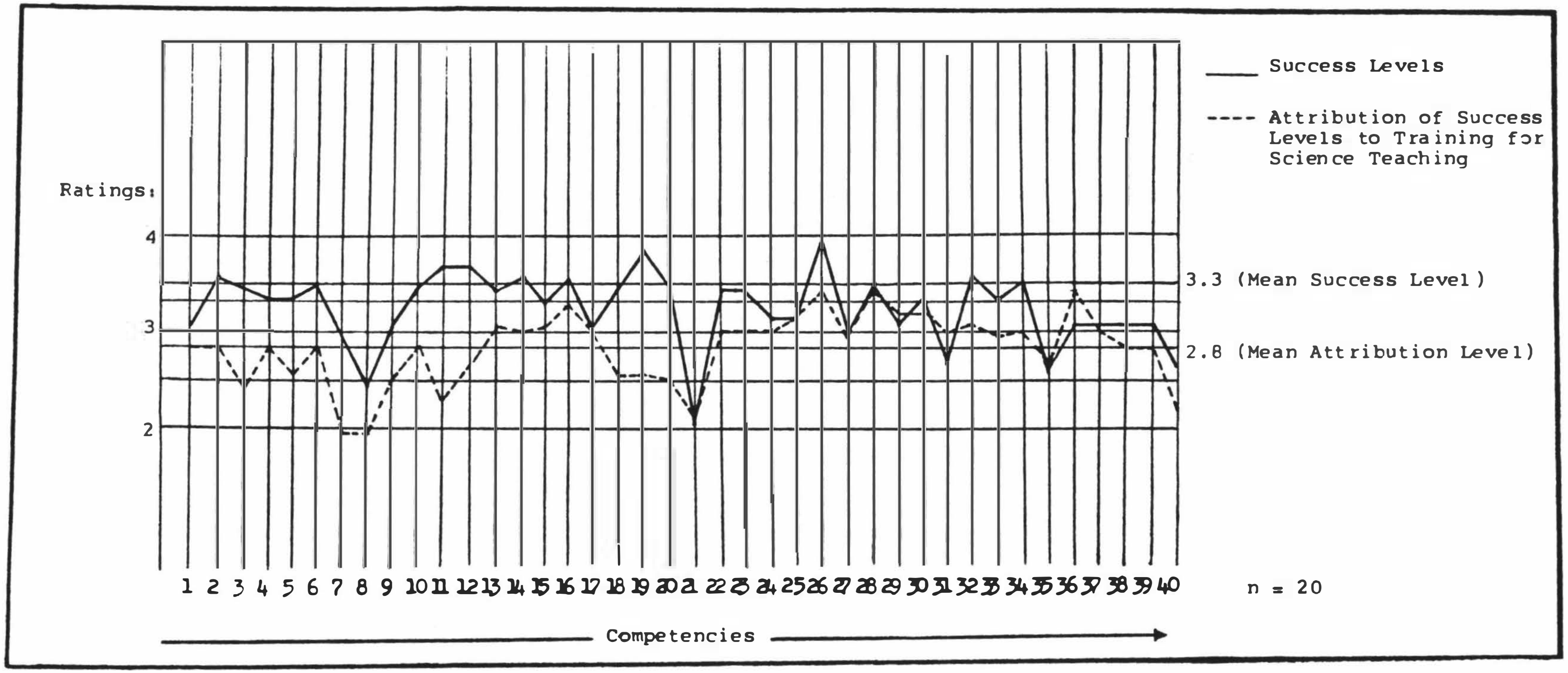
From Figure 8 and Table 4a it can be seen that: -

(i) Attribution ratings of success levels in the 40 general teaching competencies to training ranged from 1.9 to 3.4 with the mean falling at 2.8. In terms of the Attribution Scale this means that the lowest rating is equivalent to the response "<u>not very much</u> attributed to training", and the highest to the response "<u>very much</u> attributed to training". A mean of 2.8 would be located at a point on the scale that means "<u>partly</u> attributed to training".

(ii) Averaged success levels that were indicated for 28 of the 40 general competencies were "partly" attributed to training for science teaching (ratings from 2.2 to 3.0 on the Attribution Scale).

Figure 8

General Competencies: Reported Success Levels and Attribution to Training (All Teachers)



(iii) Averaged success levels in 10 competencies were "very much" attributed to training according to the Attribution Scale. They were: -

- evaluating pupils' acquisition of process skills (item 36). Success rating: 3.1 - attribution rating: 3.4;
- teaching pupils to classify (item 28). Success rating: 3.5 - attribution rating: 3.4;
- teaching pupils to observe (item 26). Success rating: 3.9 - attribution rating: 3.4;
- preparing science activities (item 16). Success rating: 3.6 - attribution rating: 3.3;
- teaching pupils to infer (item 29). Success rating: 3.1 - attribution rating: 3.2;
- teaching pupils to predict results (item 30). Success rating: 3.3 - attribution rating: 3.2;
- developing pupils' communication skills in science (item 25). Success rating: 3.2 - attribution rating: 3.2;
- planning the science programme (item 13). Success rating: 3.4 - attribution rating: 3.1;
- devising objectives for science lessons (item 15). Success rating: 3.3 - attribution rating: 3.1,
- teaching pupils to experiment (item 32). Success rating:3.6 - attribution rating: 3.1.

For all of these 10 competencies the averaged success levels were equivalent to the response of "high" levels of success.

It is noteworthy that 7 of the 10 competencies entailed process skills (items 25, 26, 28 29 30 32 and 36). The other three pertained to programme planning and lesson preparation (items 13, 15 and 16).

(iv) Attribution ratings for reported success levels in 2 general competencies were equivalent to the response of "not very much attributed to training" on the Attribution Scale. These were: -

- benefitting from collaborating with Science Resource Teachers (item 7). Success rating: 2.9 - attribution rating: 1.9;
- benefitting from collaborating with the Head of Science Department (item 8). Success rating: 2.4 - attribution rating: 1.9.

Both of these competencies were reportedly being implemented at a success level that was "average" on the Success Scale.

Thus the averaged responses indicated that: -

(i) attribution ratings for reported success levels in 10 (25.0%) of the 40 general competencies were equivalent to the response of "very much attributed to training";

(ii) attribution ratings for reported success levels in 28 (70.0%) of the 40 general competencies were equivalent to the response of "partly" attributed to training; and

(iii) attribution ratings for reported success levels in 2 general competencies were equivalent to the response of "not very much attributed to training".

For the personal (teacher) attributes the results were as follows: -

(i) Averaged attribution ratings of success levels to training in the 7 personal (teacher) attributes ranged from 2.6 to 3.1 with the mean falling at 2.9. In terms of the Attribution Scale this means that the lowest rating is equivalent to the response of "partly attributed to training", the highest to the response of "very much attributed to training", and the mean (2.6) to the response of "partly attributed to training". (See Table 4b and Figure 9).

(ii) Averaged competence levels in 4 of the 7 teacher-attributes were "partly" attributed to training according to the Attribution Scale (ratings from 2.6 to 2.9). They were: -

- the teachers' own motivation to teach science (item 4). Success rating: 3.3 - attribution rating: 2.9;
- the teachers' own positiveness of attitude toward the teaching of science (item 3). Success rating: 3.4 - attribution rating: 2.8;
- the teachers' own knowledge of the subject matter of science as taught in the elementary schools (item 1). Success rating: 3.3 - attribution rating: 2.7;
- the teachers' own understanding of the subject matter of science as taught in the elementary schools (item 2). Success rating: 3.4 - attribution rating: 2.6.

(iii) Averaged competence levels for 3 personal (teacher) attributes were "very much" attributed to training according to the Attribution Scale (ratings from 3.1 to 3.2). These were: -

- the teachers' own ability to teach science (item 5). Success rating: 3.2 - attribution rating: 3.2;
- the teachers' own skills in the teaching of science (item 6). Success rating: 3.3 - attribution rating 3.1;
- the teachers' own confidence in the teaching of science (item 7). Success rating: 3.4 - attribution rating: 3.1.

Thus, the averaged responses indicated that the first-year teachers' own skills, confidence and ability to teach science (items 6, 7, and 5 respectively) were more highly attributed to training than their own knowledge and understanding of science as taught in the elementary schools (items 1 and 2); positiveness of attitude toward the teaching of science (item 3); or their motivation to teach science (item 4).

Figure 9

Personal (teacher) Attributes

Reported Competence Levels and Attribution to Training: All Teachers

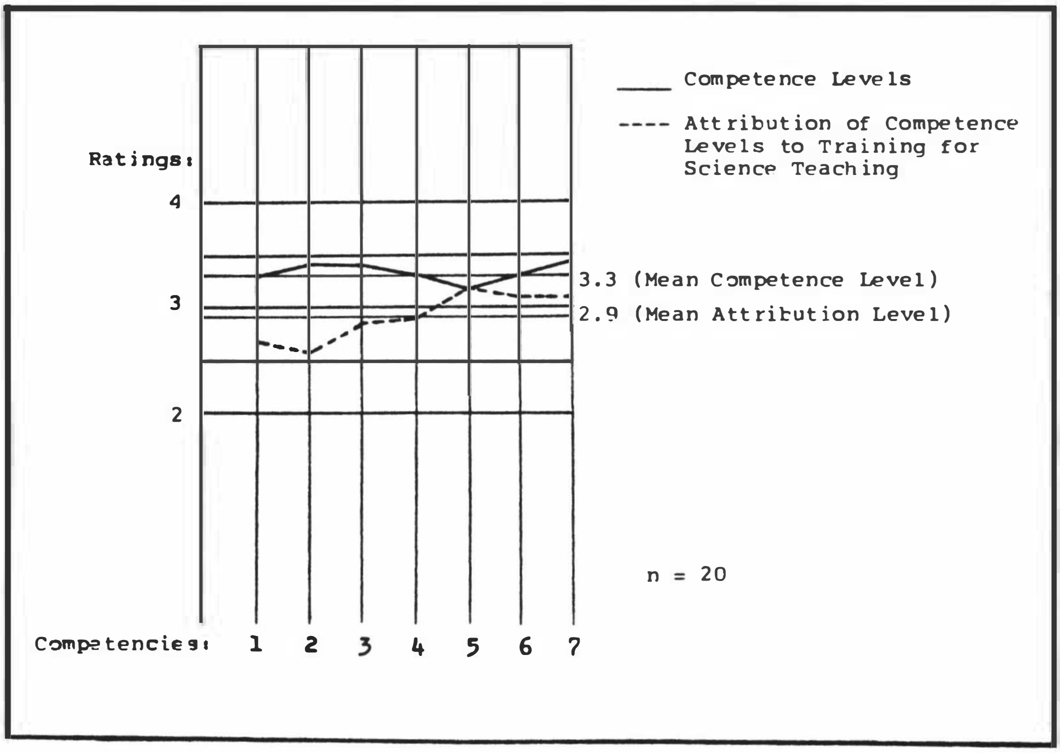


TABLE 4b: REPORTED PERSONAL COMPETENCY LEVELS, EFFECTS ON SUCCESS AND ATTRIBUTION TO TRAINING: (Groups 1 and 2 combined)

Item #	Competence Level	Effect of competence level on overall success	Attribution of competence level to training
1	3.3	3.8	2.7
2	3.4	3.7	2.6
3	3.4	3.9	2.8
4	3.3	3.9	2.9
5	3.2	4.0	3.2
6	3.3	3.8	3.1
7	3.4	3.5	3.1
Mean:	3.3	3.8	2.9

<u>If the competencies for which provisions were made during science curriculum training are being employed by first-year teachers, what effect does this have on their overall level of success as science teachers?</u> (Question 4)

This question will first be answered in relation to the general teaching competencies (measured by Section A of the questionnaire). A graphic representation of the answer to question 4 as it bears on general teaching competencies is to be found in Figure 10. Figure 10 shows:

(i) the indicated levels of success; and

(ii) the extent to which the levels of success indicated were thought to affect the overall level of success of the science teachers.

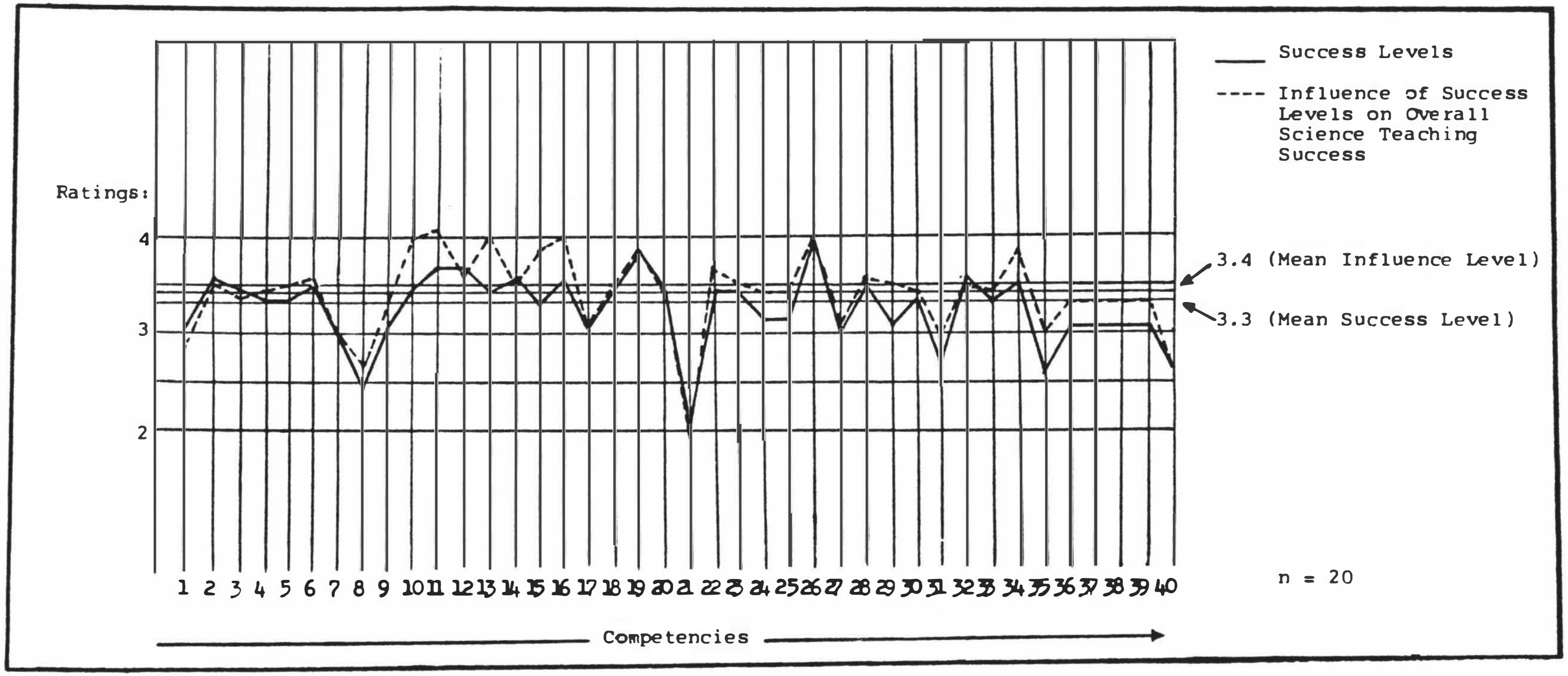
The data from which Figure 10 is derived are to be found in Table 4a (columns 2 and 3).

From Figure 10 and Table 4a it can be seen that: -

(i) The influence ratings derived from the aggregated (or group) scores ranged from 1.9 to 4.1 with the

Figure 10

Reported Success Levels and Influence on Overall Science Teaching Success: All Teachers



mean falling at 3.4. This means that the lowest rating is equivalent to the response of "a low level of influence"* on the Influence Scale, the highest to the response of "an extremely high level of influence", and the mean (3.4) to the response of "a high level of influence".

(ii) In 32 of the 40 general competencies the group scores were between 3.1 and 4.0 on the Influence Scale. This means that reportedly, self-assured success levels in all of these competencies had a "high" amount of influence on the overall success of the first-year teachers. For 31 of these 32 competencies the reported group scores on the Success Scale were above 3.0 or equivalent to the response of "high" levels of success. The success level of the other competency (item 27) was reportedly "average".

(iii) In 6 of the 40 general teaching competencies the group scores were equivalent to the response of "average" levels of influence" on the Influence Scale. These 6 competencies were: -

- preparing testing and evaluation instruments for members of science class (item 35)-influence rating: 3.0 - success rating: 2.6;
- teaching pupils to hypothesize (item 31) - influence rating: 3.0 - success rating: 2.7;
- benefitting from collaborating with Science Resource Teachers (item 7)-influence rating: 2.9 - success rating: 2.9;
- using the prescribed science syllabus (item 1)-influence rating: 2.8 - success rating: 3.1,
- writing progress reports for members of science classes (item 40)-influence rating: 2.7 - success rating: 2.7; and
- benefitting from collaborating with the Head of Science Department (item 8) - influence rating: 2.7 - success rating: 2.4.

* throughout the study, 'influence' of perceived levels of success in competencies on the overall level of success of the teachers is always perceived influence.

In one of these competencies (item 1) the reported group score on the Success Scale was 3.1 or equivalent to a "high" level of success. In the other 5 competencies the group ratings were equivalent to "average" amounts of success.

(iv) In 1 general teaching competency - "using the science teaching kit" (item 21) the group score was equivalent to the response of a "low level of influence" on the Influence Scale. The group score on the Success Scale for this competency was equivalent to an "average amount of success".

It is noteworthy that this particular competency was the one for which the group ratings yielded:

(a) the lowest group score on the Influence Scale and

(b) the lowest group score on the Success Scale.

(v) In one general teaching competency the group score on the Influence Scale was equivalent to the response of an "extremely high" level of influence. This competency was: -

- controlling pupils during science classes (item 11) - influence rating 4.1 - success rating: 3.7.

The results for the personal (teacher) attributes are shown in Figure 11 which is a composite graph showing: -

(i) group ratings of competence levels in personal (teacher) attributes (derived from column 2 of Table 4b); and

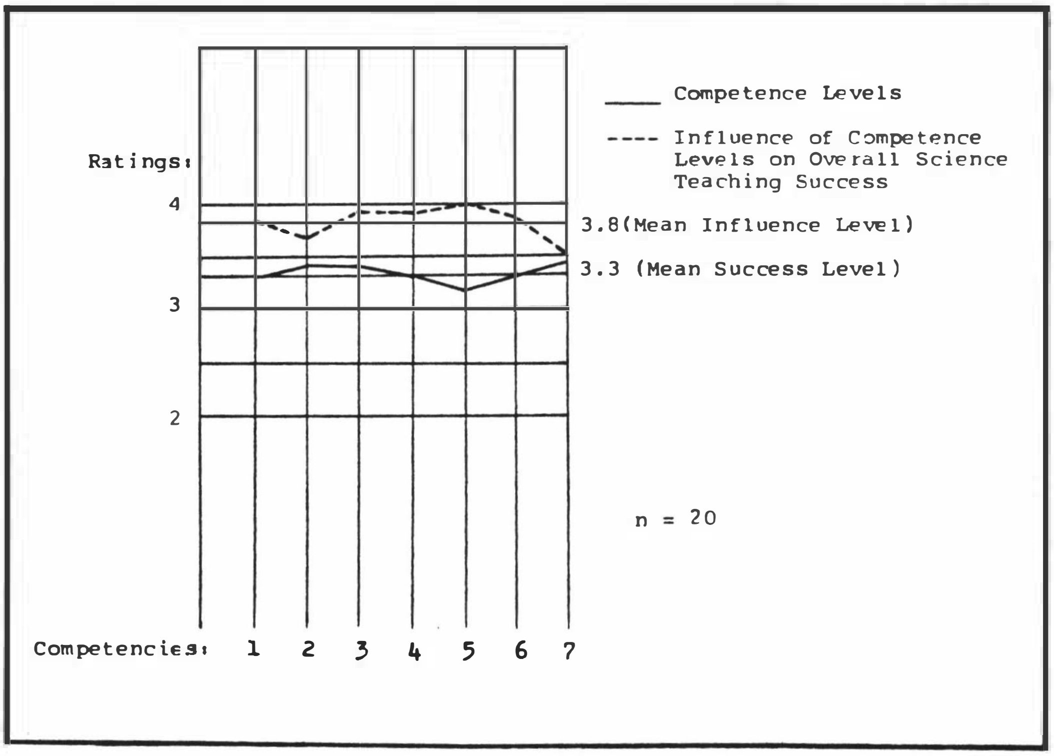
(ii) influence of competence levels on overall level of success in science teaching (derived from column 3 of Table 4b).

From Figure 11 and Table 4b the following results can be seen:

(i) The influence ratings derived from the group scores for the personal (teacher) attributes ranged from 3.5 to 4.0 with the mean falling at 3.8. All of these ratings (lowest, highest and mean) are equivalent

Figure 11

Personal (teacher) Attributes: Reported Competence Levels and Influence on Overall Science Teaching Success (All Teachers)



to the response of "a <u>high</u> level of influence" on the Influence Scale. For all of these personal (teacher) attributes the group scores were equivalent to the response of "<u>high</u>" levels of success on the Success Scale.

(ii) The personal (teacher) attribute with the <u>highest</u> group score on the Influence Scale was: "The teacher's own <u>ability</u> to teach science" (item 5) - influence rating: 4.0 - Success rating 3.2.

(iii) The personal (teacher) attribute with the <u>lowest</u> group score on the Influence Scale was: "The teacher's own <u>confidence</u> in teaching science (item 7) - influence rating: 3.5 - success rating: 3.4.

<u>What effect does the spacing or massing of training have on the first-year teachers' use of the teaching competencies for which provisions were made during training?</u> (Question 5).

Comparisons of the reported competence levels of the teachers who received spaced curriculum training (group 1) and those who received massed curriculum training (group 2) in the competencies provided during training were made by superimposing the graphs showing the competence levels of group 1 over that of group 2 (Figures 12 and 13). Figure 12 shows comparative levels of competence in the 40 general teaching competencies for groups 1 and 2 (derived from column 2 of Tables 5a and 6a respectively). Figure 13 shows the comparative competence levels in the personal (teacher) attributes for groups 1 and 2 (derived from column 2 of Tables 5b and 6b respectively).

The results for the general teaching competencies will be presented first.

From Figure 12 (and column 2 of Tables 5a and 6a) the results were as follows: -

(i) For group 1 the group scores ranged from 2.2 to 4.3 with the mean falling at 3.4 on the Succcess Scale. This means that the <u>lowest</u> group score for group 1

TABLE 5a

REPORTED GENERAL COMPETENCY LEVELS, EFFECTS ON SUCCESS AND ATTRIBUTION TO TRAINING: GROUP 1

Item #	Competence Level	Effect of Competence Level on Overall Success	Attribution of Competence Level to training
1	2.9	2.9	2.9
2	3.7	3.7	3.1
3	3.4	3.4	2.7
4	3.3	3.3	3.4
5	3.3	4.1	2.7
6	3.4	3.7	3.3
7	2.4	2.1	1.9
8	2.3	2.3	1.3
9	3.0	3.4	2.9
10	3.4	4.3	3.6
11	3.4	4.0	2.3
12	3.7	4.0	2.4
13	3.5	3.6	3.6
14	3.1	3.3	2.9
15	3.6	3.7	3.1
16	3.7	3.9	3.4
17	3.0	3.1	3.1
18	3.3	3.4	2.4
19	4.3	4.0	2.6
20	3.7	3.4	3.1
21	2.2	1.8	2.5
22	3.9	4.0	3.3
23	3.7	3.6	3.4
24	3.6	3.5	3.4
25	3.4	3.7	3.3
26	4.1	4.2	3.7
27	3.4	3.4	3.1
28	4.1	4.1	3.6
29	3.9	3.9	3.8
30	3.6	3.6	3.4
31	3.3	3.1	3.4
32	3.9	3.4	3.1
33	3.6	3.4	3.1
34	3.9	4.0	3.1
35	3.0	3.4	3.2
36	3.4	3.3	3.9
37	3.3	3.1	3.1
38	3.9	3.6	3.0
39	3.3	3.1	3.0
40	3.2	2.8	2.0
Mean:	3.4	3.5	3.0

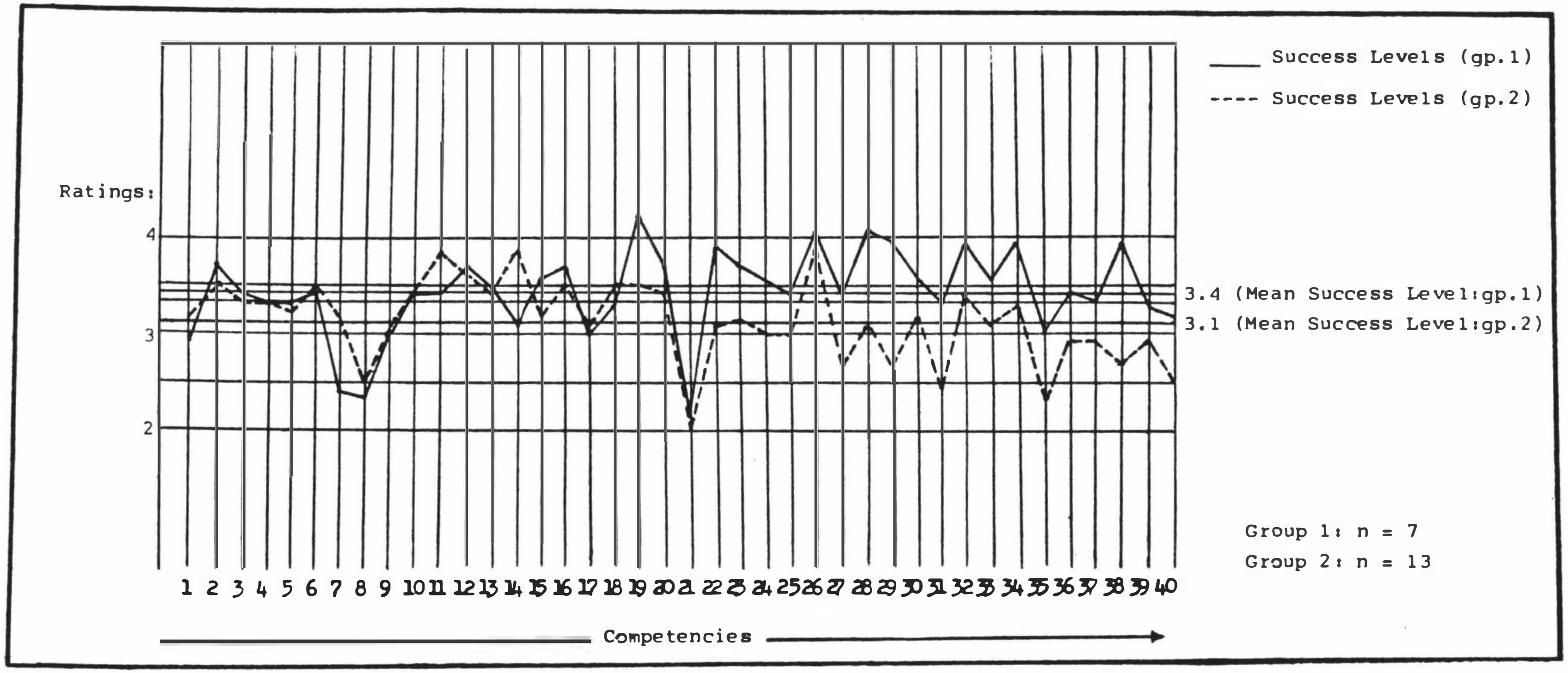
TABLE 6a

REPORTED GENERAL COMPETENCY LEVELS, EFFECTS ON SUCCESS AND ATTRIBUTION TO TRAINING: GROUP 2

Item #	Competence Level	Effect of Competence Level On Overall Success	Attribution of Competence Level to training
1	3.2	2.8	2.8
2	3.5	3.4	2.6
3	3.3	3.2	2.2
4	3.3	3.4	2.5
5	3.2	3.2	2.5
6	3.5	3.5	2.5
7	3.2	3.4	2.0
8	2.5	3.0	2.3
9	3.1	3.2	2.3
10	3.4	3.8	2.4
11	3.8	4.1	2.2
12	3.6	3.4	2.8
13	3.4	4.2	2.9
14	3.8	3.5	3.1
15	3.2	3.9	3.0
16	3.5	4.0	3.2
17	3.1	3.0	3.0
18	3.5	3.5	2.7
19	3.5	3.3	2.5
20	3.4	3.4	2.2
21	2.0	1.9	2.1
22	3.1	3.5	2.8
23	3.2	3.5	2.7
24	3.0	3.3	2.8
25	3.0	3.2	3.1
26	3.8	3.9	3.2
27	2.7	2.9	2.8
28	3.1	3.2	3.2
29	2.7	3.3	2.9
30	3.2	3.3	3.1
31	2.4	2.9	2.8
32	3.4	3.5	3.1
33	3.1	3.4	2.7
34	3.3	3.7	2.9
35	2.3	2.7	2.4
36	2.9	3.2	3.2
37	2.9	3.3	2.9
38	2.7	3.2	2.7
39	2.9	3.3	2.7
40	2.5	2.6	2.3
Mean:	3.1	3.3	2.7

Figure 12

General Competencies: Reported Success Levels (Groups 1 and 2)



is equivalent to the response of "an average level of success", the highest group score to the response of "an extremely high level of success", and the mean to the response of "a high level of success".

(ii) For group 2 the group scores ranged fron 2.0 to 3.8 with the mean falling at 3.1 on the Success Scale. This means that the lowest group score for group 2 would be equivalent to the response of "a low level of success", the highest to the response of "a high level of success" and the mean also to the response of "a high level of success".

(iii) For group 1 the averaged scores yielded success ratings that were equivalent to the response of "an extremely high level of success" for 3 general competencies. They were:

- integrating science with other subjects - item 19 - success rating: 4.3;
- teaching pupils to observe - item 26 - success rating: 4.1; and
- teaching pupils to classify - item 28 - success rating: 4.1.

For group 2 no averaged scores yielded success ratings which were equivalent to the response of an "extremely high" level of success on the Success Scale.

(iv) For group 1 the averaged scores yielded success ratings that were equivalent to the response of "a high level of success" for 29 general competencies.

For group 2 the group scores yielded success ratings that were equivalent to the response of "high" levels of success for 28 general competencies.

(v) The averaged scores for group 1 yielded success ratings that were equivalent to the response of "average" levels of success for 8 general competencies.

The averaged scores for group 2 yielded success ratings equivalent to the response of "average" levels of success for 12 of the 40 general comeptencies.

(vi) For both groups of teachers the general competency with the lowest group rating on the Success Scale was - "using the science teaching kit" - item 21 - success rating group 1 - 2.2; success rating group 2 - 2.0.

(vii) Reportedly, the mean level of success was higher for group 1 (teachers who received spaced curriculum training) than for group 2 (teachers who received massed curriculum training) i.e. a reported mean of 3.4 on the Success Scale for group 1 and 3.1 on the Success Scale for group 2. However, both of these mean scores are equivalent to the response of "high" levels of success on the Success Scale.

(viii) The averaged scores of the teachers who received spaced curriculum training (group 1) yielded higher levels of success on the Success Scale than those who received massed curriculum training in 30 of the 40 general teaching competencies.

(ix) For 2 general competencies:

- "Using science resource books" (item 4) and
- "Organizing pupils during science lessons" (item 10) the averaged ratings of both groups of teachers were the same.

(x) For 8 general competencies the averaged scores of group 2 were higher than those of group 1 (Table 7).

TABLE 7: COMPETENCIES FOR WHICH THE AVERAGED SCORES OF GROUP 2 YIELDED HIGHER SUCCESS RATINGS THAN THOSE OF GROUP 1

Item No.	Competencies	Success Ratings	
		Group 2	Group 1
1	Using the prescribed science syllabus	3.2	2.9
6	Using science equipment	3.5	3.4
8	Benefitting from collaborating with Heads of Science Departments	2.5	2.3
9	Adapting the classroom environment in the interest of science teaching	3.1	3.0
11	Controlling pupils during science lessons	3.8	3.4
14	Extending the science programme beyond the classroom	3.8	3.1
17	Devising open-ended problems for science classes	3.1	3.0
18	Modifying materials to fit specific class needs or science activities	3.5	3.3

<u>For the personal (teacher) attributes</u> the results were as follows: -

(i) For group 1 the group scores ranged from 3.4 to 3.7 on the Success Scale with the mean falling at 3.6 (Table 5b). All 3 of these scores are equivalent to the response of "high" levels of competence.

For group 2 the averaged scores ranged from 3.0 to 3.4 on the Success Scale with the mean falling at 3.2 (Table 6b). On the Success Scale the lowest score is equivalent to the response of "an <u>average</u> level of success" while the highest score and the mean are both equivalent to the response of "<u>high</u>" levels of success.

(ii) Whereas for group 1 <u>all</u> of the averaged scores for comeptence levels in the personal (teacher) attributes were equivalent to the response of "<u>high</u>" levels of success on the Success Scale, for group 2 averaged scores for 5 competence levels in the 7 personal (teacher) attributes were equivalent to the response of "<u>high</u>" levels of success on the Success Scale. For the other 2 personal (teacher) attributes the averaged scores of group 2 were equivalent to the response of "average" levels of success. They were:

- the teacher's own ability to teach science - item 5 - success rating: 3.0; and
- the teacher's own skills in teaching science - item 6 - success rating: 3.0 (Figure 13).

(iii) The averaged scores of group 1 (teachers who received spaced curriculum training) yielded <u>higher</u> success ratings than the averaged scores of group 2 for <u>6</u> of the 7 personal (teacher) attributes. For the other teacher- attribute "the teacher's own <u>understanding</u> of the subject matter of science as taught in the elementary schools (item 2) averaged success ratings were the same for both groups.

TABLE 5b: REPORTED PERSONAL COMPETENCY LEVELS, EFFECTS ON SUCCESS AND ATTRIBUTION TO TRAINING: GROUP 1

Item #	Competence Level	Effect of Competence level on Overall Success	Attribution of Competence level to training
1	3.4	3.9	3.7
2	3.4	3.6	3.4
3	3.7	4.3	3.0
4	3.6	3.7	3.3
5	3.6	4.0	3.6
6	3.7	4.3	3.8
7	3.7	3.9	3.9
Mean:	3.6	4.0	3.5

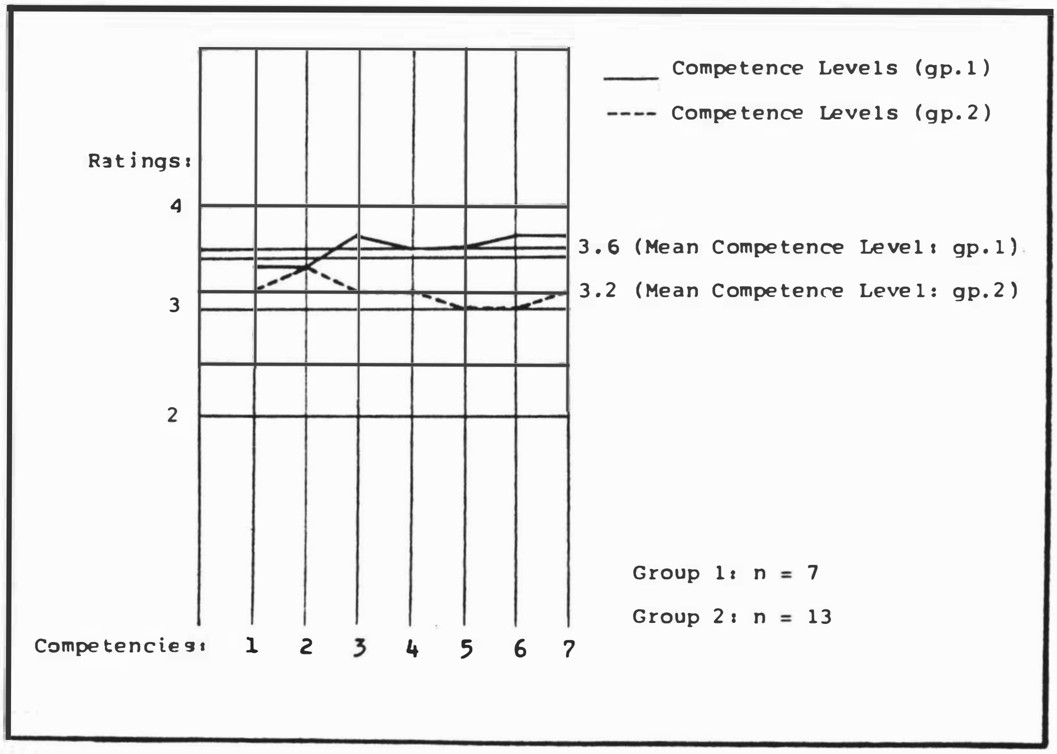
TABLE 6b: REPORTED PERSONAL COMPETENCY LEVELS, EFFECTS ON SUCCESS AND ATTRIBUTION TO TRAINING: GROUP 2

Item #	Competence Level	Effect of Competence level on Overall Success	Attribution of Competence level to training
1	3.2	3.8	2.1
2	3.4	3.7	2.2
3	3.2	3.7	2.6
4	3.2	3.9	2.7
5	3.0	3.9	2.9
6	3.0	3.5	2.8
7	3.2	3.3	2.7
Mean:	3.2	3.7	2.6

Figure 13

Personal (teacher) Attributes:

Reported Competence Levels (Groups 1 and 2)



<u>To what extent do teachers who received spaced curriculum training and those who received massed curriculum training attribute the levels of success they indicate for the competencies provided during science curriculum training to the actual process of training for science teaching?</u> (Question 6)

The findings for this question were as follows: -

(i) For group 1 (teachers who received spaced curriculum training) the averaged scores yielded attribution ratings for success levels in the 40 general competencies which ranged from 1.3 to 3.9 with the mean falling at 3.0 (Table 5a and Figure 14). In terms of the Attribution Scale this means that the lowest score was equivalent to the response of "<u>not very much</u> attributed to training", the highest to the response of "<u>very much attributed</u> to training", and the mean (3.0) to a response of "<u>partly</u> attributed to training".

For group 2 (teachers who received massed curriculum training) the averaged scores yielded attribution ratings which ranged from 2.0 to 3.2 with the mean falling at 2.7 (Figure 15 and Table 6a). According to the Attribution Scale the lowest attribution rating is equivalent to the response of "<u>not very much</u> attributed to training", the highest to the response of "<u>very much</u> attributed to training", and the mean to the response of "<u>partly</u> attributed to training".

(ii) The averaged scores of group 1 yielded attribution ratings that were equivalent to the response of "<u>very much</u> attributed to training" for success levels in <u>25</u> general competencies.

On the Success Scale the reported success levels of 2 of these 25 competencies (items 26 and 28) were "<u>extremely high</u>". Reported success levels for 21 were "<u>high</u>" and success levels for the remaining 2 were reportedly "<u>average</u>".

Figure 14

General Compenticies: Reported Success Levels and Attribution to Training (Group 1)

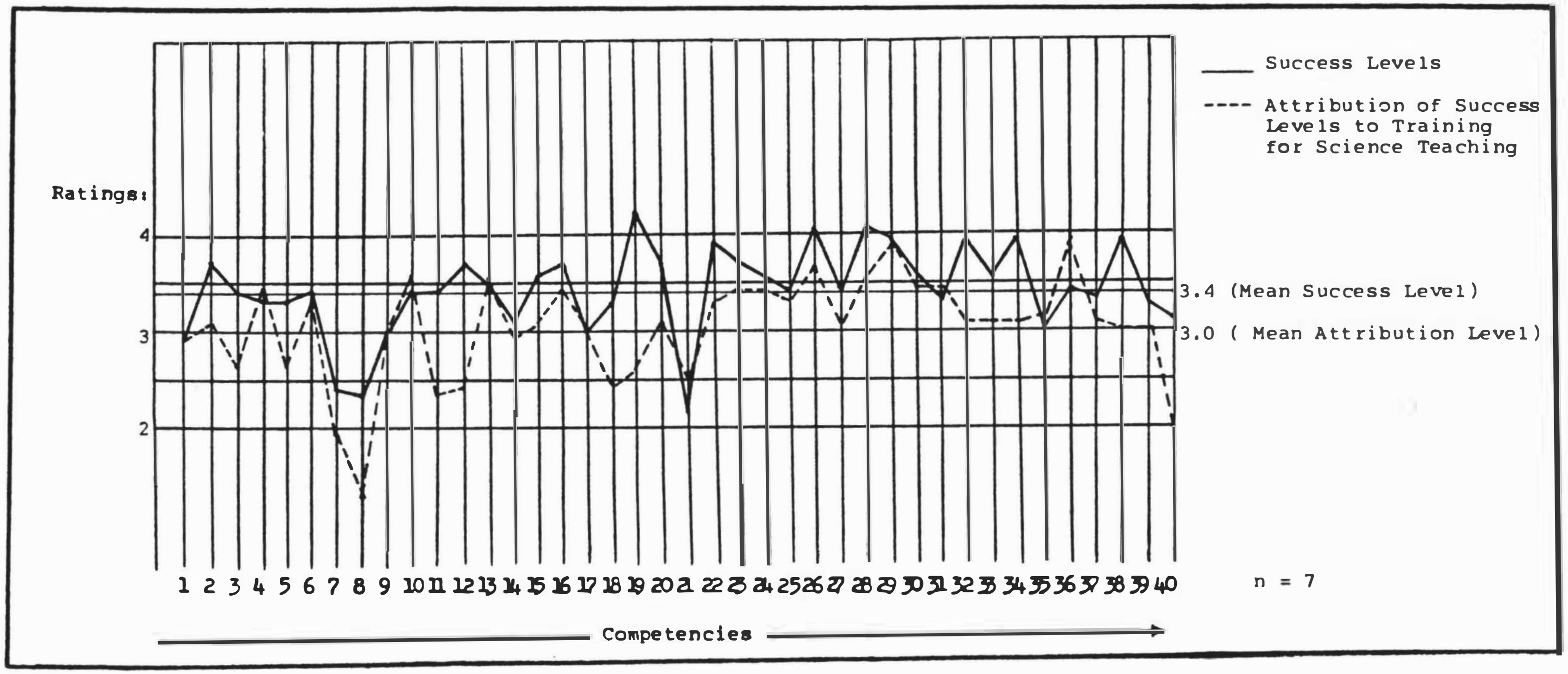
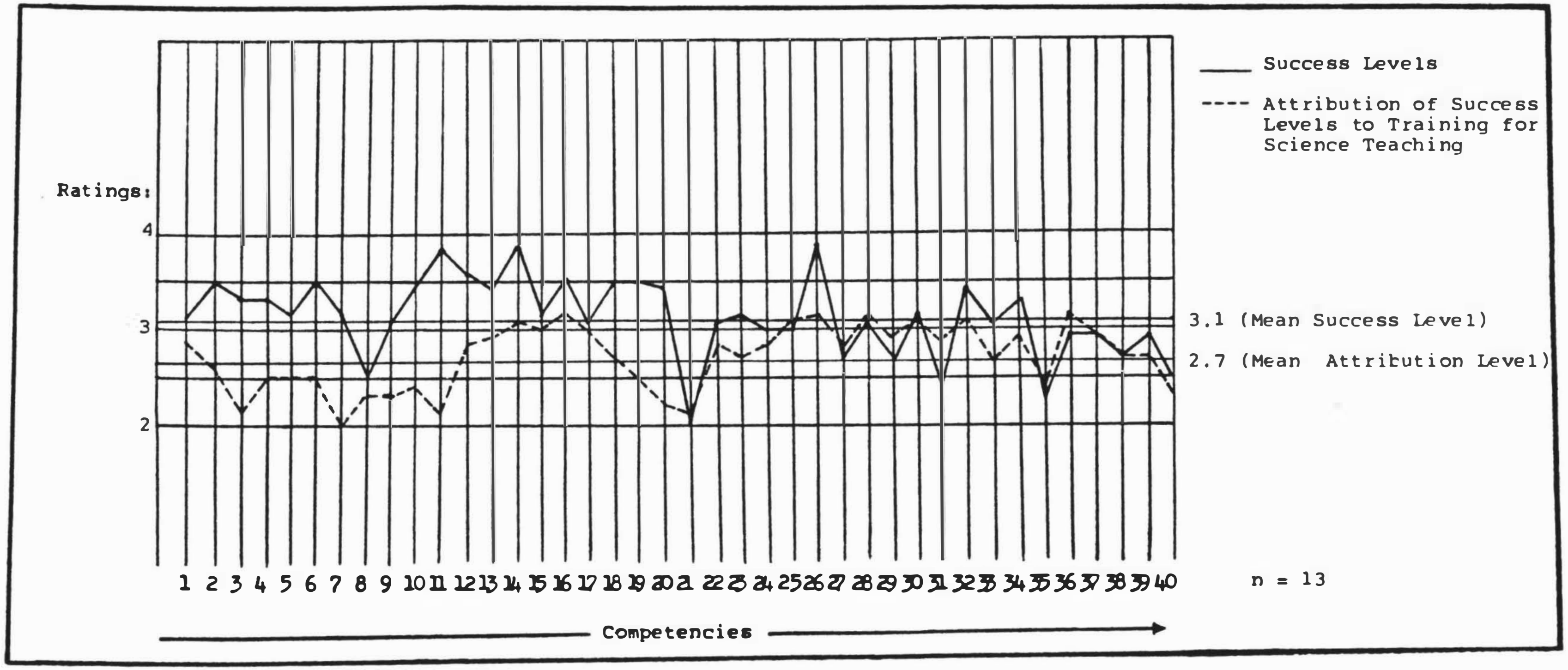


Figure 15

General Competencies: Reported Success Levels and Attribution to Training (Group 2)



For group 2 the averaged scores yielded attribution ratings that were equivalent to the response of "very much attributed to training" on the Attribution Scale for success levels in 8 general competencies. Group ratings on the Success Scale showed that reported success levels in 6 of these 8 competencies were equivalent to the response of "high levels of success" and success levels in the remaining 2 were equivalent to the response of "average levels of success".

(iii) The averaged scores for group 1 yielded attribution ratings that were equivalent to the response of "partly attributed to training" on the Attribution Scale for 12 general competencies. For 1 of these 12 competencies (item 19) the reported success level was "extremely high". In 8 the reported success levels were equivalent to the response of "high", and in 3 the success levels were reportedly "average".

For group 2 the averaged scores yielded attribution ratings for success levels in 31 general competencies which corresponded to the response of "partly attributed to training" on the Attribution Scale. Success ratings for 20 of these 31 competencies were equivalent to the response of "high" on the Success Scale, and for 11 competencies success ratings were equivalent to the response of "average" on the Success Scale.

(iv) For group 1 the averaged scores yielded attribution ratings that were equivalent to the response of "not very much attributed to training" for success levels in 3 general competencies. These were:

- benefitting from collaborating with the Science Resource Teacher (item 7) - success rating: 2.4 - attribution rating: 1.9;
- benefitting from collaborating with the Head of Science Department (item 8) - success rating: 2.3 - attribution rating: 1.3; and

- writing progress reports for members of science class (item 40) - success rating: 3.2 - attribution rating: 2.0.

For group 2 the averaged scores yielded an attribution rating for the success level in 1 general competency that was equivalent to the response of "not very much attributed to training" on the Attribution Scale. The competency in this case was:

- benefitting from collaborating with the Science Resource Teacher (item 7) - success rating: 3.2 - attribution rating: 2.0.

(v) For 33 general teaching competencies the averaged scores of group 1 yielded attribution ratings that were higher than those of group 2. For 6 general competencies the averaged scores of group 2 yielded higher attribution ratings than those of group 1 (Table 8). The one general competency for which the attribution scores of both groups were the same was - teaching pupils to experiment (item 32) - attribution rating: 3.1.

(vi) Of the 30 general competencies for which the averaged scores of group 1 yielded success ratings that were higher than those of group 2, averaged ratings for 26 competencies also yielded higher scores on the Attribution Scale.

(vii) Although the averaged scores of group 2 yielded higher success ratings than group 1 for 8 general competencies (Table 7) attribution ratings for success levels in 5 of these 8 competencies were higher for group 1 than for group 2 (Table 9).

TABLE 8: COMPETENCIES FOR WHICH THE AVERAGED SCORES OF GROUP 2 YIELDED HIGHER ATTRIBUTION RATINGS THAN THOSE OF GROUP 1

Item No	Competencies	Group 1	Group 2
		Attribution Rating	Attribution Rating
7	Benefitting from collaborating with Science Resource Teachers	1.9	2.0
8	Benefitting from collaborating with the Head of Science Department	1.3	2.3
12	Getting pupils to observe safety rules during science lessons	2.4	2.8
14	Extending the science programme beyond the classroom	2.9	3.1
18	Modifying materials to fit specific class needs or science activities	2.4	2.7
40	Writing progress reports for members of science class	2.0	2.3

TABLE 9: COMPETENCIES FOR WHICH THE AVERAGED SCORES OF GROUP 2 YIELDED HIGHER SUCCESS RATINGS THAN THOSE OF GROUP 1 BUT IN WHICH AVERAGED SCORES OF GROUP 1 YIELDED HIGHER ATTRIBUTION RATINGS THAN THOSE OF GROUP 2.

Item No	Competencies	Group 1		Group 2	
		Success Ratings	Attribution Ratings	Success Ratings	Attribution Ratings
1	Using the prescribed science syllabus	2.9	2.9	3.2	2.8
6	Using science equipment	3.4	3.3	3.5	2.5
9	Adapting the classroom environment in the interest of science teaching	3.0	2.9	3.1	2.3
11	Controlling pupils during science lessons	3.4	2.3	3.8	2.2
17	Devising open-ended problems for science classes	3.0	3.1	3.1	3.0

For the personal (teacher) attributes the results were as follows: -

(i) Averaged scores for group 1 yielded attribution ratings which ranged from 3.0 to 3.9 with the mean falling at 3.5 (Table 5b and Figure 16). In terms of the Attribution Scale the lowest score is equivalent to the response of "partly attributed to training", the highest to the response of "very much attributed to training", and the mean also to the response of "very much attributed to training".

Averaged scores for group 2 yielded attribution ratings which ranged from 2.1 to 2.9 with the mean falling at 2.6 (Table 6b and Figure 17). In terms of the Attribution Scale the lowest, highest, and mean scores are equivalent to the response of "partly attributed to training".

(ii) The averaged scores of group 1 yielded attribution ratings that were equivalent to the response that success levels in these competencies were "very much attributed to training" for 6 of the 7 personal competencies. For the other competency - "the teachers' own positiveness of attitude toward the teaching of science" (item 3) the attribution rating was equivalent to the response of "partly attributed to training". Success ratings for all of these competencies were equivalent to the response of "high" on the Success Scale.

For group 2 the averaged scores yielded attribution ratings that were equivalent to the response of "partly attributed to training" on the Attribution Scale for success levels in the 7 teacher-attributes. Success ratings for 5 of these 7 competencies were equivalent to the response of "high" on the Success Sale and success ratings in 2 were equivalent to the response of "average".

Figure 16

Personal (teacher) Attributes:

Reported Competence Levels and Attribution to Training (Group 1)

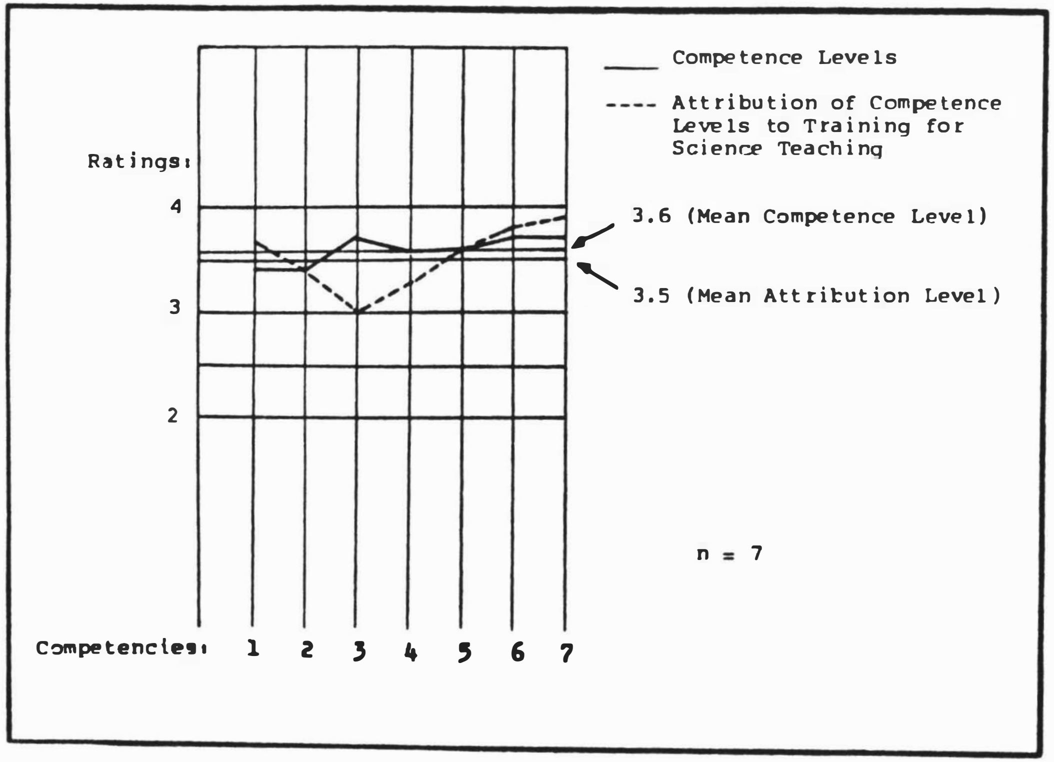
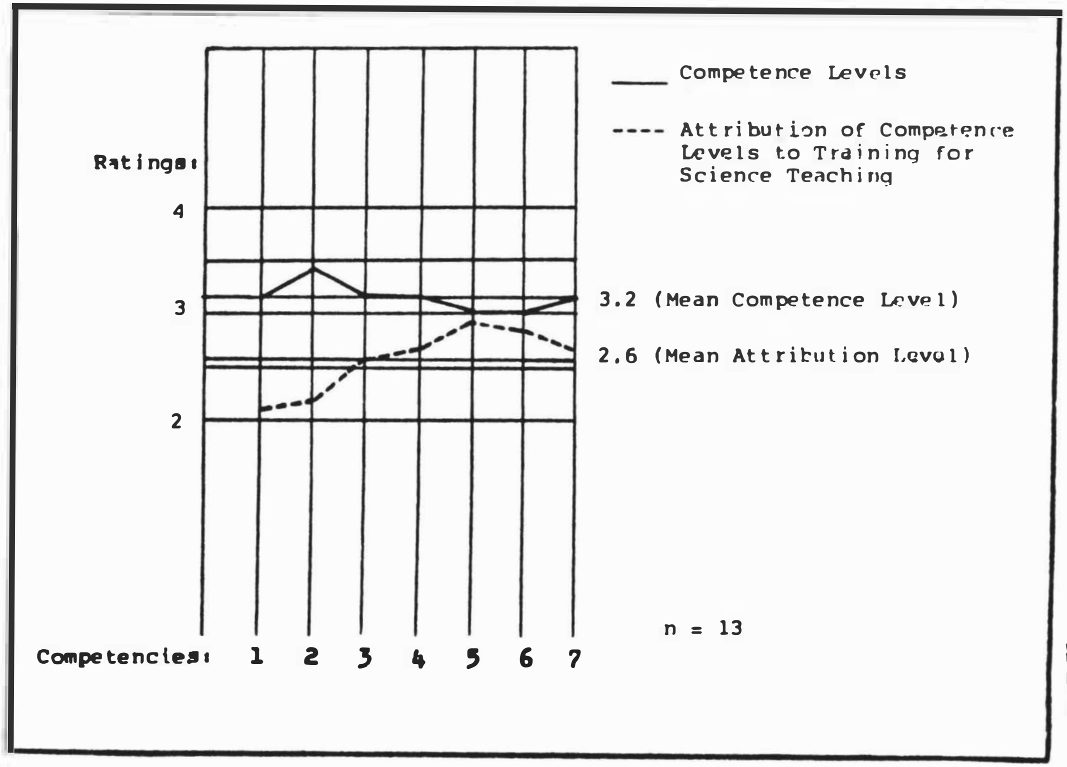


Figure 17

Personal (teacher) Attributes:

Reported Competence Levels and Attribution To Training (Group 2)



(iii) Attribution ratings (derived from the averaged scores of the group) for group 1 were higher than those for group 2 for all of the 7 personal (teacher) attributes. Also, success ratings were higher for group 1 in 6 of these 7 teacher-attributes.

What effect does the employment of the competencies for which provisions were made during science curriculum training have on the overall level of success of the teachers who received spaced curriculum training and those who received massed curriculum training? (Question 7)

The findings for this question showed that, for general competencies: -

(i) The averaged scores of group 1 yielded influence ratings which ranged from 1.8 to 4.3 with the mean falling at 3.5 (Table 5a and Figure 18). On the Influence Scale the lowest rating is equivalent to the response of "a low level influence", the highest to the response of "an extremely high level of influence", and the mean to the response of "a high level of influence".

The averaged scores of group 2 yielded influence ratings which ranged from 1.9 to 4.2 with a mean of 3.3 (Table 6a and Figure 19). On the Influence Scale the lowest rating is equivalent to the response of "a low level of influence", the highest to the response of "an extremely high level of influence", and the mean to the response of "a high level of influence".

(ii) For group 1, averaged influence ratings in 4 general competencies were equivalent to "an extremely high level of influence" on the Influence Scale. They were:

- organizing pupils during science lessons (item 10) - success rating: 3.4 - influence rating: 4.3;
- teaching pupils to observe (item 26) - success rating: 4.1 - influence rating: 4.2;

Figure 18

General Competencies: Reported Success Levels and Influence on Overall Science Teaching Success (Group 1)

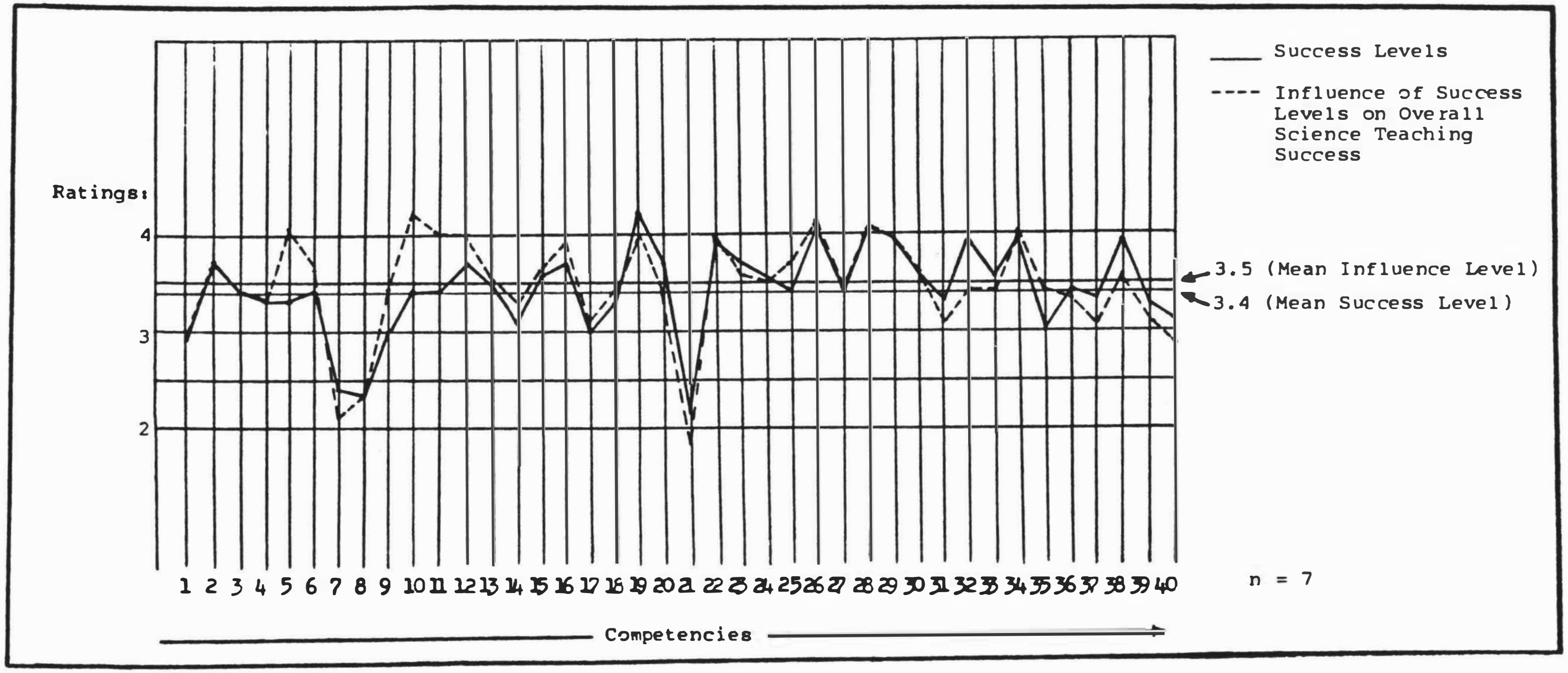
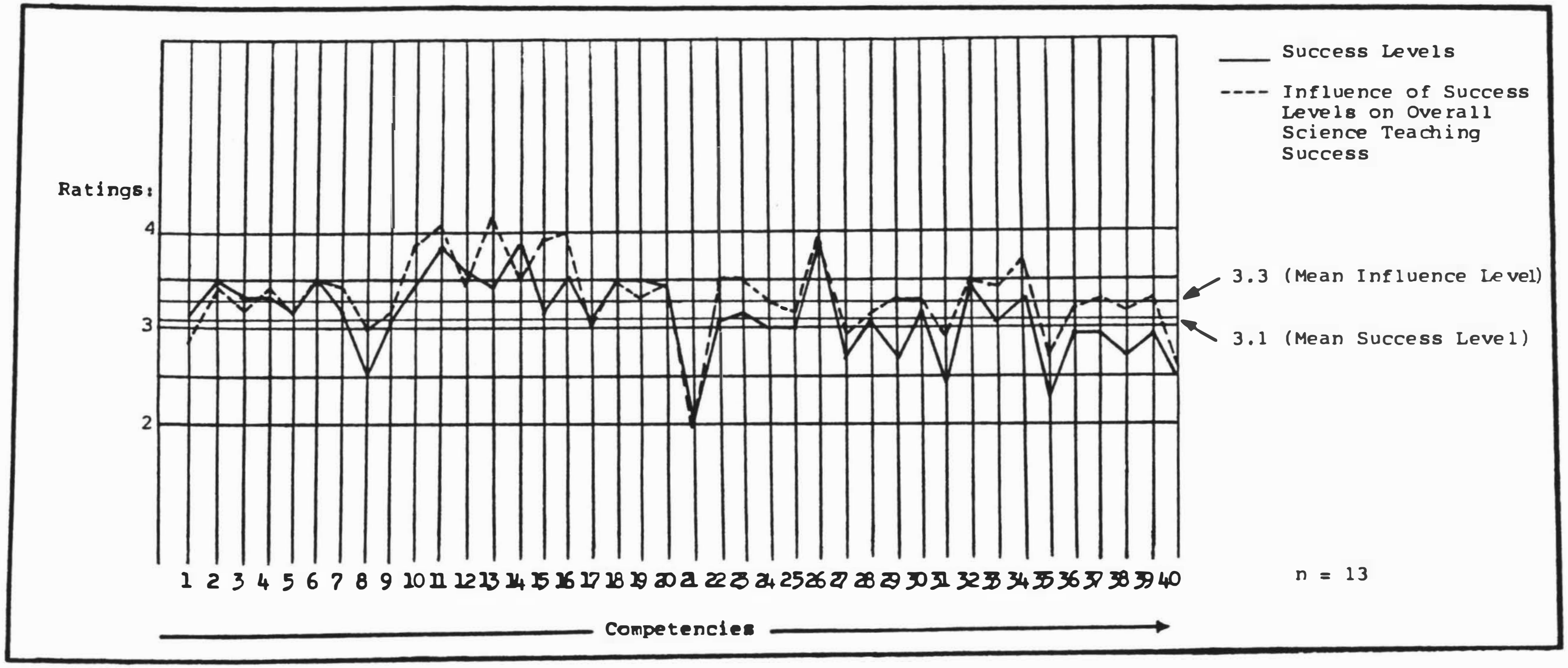


Figure 19

General Competencies: Reported Success Levels and Influence on Overall Science Teaching Success (Group 2)



- teaching pupils to classify (item 28) - success rating: 4.1 - influence rating: 4.1; and
- getting access to science equipment (item 5) - success rating: 3.3 - influence rating: 4.1.

For all of these competencies the success ratings were equivalent to responses that were above "average" on the Success Scale.

For group 2, averaged influence ratings in 2 general competencies were equivalent to the response of "an extremely high level of influence" on the Influence Scale. They were:

- planning the science programme (item 13) - success rating: 3.4 - influence rating: 4.2; and
- controlling pupils during science classes (item 11) - success rating: 3.8 - influence rating: 4.1.

(iii) For group 1, averaged influence ratings in 31 of the 40 general competencies were equivalent to the response of "a high level of influence" on the Influence Scale. For 3 of these 31 competencies (items 9, 17 and 35) averaged scores yielded success ratings that were equivalent to the response of "average" on the Success Scale. For the other 28 the averaged scores yielded success ratings equivalent to responses that were above "average" on the Success Scale.

For group 2, averaged influence ratings for 30 of the 40 general competencies were equivalent to the response of a "high level of influence" on the Influence Scale. For 7 of these competencies (items 24, 25, 29, 36, 37, 38 and 39) averaged scores yielded success ratings that were equivalent to the response of "average" on the Success Scale. For the other 23, success ratings were equivalent to responses that were above "average" on the Success Scale.

(iv) For group 1, averaged influence ratings in 4 general competencies, were equivalent to the response of "an average amount of influence" on the Influence Scale. They were:

- using the prescribed science syllabus (item 1) - success rating: 2.9 - influence rating: 2.9;
- benefitting from collaborating with the Science Resource Teacher (item 7) - success rating: 2.4 - influence rating: 2.1;
- benefitting from collaborating with the Head of Science Department (item 8) - success rating: 2.3 - influence rating: 2.3; and
- writing progress reports for members of science class (item 40) - success rating: 3.2 - influence rating: 2.8.

For group 2, averaged influence ratings in 7 general competencies (items 1, 8, 17, 27, 31, 35 and 40) were equivalent to the response of "an average amount of influence" on the Influence Scale. For 5 of these competencies (items 8, 27, 31, 35 and 40) success ratings were equivalent to the response of "average" on the Success Scale, for the other 2 (items 1 and 17), success ratings were equivalent to the response of "high".

(v) For both groups of teachers the group rating for the success level of one general comeptency - "using the science teaching kit" (item 21) - was equivalent to the response of "a low level of influence" on the Influence Scale. For group 1 the success rating for this competency was reportedly "average" and the influence rating was 1.8. For group 2 the success rating for item 21 was reportedly "low" and the influence rating was 1.9.

It is noteworthy that item 21 was the one general teaching competency for which the averaged scores of both groups yielded the lowest success rating. Thus for both groups the one general competency with the lowest success rating was also the one with the lowest influence rating.

The results for the personal (teacher) attributes showed that:

(i) The averaged scores for group 1 yielded influence ratings ranging from 3.6 to 4.3 and a mean of 4.0 (Table 5b and Figure 20). On the Influence Scale the lowest rating is equivalent to the response of "a high level of influence", the highest, to the response of "an extremely high level of influence", and the mean to a response of "a high level of influence".

The averaged scores for group 2 yielded influence ratings which ranged from 3.3 to 3.9 with a mean rating of 3.7 (Table 6b and Figure 21). All of these ratings are equivalent to a "high level of influence" on the Influence Scale.

(ii) For group 1 influence ratings for success levels in 2 personal (teacher) attributes were equivalent to an "extremely high level of influence" on the Influence Scale. These competencies were:

- the teachers' own positiveness of attitude toward the teaching of science (item 3) - success rating: 3.7 - influence rating: 4.3; and
- the teachers' own skills in the teaching of science (item 6) - success rating: 3.7 - influence rating: 4.3.

For group 2 there were no influence ratings which were equivalent to an "extremely high level of influence" on the Influence Scale.

Figure 20

Personal (teacher) Attributes: Reported Competence Levels

and Influence on Overall Science Teaching Success (Group 1)

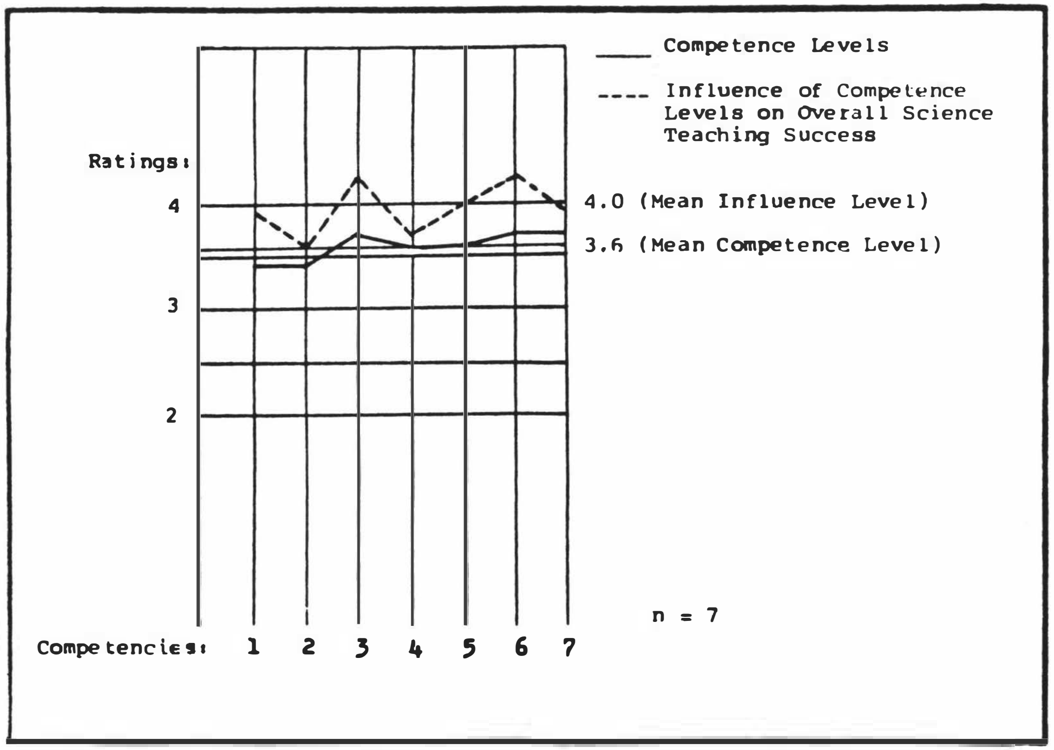
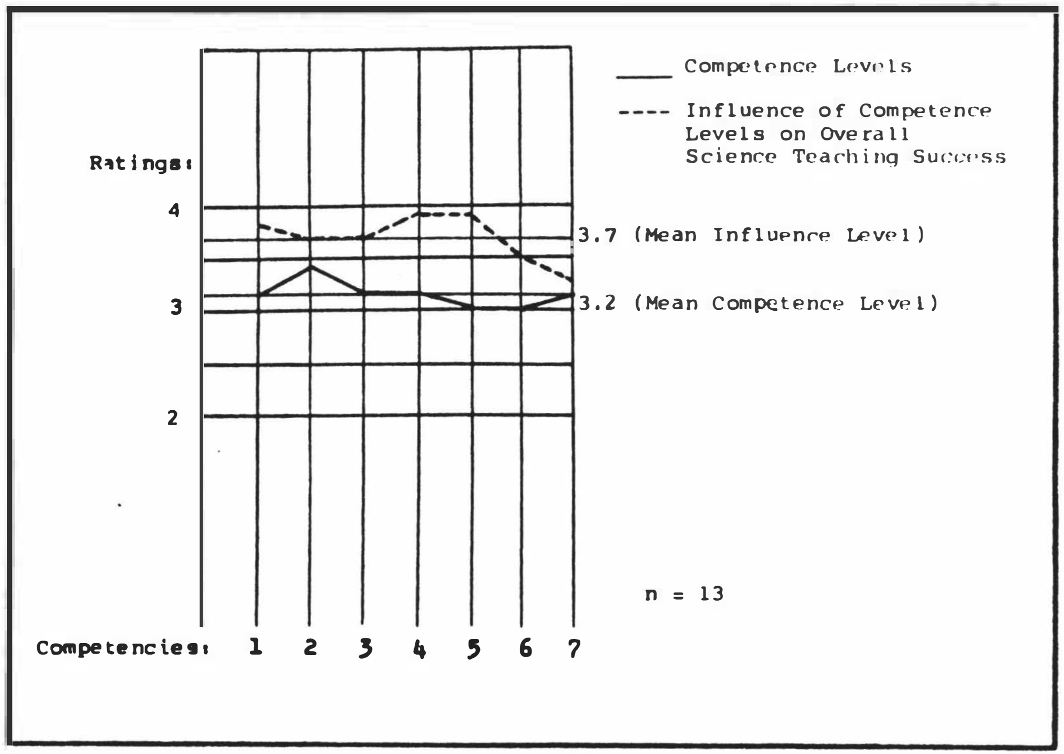


Figure 21

Personal (teacher) Attributes: Reported Competence Levels

and Influence on Overall Science Teaching Success (Group 2)



(iii) For group 1 influence ratings for success levels in 5 personal (teacher) attributes were equivalent to "high" levels of influence on the Influence Scale (items 1, 2, 4, 5 and 7).

For group 2 influence ratings in all of the 7 personal (teacher) attributes were equivalent to the response of "high" levels of influence on the Influence Scale.

(iv) Influence ratings for success levels in 5 teacher-attributes (items 1, 3, 5, 6 and 7) were higher for group 1 than for group 2.

(v) Finally, it is noteworthy that for both groups of teachers averaged scores for "the teachers' own ability to teach science" (item 5) yielded influence scores that were higher than those for either the teachers own knowledge or understanding of science as taught in the elementary school (items 1 and 2).

The preceding part of this chapter has presented findings about:

(i) the levels of success that both groups of teachers (combined and separately) reported that they were experiencing in the teaching competencies provided during science curriculum training;

(ii) their attribution of these levels of success to training; and

(iii) the reported influence of these levels of success on their overall level of success as science teachers.

The general picture that emerges from the results is that first, the first-year teachers as a whole: -

(i) Indicated that they were practicing the competencies (general and personal) provided during science curriculum training with a mean level of success that was equivalent to the rating of "high" on the Success Scale. These mean ratings were 3.3 for the 40 general competencies and 3.3 for the 7 personal (teacher) attributes.

(ii) Attributed the levels of success that they perceived that they were experiencing in the 40 general competencies and 7 personal (teacher) attributes to science curriculum training with mean attribution levels of 2.8 and 2.9 respectively on the Attribution Scale. Both of these mean attribution levels are equivalent to the response of "partly attributed to training".

(iii) Indicated that the levels of success that they perceived themselves to be experiencing in both general and personal competencies influenced their overall level of success as science teachers with mean levels of influence that were equivalent to the response of "high" on the Influence Scale. The mean level of influence for the general competencies was 3.4. For the personal (teacher) attributes it was 3.8.

Second, the general picture that emerges for the two differently trained groups is as follows:

(i) Both groups of teachers indicated that they were practicing the 47 competencies provided during science curriculum training with mean success levels that were equivalent to the response of "high" on the Success Scale. These mean scores were as follows:

Group 1: General competencies-3.4, personal (teacher) attributes - 3.6.

Group 2: General competencies - 3.1 personal (teacher) attributes - 3.2.

(ii) Group 1 (teachers who received spaced curriculum training) attributed their perceived levels of success in the 47 competencies more highly to science curriculum training than did group 2 (teachers who received massed curriculum training). The mean attribution levels for both groups were as follows:

Group 1: - mean attribution level of general competencies - 3.0 on the Attribution Scale;

- mean attribution level of personal (teacher) attributes - 3.5 on the Attribution Scale.

Group 2: - mean attribution level of general competencies - 2.7 on the Attribution Scale;

- mean attribution level of personal (teacher) attributes - 2.6 on the Attribution Scale.

(iii) Both groups of teachers indicated that their perceived levels of success in the 40 general competencies had a mean level of influence on their overall level of science teaching success that was equivalent to the response of "high" on the Influence Scale. The same was true for the personal (teacher) attributes.

Third, responses to several general competencies are worth considering in their own right.

(i) Items 8 and 21 were among the 5 competencies for which the averaged scores of both groups of teachers (combined as well as separately) yielded the lowest success ratings (Tables 4a, 5a and 6a).

The lack of reported success in "collaborating with the Head of Science Department" (item 8), and "using the science kit" (item 21) was partly because the performance of these competencies was not required in some schools and partly because some of the teachers themselves were unable to cope.

Six of the 20 teachers reported never collaborating with the Head of Science Department (item 8) for the simple reason that there were no Heads of Science Departments in their schools, and 8 of the 14 who did reported success levels that were less than "average" i.e. ratings of 2 or less (Appendix I).

Two respondents reported never having used the science kit prepared at Teachers College (item 21). Thirteen of the 18 who did said they experienced less than "average" success in its use.

Three of the teachers reported never being required to write progress reports on members of their science classes (item 40). Of the 17 who did, 7 experienced less than "average" success levels (ratings of 2 or less).

(ii) One standard 3/4 teacher (teacher 15) reported never having to exercise her own judgement over how to use the science syllabus (item 2). And another teacher (who taught new entries and infants) - teacher 11 - reported never having to: "help pupils develop concepts in science" (item 24), "teach pupils to hypothesize" (item 31), or "teach pupils to experiment" (item 32). See Appendix I).

In cases where teachers reported never having used particular competencies these teachers were omitted from the group when the group scores for these competencies were being determined.

With these findings established Chapter 4 is brought to a close. In the following chapter the findings connected with training in science teaching and the subsequent teaching patterns of the first-year teachers are reported.

CHAPTER 5

FINDINGS - TEACHING PATTERNS

In this chapter findings on preservice training in science teaching and subsequent year-one teaching patterns are presented. They are organized round 34 questions most of which were generated from the issues discussed in Chapter 2. Others - of a comparative nature - were prompted by some of the findings themselves.

The chapter is divided into three sections. Section 1 deals with the patterns of teaching recommended by the lecturers and those that they employed themselves. Section 2 deals with the perceived, recommended, and actual teaching patterns of the year-one teachers. In Section 3 a general summary of the results is presented.

SECTION I

LECTURERS: TEACHING PATTERNS

PART A:

LECTURERS: RECOMMENDED TEACHING PATTERNS

What instructional patterns were recommended by the science lecturers for the teaching of elementary science? (Question 1)

The instructional patterns that were recommended by the lecturers were derived from the percentages of lesson time each had recommended for the specific functional and structural transactions when interviewed. Tables 10a and 10b contain the details. A graphic representation of these results is to be found in Figure 23.

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* The instrument used for describing instructional patterns in this study was devised by Adams (1965). In his system of classifying classroom events classroom behaviours are divided into both functional and structural categories (see Chapter 3). Consequently, all instructional patterns reported in this study comprise profiles showing both functional and structural aspects of classroom transactions.

TABLE 10a

LECTURERS: RECOMMENDED FUNCTIONAL TIME

	% TIME									
	INFORMATION DISSEMINATION			INTELLECTUALIZATION			OPERATION			OTHER
LECTURERS:	SC.	SOC.	ORG.	SC.	SOC.	ORG.	SC.	SOC.	ORG.	
1	7	1	2	28	4	8	30	15	5	-
2	2.9	0.1	7	12.5	1.25	11.25	45.5	3.25	16.25	-
3	4	0.5	0.5	18	1	1	67.5	3.75	3.75	-
4	1.5	1	2.5	35	21	14	20	1.25	3.75	-
5	1.8	0.1	0.1	25.2	1.4	1.4	35	28	7.0	-
Mean, Lecturers 1 - 4:	3.9	0.7	3.0	23.4	6.8	8.6	40.8	5.8	7.0	-
Mean, Lecturers 1 & 5	4.4	0.6	1.0	26.6	2.7	4.7	32.5	21.5	6.0	-
Mean, All Lecturers:	3.44	0.54	2.42	23.74	5.73	7.13	39.6	10.25	7.15	-

SC. = SCIENCE
SOC. = SOCIATION
ORG. = ORGANIZATION

TABLE 10b

LECTURERS: RECOMMENDED STURCTURAL TIME

LECTURERS:	EMITTER IND. PUP.	EMITTER MULT. PUP.	EMITTER WHL. CLASS	TARGET IND. PUP.	TARGET MULT. PUP.	TARGET WHL. CLASS	AUDIENCE IND. PUP.	AUDIENCE MULT. PUP.	AUDIENCE WHL. CLASS	OTHER
	% TIME									
1	6	15	7	12	15	8	12	20	5	-
2	11	10	2	23	30	5	11	5	3	-
3	10	10	10	5	20	8	5	30	2	-
4	10	30	10	5	10	10	5	20	0	-
5	2.5	-	8	10	15	2	2.5	60	-	-
Mean, Lecturers 1 - 4:	9.25	16.25	7.25	11.25	18.75	7.75	8.25	18.75	2.5	-
Mean, Lecturers 1 & 5:	4.2	7.5	7.5	11.0	15.0	5.0	7.3	40.0	2.5	-
Mean, All Lecturers:	7.9	13	7.4	11	18	6.6	7.1	27	2	-

IND. PUP. = INDIVIDUAL PUPIL
MULT. PUP. = MULTIPLE PUPIL
WHL. CLASS = WHOLE CLASS

Figure 22

Lecturer-recommendations: Range and Mean

a. Functional Transactions

b. Structural Transactions

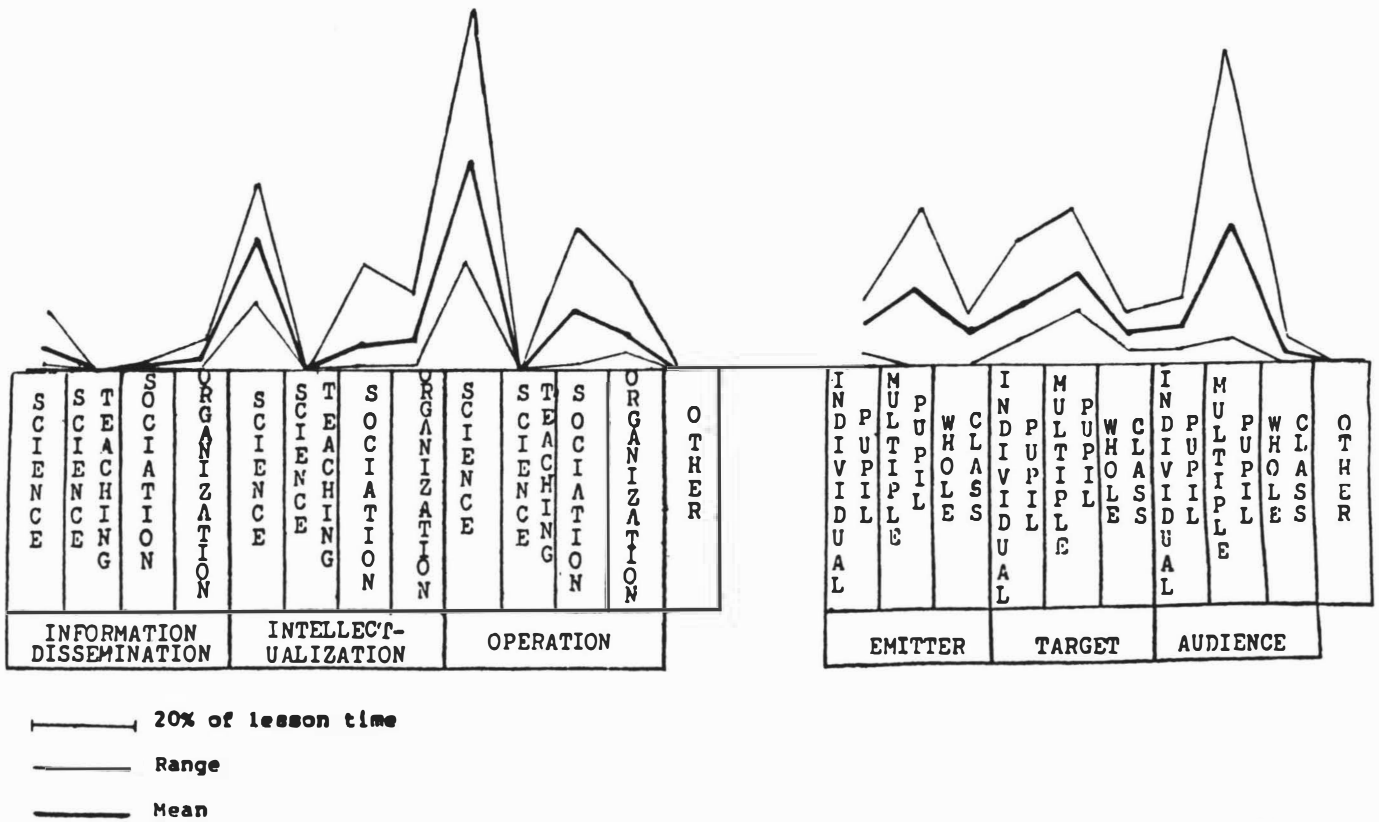


Table 10a and Figure 22 reveal that: there were wide ranges in the percentages of lesson time recommended for certain functional aspects of elementary science teaching. Namely:

(i) intellectualization about science - a range of 12.5% to 35% of the total lesson time;

(ii) intellectualization about sociation - 1% to 21%;

(iii) operation about science - 20% to 67.5%;

(iv) operation about sociation - 1.25% to 28%.

There were also wide ranges in the percentages of lesson time recommended for certain structural aspects of elementary science teaching (Table 10b). These were: -

(i) teacher emitting to multiple pupils - 0% to 30%;

(ii) teacher as the target of individual pupils - 5% to 23%;

(iii) teacher as the target of multiple pupils - 10% to 30%;

(iv) teacher as audience to multiple pupils - 5% to 60%.

When averaged* the results for all 5 lecturers produced the following results: -

For functional transactions:

(i) The highest amount of lesson time was registered for operation about the subject matter of science - 39.6% of the total lesson time.

(ii) The next highest was for intellectualization about the subject matter of science - 23.74%.

---

* All averaged scores in this section of the chapter were determined by dividing the tally of separate entries by the number of lecturers for a particular structural or functional category.

The significance of averaged scores is circumscribed somewhat by the small sample size (n = 5) and the fact that for certain functional and structural transactions there were wide ranges in lecturer recommended and actual transactional times.

(iii) The times registered for operation about sociation, operation about organization, intellectualization about sociation and intellectualization about organization all rated lower, accounting for between 5 and 11% of the time.

(iv) Relatively low amounts of lesson time (less than 4%) were registered for INFORMATION DISSEMINATION - whether about science, sociation, or operation. (See Figure 22).

These results indicate that for functional transactions the science lecturers, as a group, recommended little giving of information about any transaction - whether it was giving information about the subject matter of science, about sociation or about organization. Instead the emphasis was placed firstly on operation with the subject matter of science and secondly, on intellectualization about the subject matter of science.

For structural transactions, the averaged results revealed:

(i) The highest amount of lesson time was registered for "the teacher as audience to small groups of pupils" (27% of the total lesson time), followed by: the teacher as the target of small groups of pupils - 18%.

(ii) Relatively low amounts of lesson time were registered for the teacher's dealing with the whole class - whether as the emitter (7.4% of the lesson time), the target (6.6%), or as audience to the whole class (2%).

Thus generally, according to the averaged amounts of time registered for structural categories (Table 10b), the emphasis was placed primarily on the teacher's dealing with SMALL GROUPS OF PUPILS Firstly as audience to small groups of pupils (27% of the lesson time), Secondly as the target of small groups (18%); and thirdly as the emitter to small groups of pupils (13%).

Secondarily, emphasis was placed on the teacher's dealing with INDIVIDUAL PUPILS (11% of the lesson time as the target, 7.9% as the emitter and 7.1% as audience to individual pupils.

Finally, the least emphasis was placed on the teacher's dealing with the whole class - 7.4% of the lesson time as the emitter, 6.6% of the lesson time as the target, and 2% of the lesson time as audience to the whole class.

How do the amounts of lesson time recommended by the individual lecturers for the functional and structural aspects of elementary science teaching compare with each other? (Question 2)

Profiles for the actual amounts of lesson time recommended by each lecturer for the functional and structural aspects of elementary science teaching are shown in Figure 23. Certain features of commonality were evident in all of the profiles.

For functional transactions (Figure 23 and Table 10a): -

(i) 20% or more (up to 67.5%) of the total lesson was recommended by all lecturers for operation about science.

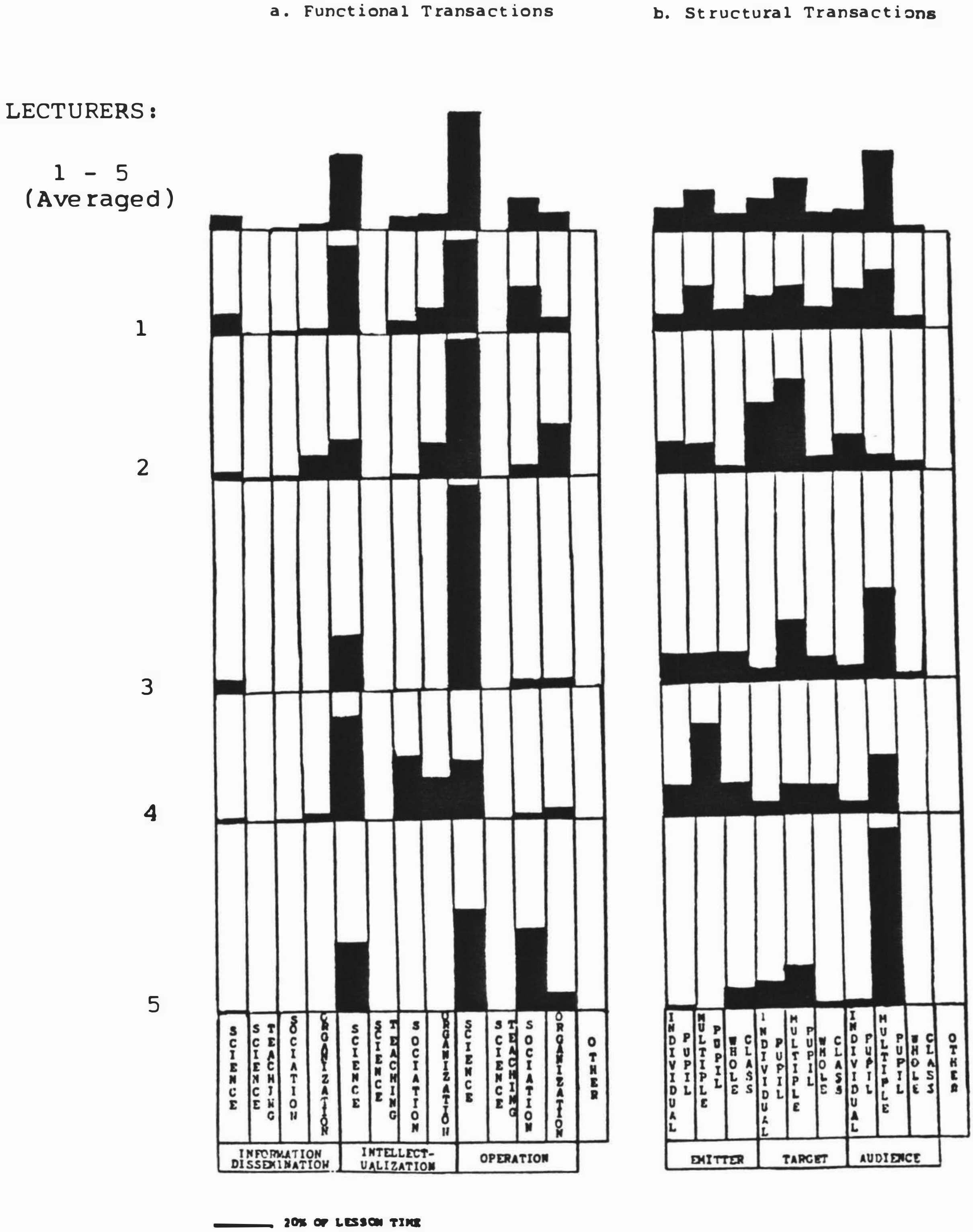
(ii) A greater proportion of lesson time was recommended for operation about science (20 - 67.5%) than for either operation about sociation (1.25 - 28%) or operation about organization (3.75 - 16.25%).

(iii) For 4 of the 5 lecturers operation about science was the functional transaction for which the highest amount of lesson time was recommended. The other lecturer (lecturer 4) recommended the highest amount of time for intellectualization about the subject matter of science (35%) with operation about science next (20%).

(iv) 12.5% or more (up to 35%) of the total lesson time was recommended by all lecturers for intellectualization about the subject matter of science.

Figure 23

Science Lecturers: Recommended Transactional Patterns



(v) A greater proportion of lesson time was recommended for intellectualization about science (12.5 - 35%) than for either
- intellectualization about sociation (1 -21%), or
- intellectualization about organisation (1 - 14%).

(vi) relatively low amounts of lesson time (0.1 - 7%) were recommended by all lecturers for INFORMATION DISSEMINATION either about science, about sociation or about organization.

For structural transactions (Figure 23 and Table 10b): -

(i) 20% or more (up to 60%) of the lesson time was recommended by 4 of the 5 lecturers (lecturer 1, 3, 4 and 5) for the teacher's being audience to small groups of pupils.

(ii) 11% or less of the total lesson time was recommended by all lecturers for the teacher as the EMITTER either to individual pupils or to the whole class. In the case of the teacher's emitting to multiple pupils lecturer 4 recommended 30% of the lesson time; lecturer one - 15%; lecturers two and three - 10%; and lecturer five - 0%.

(iii) Each lecturer recommended that a greater proportion of the lesson time (10-30%) be spent by the teacher as the target of multiple pupils than as the target of individual pupils (5 - 23%), and 4 of the 5 lecturers (1, 2, 3 and 5) also recommended more time for the teacher as the target of multiple pupils (15 - 30%) than as the target of the whole class (2 - 8%). Lecturer 4 recommended an equal amount of lesson time (10%) for these last two transactions.

(iv) Four of the 5 lecturers (lecturers 1, 3, 4 and 5) recommended a greater proportion of lesson time (20 - 60%) for the teacher's being audience to multiple pupils than for the teacher's being audience to either individual pupils (2.5 - 12%) or to the whole class (0 - 5%).

Lecturer 2 recommended a higher amount of lesson time for the teacher's being audience to multiple pupils (5%) than for the teacher's being audience to the whole class (3%). He recommended that 11% of the lesson time should be spent by the teacher as audience to individual pupils.

(v) 10% or less of the total lesson time was recommended by all lecturers for the teacher's dealing with the whole class - whether as emitter, target or audience.

Despite variations in the recommendations of the individual lecturers the general picture that emerges from the recommendations of each is that of a fairly active teacher who spends a good deal of lesson time (20 - 67.5%) on operation about science, little time (10% or less of the lesson) giving information or dealing with the whole class; and a moderate amount of time (12.5 - 35%) intellectualizing about science.

PART B

LECTURERS: ACTUAL TEACHING PATTERNS

What were the actual teaching patterns of the science lecturers? (Question 3)

The ranges and means for the actual teaching patterns of the lecturers are to be found in Figure 24. The results showed that the ranges in the average teaching patterns of the lecturers were narrow for: -

(i) 9 of the 12 functional transactions, and
(ii) 8 of the 9 structural transactions.

The 3 functional transactions with the widest ranges were:

(i) information dissemination about science (5.6% to 25% of the lesson time);

Figure 24

Lecturer-transactions: Range and Mean

a. Functional Transactions

b. Structural Transactions

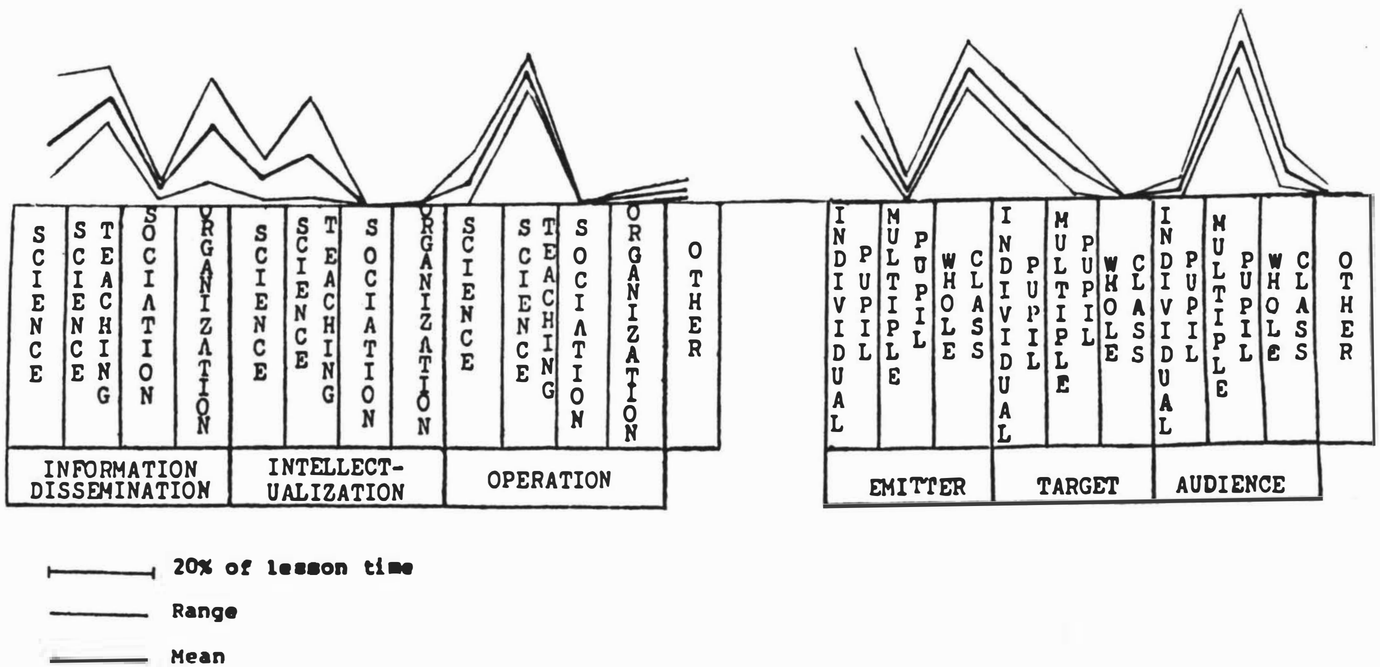


TABLE 11a

LECTURERS: ACTUAL FUNCTIONAL TIME

	% TIME												
	INFORMATION DISSEMINATION				INTELLECTUALIZATION				OPERATION				OTHER
LECTURERS:	SC.	SC. TCH.	SOC.	ORG.	SC.	SC. TCH.	SOC.	ORG.	SC.	SC. TCH.	SOC.	ORG.	
1	11.7	20.8	4.9	14.6	6.9	5.3	0.1	0.3	7.4	26.3	-	1.0	0.7
2	7.1	15.8	1.9	24.6	4.4	2.4	-	0.2	10.5	27.8	-	3.0	2.3
3	5.6	26.0	5.1	24.0	1.3	12.4	0.2	-	0.8	22.0	-	0.2	2.4
4	25.0	21.77	2.8	4.9	8.4	5.7	0.2	0.6	0.6	26.5	-	0.03	3.5
5	9.4	19.0	4.5	7.7	6.2	20.7	0.03	0.6	-	25.7	-	1.3	4.87
Mean, Lecturers 1 - 4:	12.3	21.1	3.7	17.1	5.3	6.5	0.1	0.3	4.8	25.6	-	1.0	2.2
Mean, Lecturers 1 & 5:	10.6	20.0	4.7	11.2	6.5	13.0	0.1	0.4	3.7	26.0	-	1.1	2.7
Mean, All Lecturers:	11.8	20.7	3.8	15.2	5.4	9.3	0.1	0.3	3.9	25.6	-	1.1	2.8

SC. = SCIENCE
SOC. = SOCIATION
ORG = ORGANIZATION
SC. TCH. = SCIENCE TEACHING

TABLE 11b

LECTURERS: ACTUAL STRUCTURAL TIME

LECTURERS:	% TIME									
	EMITTER			TARGET			AUDIENCE			OTHER
	IND. PUP.	MULT. PUP.	WHL. CLASS	IND. PUP.	MULT. PUP.	WHL. CLASS	IND. PUP.	MULT. PUP.	WHL. CLASS	
1	21.3	3.66	21.36	9.9	4.74	-	3.4	30.7	3.0	1.94
2	13.6	1.0	28.1	9.9	0.9	-	1.6	35.3	9.6	-
3	28.9	1.7	27.2	13.2	2.4	-	0.1	24.1	2.4	-
4	18.3	1.4	23.5	19.3	7.2	0.3	0.7	27.4	1.9	-
5	13.8	0.5	29.8	12.0	11.6	0.3	0.1	27.0	4.9	-
Mean, Lecturers 1 - 4:	20.5	2	25	13.1	3.8	0.1	1.4	29.4	4.2	0.5
Mean, Lecturers 1 & 5:	17.6	2.1	25.6	10.9	8.2	0.2	1.7	28.8	3.9	1.0
Mean, All Lecturers:	19.2	1.7	25.9	12.9	5.3	0.1	1.2	28.9	4.4	0.4

IND. PUP. = INDIVIDUAL PUPIL
MULT. PUP. = MULTIPLE PUPIL
WHL. CLASS = WHOLE CLASS

(ii) information dissemination about organization (4.9% to 24.6%);

(iii) intellectualization about science teaching (2.4% to 20.7%).

The functional transaction - operation about sociation - did not feature at all (Table 11a).

The structural transaction with the widest range was - the teacher emitting to individual pupils - (13.6% to 28.9% of the lesson time). The one with the lowest range was - the teacher as the target of the whole class (0% to 0.3%). Table 11b.

The averaged results for functional transactions showed that during the lecturers' own teaching sessions the highest proportion of time was spent on operation about science teaching (25.6%). This was followed by:

(i) giving information about science teaching (20.7%);

(ii) giving information about organization (15.2%);

(iii) giving information about science (11.8%); and

(iv) intellectualization about science teaching (9.3%).

For the functional transactions:
- giving information about sociation,
- intellectualization about science,
- intellectualization about sociation and about organization, and
- operation about sociation or about organization

the averaged amounts of lesson time did not exceed 5.4%.

For structural transactions (Figure 24) the averaged results revealed that the highest amount of lesson time was spent by the lecturers as audience to multiple pupils (28.9% of the total lesson time). This was followed by:

(i) the lecturers' emitting to the whole class (25.9%);

(ii) the lecturers' emitting to individual pupils (19.2%); and

(iii) the lecturers as targets of individual pupils (12.9%).

For each of the other structural transactions - the lecturers:

- emitting to multiple pupils,
- as targets of multiple pupils,
- as targets of the whole class,
- as audience to individual pupils, or
- as audience to the whole class the percentages of lesson time did not exceed 5.3%.

How do the averaged teaching patterns of the individual lecturers compare with each other? (Question 4)

Although the profiles of the individual lecturers varied (Figure 25), similarities existed in the following areas:

For functional transactions:

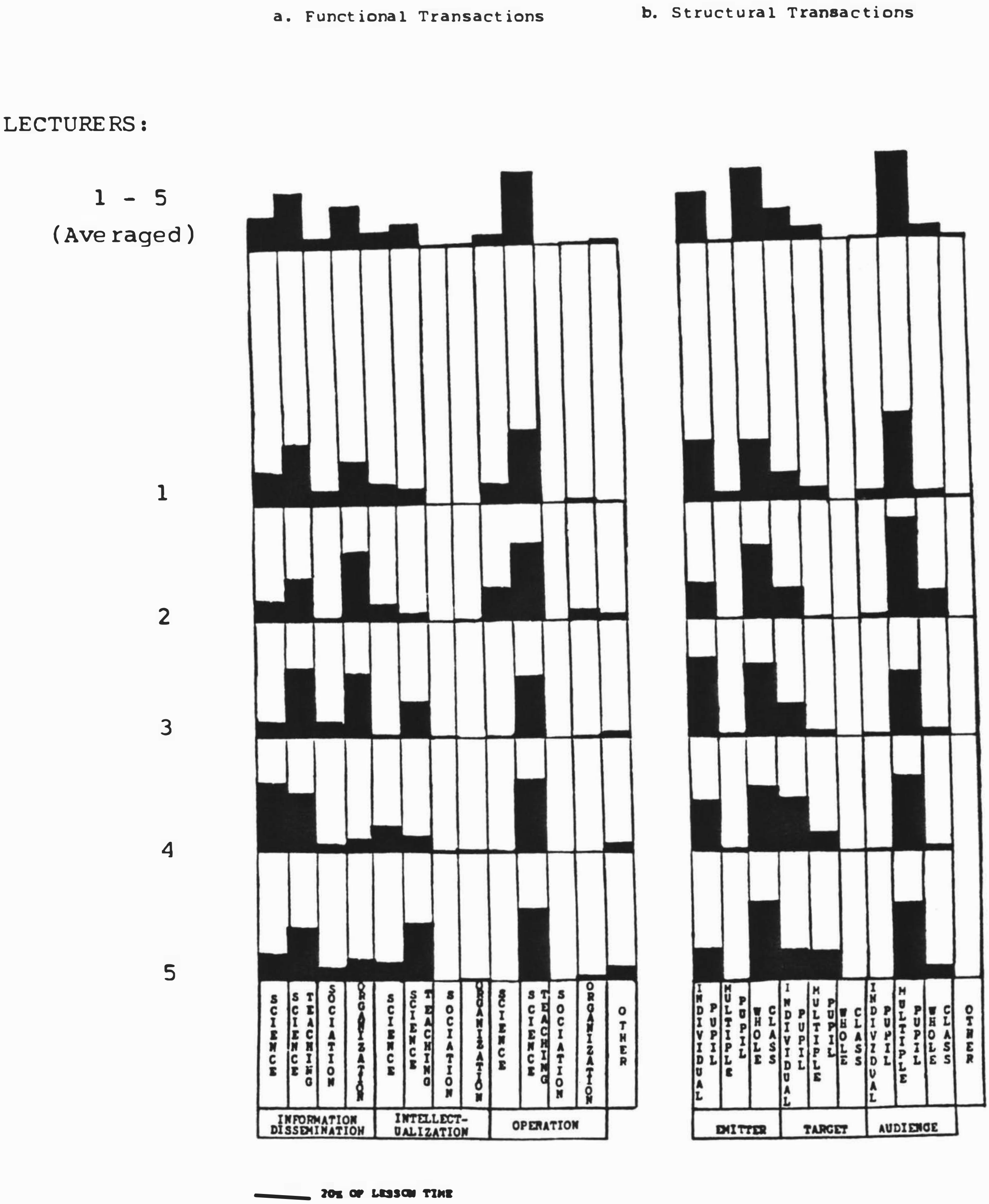
(i) during the teaching sessions of all lecturers more time was spent on operation about science teaching (22 - 27.8% of the total lesson time) than on either:
- operation about science (0 - 10.5%);
- operation about sociation (0%); or
- operation about organization (0.03 - 3%).

(ii) For 4 of the 5 lecturers (lecturers 1, 2, 4 and 5) operation about science teaching was the functional transaction for which the average amount of lesson time was highest (Table 11a).

(iii) During the teaching sessions of all lecturers more time was spent on operation about science teaching (22 - 27.8%) than on intellectualization about science teaching (2.4 - 20.7%).

Figure 25

Science Lecturers: Actual Transactional Patterns



(iv) All of the lecturer-profiles showed more <u>time for giving information about science teaching</u> (15.8 - 26%) than for either:

- <u>information dissemination about sociation</u> (1.9 - 5.1%); or
- <u>intellectualizing about science</u> (1.3 - 8.4%) .

(v) 4 of the 5 profiles (lecturers 1, 2, 3 and 5) showed a greater amount of time for <u>information dissemination about science teaching</u> (15.8 - 26%) than for either

- <u>information dissemination about science</u> (5.6 - 11.7%); or
- <u>information dissemination about sociation</u> (1.9 - 5.1%).

(vi) Finally, all lecturer-profiles showed <u>less than 5%</u> of the total lesson time for:

- <u>intellectualization about sociation</u>,
- <u>intellectualization about organisation</u>,
- <u>operation about sociation</u>,
- <u>operation about organization</u>,
- <u>other irrelevant functional transactions</u>.

<u>For structural transactions</u> (Table 11b), for all lecturers:

(i) More than 23% of the total lesson time (24.1 - 35.3%) was spent <u>as audience to multiple pupils</u>. This amount of time was higher than the averaged amounts of lesson time spent either <u>as audience to the whole class</u> (1.9 - 9.6%);
or <u>as audience to individual pupils</u> (0.1 - 3.4%).

(ii) More time was spent <u>emitting to the whole class</u> (21.36 - 29.8%) than <u>emitting to multiple pupils</u> (0.5 - 3.66%).

(iii) More time was spent <u>emitting to individual pupils</u> (13.6 - 28.9%) than <u>emitting to multiple pupils</u> (0.5 - 3.66%).

(iv) More time was spent as the <u>targets of individual pupils</u> (9.9 - 19.3% than as the <u>targets of multiple pupils</u> (0.9 - 11.6%).

(v) More time was spent as the <u>targets of multiple pupils</u> (0.9 - 11.6%) than as the <u>targets of the whole class</u> (0 - 0.3%).

(vi) Less than 10% of the total lesson time was spent by all lecturers:

- <u>emitting to multiple pupils</u> (0.5 - 3.66%),
- <u>as the targets of the whole class</u> (0 - 0.3%),
- <u>as audience to individual pupils</u> (0.1 - 3.4%),
- <u>as audience to the whole class</u> (1.9 - 9.6%), or
- on other irrelevant structural transactions (0 - 1.94%).

The general picture here is that the lecturers, as a group spent a good deal of time on - <u>operation about science teaching</u>, <u>giving information about science teaching</u>, and <u>being audience to small groups of pupils</u> while <u>less</u> time was spent on transactions such as <u>intellectualization about science teaching</u>, <u>giving information about science</u>, and <u>giving information about organization</u>; and the <u>least</u> amount of time was spent on transactions such as <u>sociation</u>, being <u>audience to individual pupils</u>, being <u>audience to the whole class</u>, <u>emitting to multiple pupils</u>, being the <u>target of multiple pupils</u> or being the <u>target of the whole class</u>.

<u>PART C</u>

<u>SCIENCE LECTURERS: ACTUAL VERSUS RECOMMENDED TEACHING PATTERNS</u>

<u>How do the overall teaching patterns of the lecturers compare with their overall recommendations?</u> (Question 5).

For functional transactions (Figure 26)* the results showed appreciable** variations between the averaged actual times, and the averaged recommended times for 5 of the 9 transactions. However, the averaged functional transactions which took place during the lecturers' own teaching sessions were, to an extent, similar to their averaged recommendations in that:

(i) a relatively high amount of lesson time (more than 29%) was spent on operation about the subject matter (science + science teaching);

(ii) a moderate amount of lesson time (more than 14% but less than 27%) was spent on intellectualization about the subject matter; and

(iii) less than 6% of the total lesson time was recommended for and spent on:
- information dissemination about sociation: averaged actual - 3.8%, averaged recommendation - 0.54; and
- intellectualization about sociation: averaged actual - 0.1%, averaged recommendation - 5.73%.

For 2 functional transactions the averaged amounts of lesson time spent during the lecturers' teaching sessions were appreciably higher than their averaged recommendations. They were:

(i) information dissemination about the subject matter:

---

* For functional transactions the subject matter of the lecturers included both science (content) and science teaching (methods) while their recommendations for the teaching of elementary science included only science as the subject matter. For the purposes of comparison in this chapter, unless otherwise stated, the subject matter of the lecturers (Science + Science teaching) is treated as the subject matter of science.

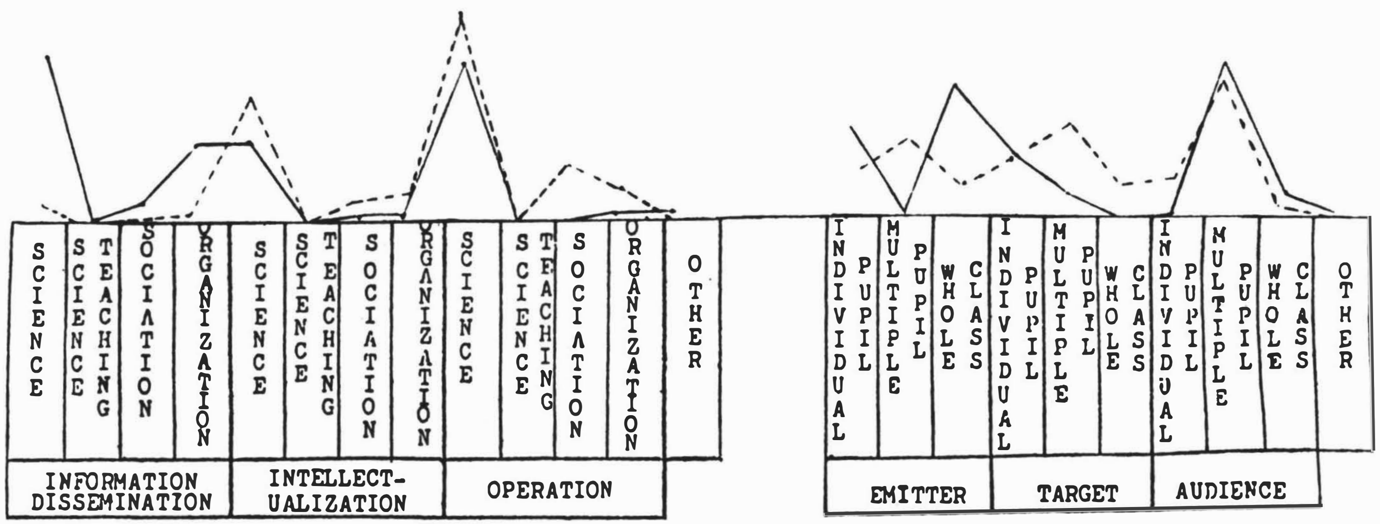
** Appreciable differences = variations of 5% or more of the lesson time for any recommended, actual, or perceived transaction.

Figure 26

Lecturer-transactions: Actual and Recommended

a. Functional Transactions

b. Structural Transactions



20% OF LESSON TIME

ACTUAL TRANSACTIONS

RECOMMENDED TRANSACTIONS

averaged actual - 32.5%, averaged recommendation - 3.44%;

(ii) information dissemination about organization: averaged actual - 15.2%, averaged recommendation - 2.42%.

For 3 functional transactions the averaged amounts of lesson time spent during the lecturers' teaching sessions were appreciably lower than their averaged recommendations:

(i) intellectualization about the subject matter: averaged actual - 14.7%, averaged recommendation - 23.74%;

(ii) operation about the subject matter: (Science + science teaching) averaged actual - 29.5%, averaged recommendation - 39.6%; and

(iii) operation about sociation: averaged actual - 0%, averaged recommendation - 10.25%.

For structural transactions (Figure 26) the averaged amounts of lesson times spent by the 5 lecturers were very similar to their averaged recommendations in 3 cases:

(i) the teacher as the target of individual pupils: averaged actual - 12.9%, averaged recommendation - 11%;

(ii) the teacher as audience to multiple pupils: averaged actual - 28.9%, averaged recommendation - 27%;

(iii) the teacher as audience to the whole class: averaged actual - 4.4%, averaged recommendation - 2%.

Also, for 3 structural transactions both averaged actual and averaged recommended times were lower than 7.2% of the total lesson time:

(i) the teacher as the target of the whole class: averaged actual - 0.1%, averaged recommendation - 6.6%;

(ii) the teacher as audience to individual pupils: averaged actual - 1.2%, averaged recommendation - 7.1%; and

(iii) the teacher as audience to the whole class: averaged actual - 4.4%, averaged recommendation - 2%.

For 2 structural transactions the averaged times spent by the lecturers were appreciably higher than their averaged recommendations:

(i) the teacher emitting to individual pupils: averaged actual - 19.2%, averaged recommendation - 7.9%;

(ii) the teacher emitting to the whole class: averaged actual - 25.9%, averaged recommendation - 7.4%.

For 2 structural transactions the averaged times spent by the lecturers were appreciably lower than their averaged recommendations:

(i) the teacher emitting to multiple pupils: averaged actual - 1.7%, averaged recommendation - 13%;

(ii) the teacher as the target of multiple pupils: averaged actual - 5.3%, averaged recommendation - 18%.

How do the teaching patterns of the individual lecturers compare with their specific recommendations? (Question 6).

When the average amounts of lesson time spent by the individual lecturers on the functional and structural aspects of science teaching were compared with their individual recommendations the results were as follows:

Lectuer 1 (Figure 27)

Functional transactions:

For one functional transaction the recommended time and the average amount of lesson time spent during the teaching sessions of Lecturer 1 were almost identical:

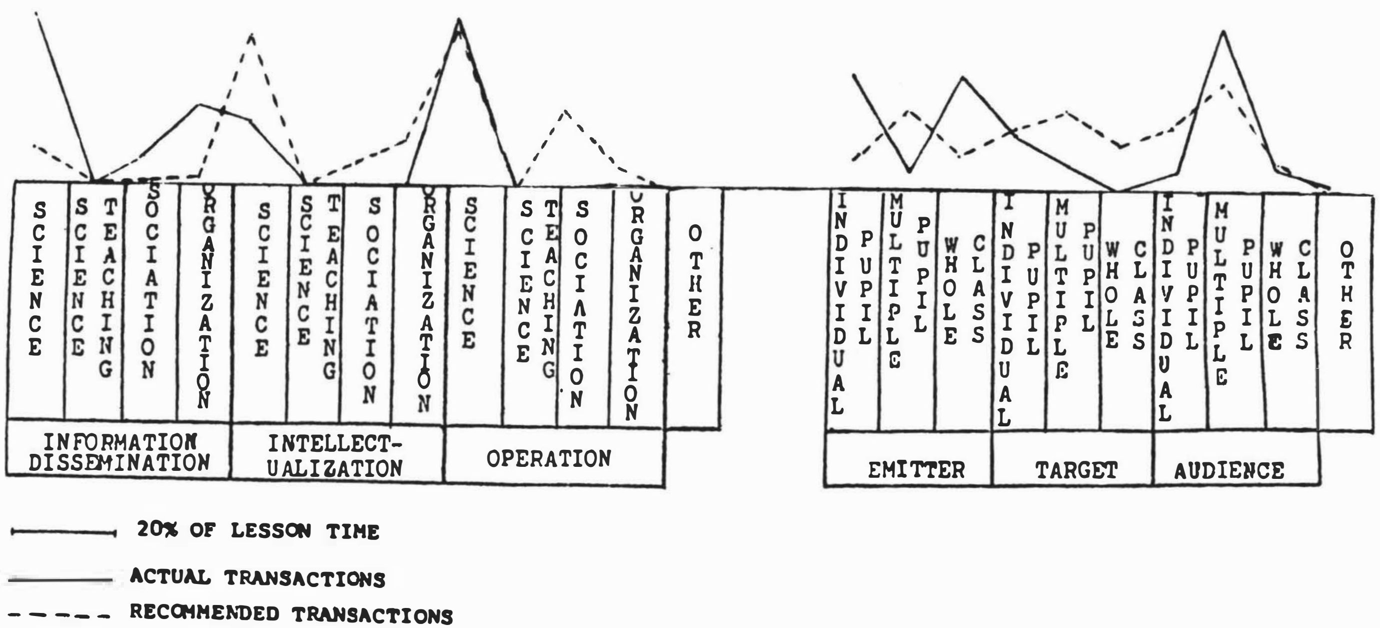
- operation about the subject matter - recommended time - 30% of the lesson time, average time spent - 33.7%.

Figure 27

Actual Transactional Pattern versus Recommendations: Lecturer 1

a. Functional Transactions

b. Structural Transactions



Also, on 3 functional transactions, 5% or less of the total lesson time was recommended, and spent:

(i) information dissemination about sociation: average time spent - 4.9%, recommended time - 1%.

(ii) intellectualization about sociation: average time spent- 0.1%, recommended time 4%;

(iii) operation about organization: average time spent - 1%), recommended time - 5%.

For 2 functional transactions the average amounts of lesson time spent during his teaching sessions were appreciably higher than the recommendations of lecturer 1:

(i) information dissemination about the subject matter: average time spent - 32.5%, recommended time - 7%,

(ii) information dissemination about organisation: average time spent - 14.6%, recommended time - 2%.

For 3 functional transactions the average amounts of lesson time spent during the teaching sessions were appreciably lower than the recommendations of lecturer 1:

(i) intellectualization about the subject matter: average time spent - 12.2%, recommended time - 28%.

(ii) intellectualization about organization: average time spent - 0.3%, recommended time - 8%;

(iii) operation about sociation: average time spent - 0% recommended time - 15%.

Structural Transactions (Figure 27):

For lecturer 1 both recommended and actual times were very similar for 2 structural transactions:

(i) the teacher as the target of individual pupils: average time spent - 9.9%, recommended time - 12%; and

(ii) the teacher as audience to the whole class: average time spent - 3.0%, recommended time - 5%.

For 3 structural transactions the average amounts of lesson time spent by Lecturer 1 were appreciably higher than his recommendations:

(i) the teacher emitting to individual pupils: average time spent 21.3%, recommended time - 6%.

(ii) the teacher emitting to the whole class: average time spent - 21.36%, recommended time - 7%;

(iii) the teacher as audience to multiple pupils: average time spent - 30.7%, recommended time - 20%.

For 4 structural transactions the average amounts of lesson time spent by Lecturer 1 were appreciably lower than his recommendations:

(i) the teacher emitting to multiple pupils: average time spent - 3.66%, recommended time - 15%;

(ii) the teacher as the target of multiple pupils: average time spent - 4.74%, recommended time - 15%.

(iii) the teacher as the target of the whole class: average time spent - 0%, recommended time - 8%;

(iv) the teacher as audience to individual pupils: average time spent - 3.4%, recommended time - 12%.

Lecturer 2

For functional transactions (Figure 28) the results were as follows:

For both the recommended and average teaching patterns of Lecturer 2 the functional transaction with the highest amount of lesson time was operation about the subject matter: average time spent - 38.3%, recommended time - 45.5%.

Also, little time (less than 3.4% of the total lesson time) was recommended for, and spent during the teaching sessions of Lecturer 2, on 3 functional transactions:

(i) information dissemination about sociation: average time spent - 1.9%, recommended time - 0.1%;

(ii) intellectualization about sociation: average time spent - 0%, recommended time - 1.25%; and

(iii) operation about sociation: average time spent - 0%, recommended time - 3.25%.

For 2 functional transactions the average amounts of lesson time spent during the teaching sessions of Lecturer 2 were appreciably higher than his recommendations:

(i) information dissemination about the subject matter: average time spent - 22.9%, recommended time - 2.9%;

(ii) information dissemination about organization: average time spent - 24.6%, recommended time - 7%.

For 3 functional transactions the average amounts of lesson time spent during the teaching sessions of Lecturer 2 were appreciably lower than his recommendations:

(i) intellectualization about the subject matter: average time spent - 6.8%, recommended time - 12.5%.

(ii) intellectualization about organization: average time spent - 0.2%; recommended time - 11.25%;

(iii) operation about organization: average time spent - 3%, recommended time - 16.25%.

Structural transactions (Figure 28):

The average times spent by Lecturer 2 were similar to his recommendations in the following cases:

(i) the teacher emitting to individual pupils: average time spent - 13.6%, recommended time - 11%,

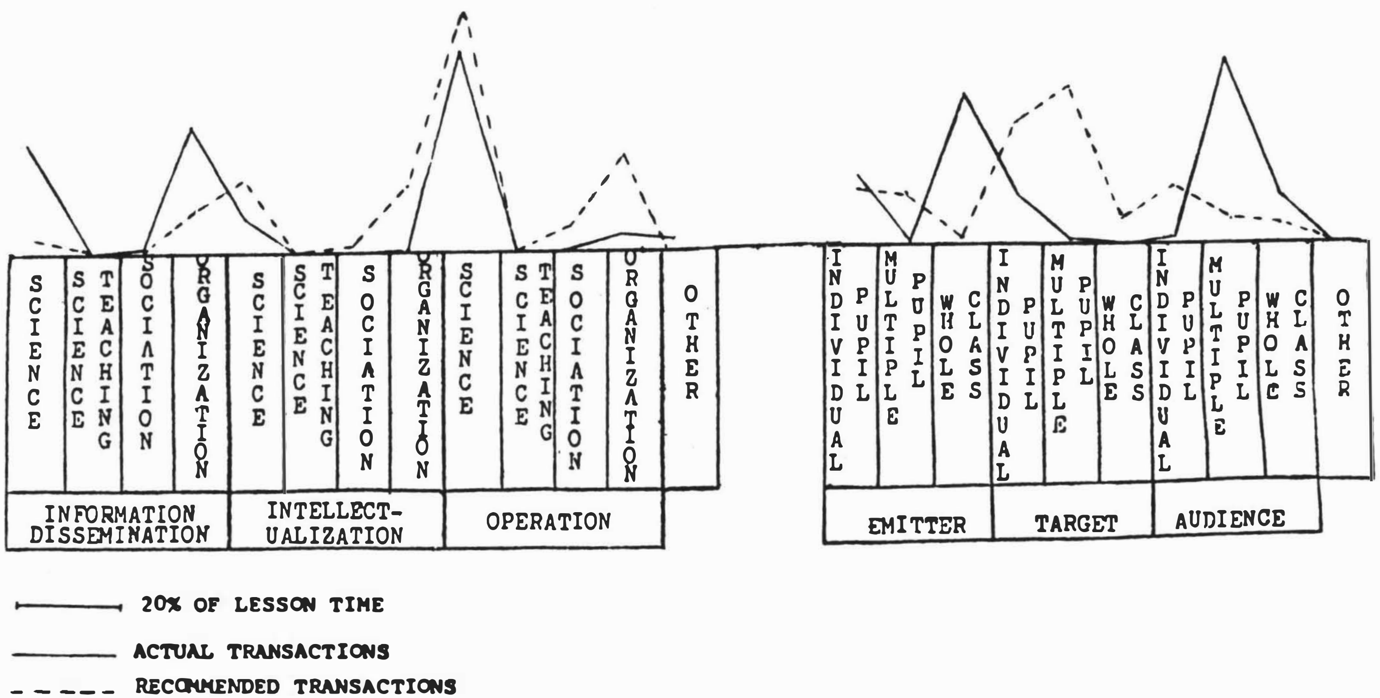
(ii) the teacher as the target of the whole class: average time spent - 0%, recommended time - 5%.

Figure 28

Actual Transactional Pattern versus Recommendations: Lecturer 2

a. Functional Transactions

b. Structural Transactions



For 3 structural transactions the average amounts of lesson time spent by Lecturer 2 were appreciably higher than his recommendations:

(i) the teacher emitting to the whole class: average time spent - 28.1%, recommended time - 2%;

(ii) the teacher as audience to multiple pupils: average time spent - 35.3%, recommended time - 5%;

(iii) the teacher as audience to the whole class: average time spent - 9.6%, recommended time - 3%.

For 4 structural transactions the average amounts of lesson time spent by Lecturer 2 were appreciably lower than his recommendations:

(i) the teacher emitting to multiple pupils: average time spent - 1%, recommended time - 10%;

(ii) the teacher as the target of individual pupils: average time spent - 9.9%, recommended time - 23%,

(iii) the teacher as the target of multiple pupils: average time spent - 0.9%, recommended time - 30%;

(iv) the teacher as audience to individual pupils: average time spent - 1.6%, recommended time - 11%.

Lecturer 3

Functional transactions (Figure 29):

For lecturer 3, there were 5 functional transactions for which the average amounts of lesson time spent during his teaching sessions and also his recommendations did not exceed 5.1% of the lesson time:

(i) information dissemination about sociation: average time spent - 5.1%, recommended time - 0.5%.

(ii) intellectualization about sociation: average time spent - 0.2%, recommended time - 1%).

(iii) intellectualization about organization: average time spent - 0%, recommended time- 1%;

(iv) operation about sociation: average time spent - 0%, recommended time - 3.75%;

(v) operation about organization: average time spent - 0.2%, recommended time - 3.75%.

There were 2 functional transactions for which the average times spent during the teaching sessions of Lecturer 3 were appreciably higher than his recommendations:

(i) information dissemination about the subject matter: average time spent - 31.6%, recommended time - 4%;

(ii) information dissemination about organization: average time spent - 24%, recommended time - 0.5%.

For 1 functional transaction the average amount of lesson time spent during the teaching sessions of lecturer 3 was appreciably lower than his recommendation:

- operation about the subject matter: average time spent - 22.8%, recommended time - 67.5%.

For one other transaction - intellectualization about the subject matter - the average time spent during the teaching sessions of lecturer 3 was slightly lower than his recommendation: average time spent - 13.7%, recommended time - 18%.

Structural transactions (Figure 29):

There were 2 structural transactions for which the average amounts of time spent by Lecturer 3 as well as his recommendations did not exceed 5% of the total lesson time:

(i) the teacher as audience to individual pupils: average time spent - 0.1%, recommended time - 5%.

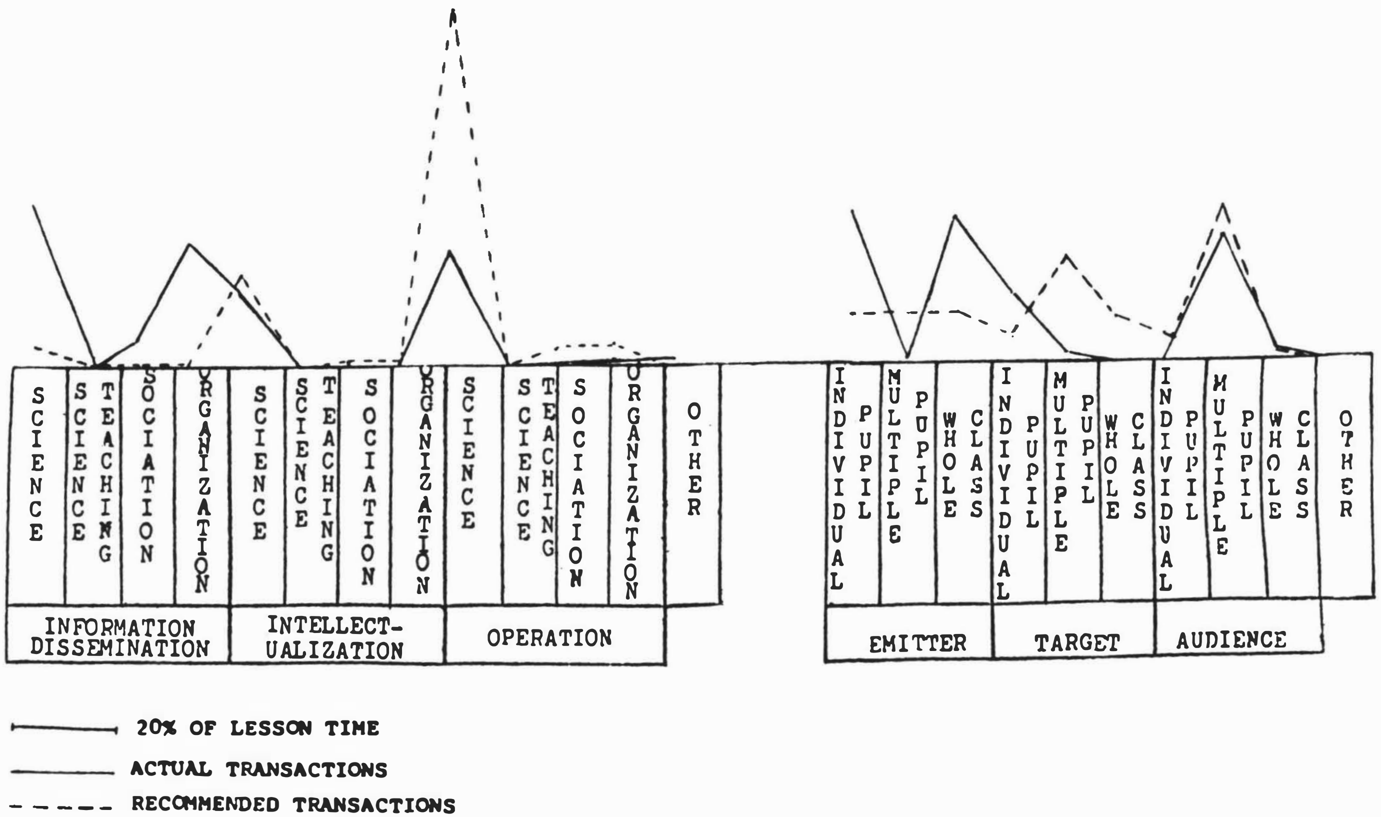
(ii) the teacher as audience to the whole class: average time spent - 2.4%, recommended time - 2%.

Figure 29

Actual Transactional Pattern versus Recommendations: Lecturer 3

a. Functional Transactions

b. Structural Transactions



For 3 structural transactions the average times spent by Lecturer 3 were appreciably higher than his recommendations:

(i) the teacher emitting to individual pupils: average time spent - 28.9%, recommended time - 10%;

(ii) the teacher emitting to the whole class: average time spent - 27.2%, recommended time - 10%;

(iii) the teacher as the target of individual pupils: average time spent - 13.2%, recommended time - 5%.

For 4 structural transactions the amounts of lesson time spent by Lecturer 3 were appreciably lower than his recommendations:

(i) the teacher emitting to multiple pupils: average time spent - 1.7%, recommended time - 10%;

(ii) the teacher as the target of multiple pupils: average time spent - 2.4%, recommended time - 20%;

(iii) the teacher as audience to multiple pupils: average time spent - 24.1%, recommended time - 30%;

(iv) the teacher as the target of the whole class: average time spent - 0%, recommended time - 8%.

Lecturer 4

Functional transactions (Figure 30)

There were 4 functional transactions for which the average amounts of lesson time spent during the teaching sessions of lecturer 4 as well as his recommendations were lower than 5% of the total lesson time:

(i) information dissemination about sociation: average time spent - 2.8%, recommended time - 1%;

(ii) information dissemination about organization: average time spent - 4.9%, recommended time - 2.5%;

(iii) operation about sociation: average time spent - 0%, recommended time - 1.25%;

(iv) operation about organization: average time spent - 0.03%, recommended time - 3.75%.

For 2 functional transactions the average amounts of time spent during the teaching session of Lecturer 4 were appreciably higher than his recommendations:

(i) information dissemination about the subject matter: average time spent - 46.77%, recommended time - 1.5%;

(ii) operation about the subject matter: average time spent - 27.1%, recommended time - 20%.

For 3 functional transactions the average amounts of lesson time spent during the teaching sessions of Lecturer 4 were appreciably lower than his recommendations:

(i) intellectualization about the subject matter: average time spent - 14.1%, recommended time - 35% of the total lesson time;

(ii) intellectualization about sociation: average time spent - 0.2%, recommended time - 21%;

(iii) intellectualization about organization: average time spent - 0.6%, recommended time - 14%.

Structural transactions (Figure 30):

For 1 structural transaction the average amount of lesson time spent by Lecturer 4 was very similar to his recommendation:

(i) the teacher as the target of multiple pupils: average time spent - 7.2%, recommended time - 10%.

Also, for 2 structural transactions the average amounts of lesson time spent by Lecturer 4 as well as his recommendations did not exceed 5% of the total lesson time:

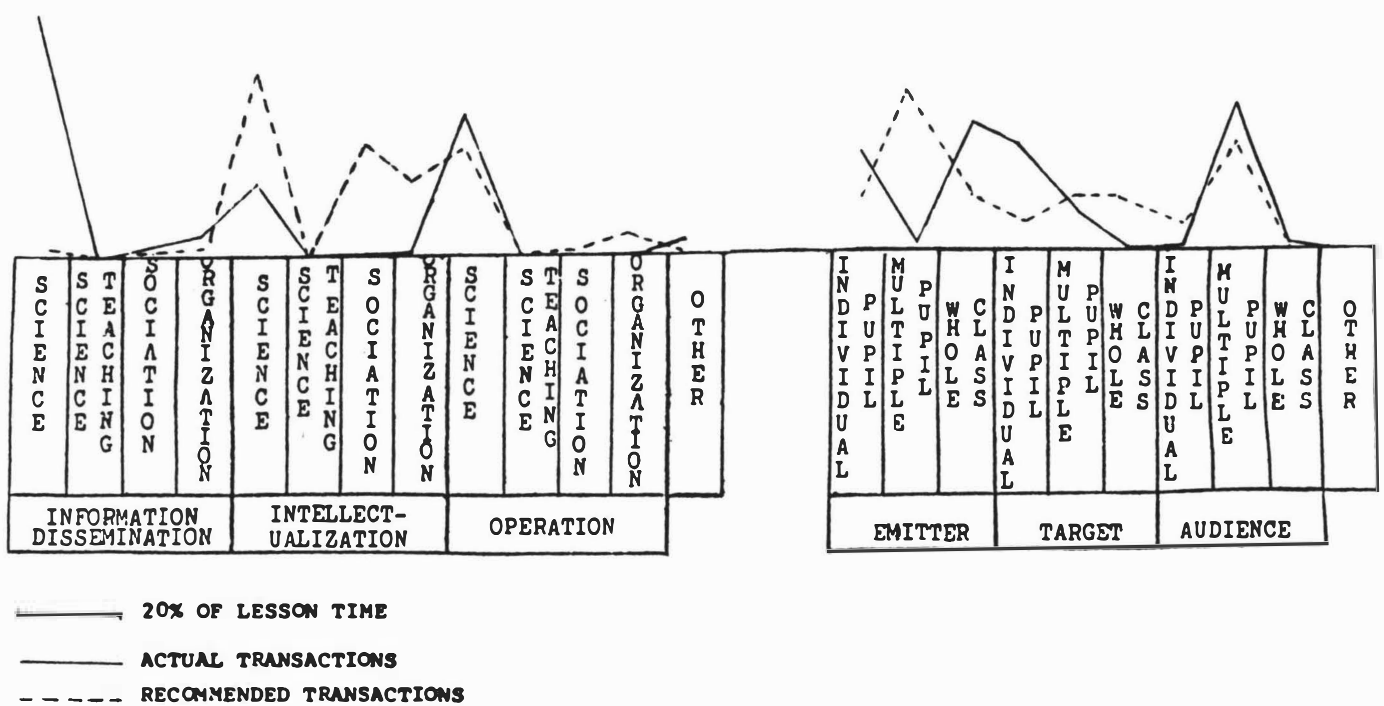
(i) the teacher as audience to individual pupils: average time spent - 0.7%, recommended time - 5%;

Figure 30

Actual Transactional Pattern versus Recommendations: Lecturer 4

a. Functional Transactions

b. Structural Transactions



(ii) <u>the teacher as audience to the whole class</u>: average time spent 1.9%, recommended time - 0%.

There were 4 structural transactions for which the average amounts of lesson time spent by Lecturer 4 were appreciably higher than his recommendations:

(i) <u>the teacher emitting to individual pupils</u>: average time spent- 18.3%, recommended time - 10% of the total lesson time;

(ii) <u>the teacher emitting to the whole class</u>: average time spent-23.5%, recommended time - 10%;

(iii) <u>the teacher as the target of individual pupils</u>: average time spent - 19.3%, recommended time - 5%;

(iv) <u>the teacher as audience to multiple pupils</u>: average time spent - 27.4%, recommended time - 20%.

For 2 structural transactions the average amounts of time spent by Lecturer 4 were appreciably lower than his recommendations:

(i) <u>the teacher emitting to multiple pupils</u>: average time spent - 1.4%, recommended time - 30%;

(ii) <u>the teacher as the target of the whole class</u>: average time spent - 0.3%, recommended time - 10%.

<u>Lecturer 5</u>

<u>Functional transactions (Figure 31):</u>

For Lecturer 5 the average amount of lesson time spent during teaching sessions on - <u>intellectualization about the subject matter</u> - was very similar to his recommendation: average time spent - 26.9%, recommended time - 25.2%.

Also, for 3 functional transactions the average amounts of lesson time spent during the teaching sessions of Lecturer 5 as well as his recommendations were less than 5% of the total lesson time:

(i) <u>information dissemination about sociation</u>: average time spent - 4.5% recommended time - 0.1%;

(ii) <u>intellectualization about sociation</u>: average time spent - 0.03%, recommended time - 1.4%;

(iii) <u>intellectualization about organization</u>: average time spent 0.6%, recommended time - 1.4%.

For 2 functional transactions the average amounts of lesson time spent during the teaching sessions of Lecturer 5 were appreciably higher than his recommendations:

(i) <u>information dissemination about the subject matter</u>: average time spent - 28.4%, recommended time - 1.8%;

(ii) <u>information dissemination about organization</u>: average time spent - 7.7%, recommended time - 0.1%.

For 3 functional transactions the average amounts of lesson time spent during the teaching sessions of Lecturer 5 were appreciably lower than his recommendations:

(i) <u>operation about the subject matter</u>: average time spent - 25.7%, recommended time - 35%;

(ii) <u>operation about sociation</u>: average time spent - 0%, recommended time - 28%;

(iii) <u>operation about organization</u>: average time spent 1.3%, recommended time - 7%.

<u>Structural transactions</u> (Figure 31):

For 2 structural transactions the average amounts of lesson time spent by Lecturer 5 were very similar to his recommendations:

(i) <u>the teacher as the target of individual pupils</u>: average time spent - 12%, recommended time - 10%;

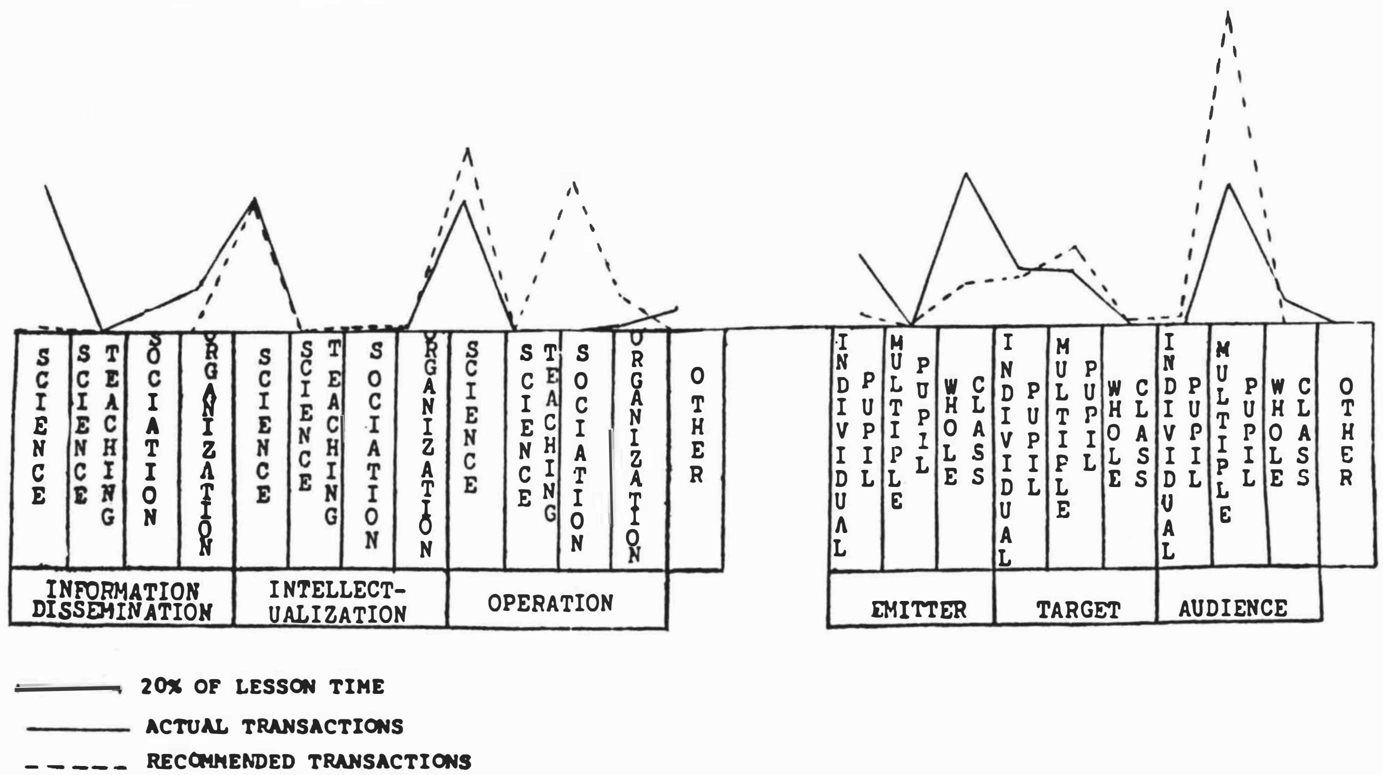
(ii) <u>the teacher as the target of multiple pupils</u>: average time spent - 11.6%, recommended time - 15%.

Figure 31

Actual Transactional Pattern versus Recommendations: Lecturer 5

a. Functional Transactions

b. Structural Transactions



For 4 structural transactions the average times spent by Lecturer 5 as well as his recommendations were lower than 5% of the total lesson time:

(i) the teacher emitting to multiple pupils: average time spent - 0.5%, recommended time - 0%;

(ii) the teacher as the target of the whole class: average time spent - 0.3%, recommended time - 2%;

(iii) the teacher as audience to individual pupils: average time spent - 0.1%, recommended time - 2.5%;

(iv) the teacher as audience to the whole class: average time spent - 4.9%, recommended time - 0%.

For 2 structural transactions the average amounts of lesson time spent by lecturer 5 were appreciably higher than his recommendations:

(i) the teacher emitting to individual pupils: average time spent - 13.8%, recommended time - 2.5%;

(ii) the teacher emitting to the whole class: average time spent - 29.8%, recommended time - 8%.

For 1 structural transaction - the teacher as audience to multiple pupils - the average time spent by Lecturer 5 was appreciably lower than his recommendation: average time spent - 27%, recommended time - 60%.

From these results it would appear that the lecturers, as a group, recommended a pattern of teaching where the major emphasis was to be placed on operation about the subject matter and the teacher's being audience to small groups of pupils. Little was to be placed on giving information (about anything) or on the teacher's working with the whole class. A moderate amount of emphasis was to be placed on intellectualization about the subject matter. By contrast, during their own teaching sessions, although operation about the subject matter was a major feature, and although intellectualization about the subject matter featured moderately, there was appreciably more* information dissemination and teacher talking to the whole class than had been recommended.

Furthermore, the amount of lesson time spent by most lecturers as audience to multiple pupils, and the amount of time spent by all lecturers emitting to individual pupils were both higher than their recommendations.

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* This particular state of affairs was partially created by situational objectives as well as by other factors and is discussed at some length in Chapter 6.

SECTION II

FIRST-YEAR TEACHERS - TEACHING PATTERNS

This section of the chapter reports the results derived from the 20 teacher-graduates and includes 6 specific aspects. Part A deals with the teachers' perceptions of the teaching patterns that were recommended by their lecturers for the teaching of elementary science. Part B deals with the teachers' perceptions of the actual teaching patterns of their lecturers, Part C with their perceptions of the teaching patterns of their specific "pre-college" science teachers and Part D with their own judgement of the strategies appropriate for the teaching of elementary science. In Part E the actual teaching patterns of the teachers are compared with:

(i) the teaching patterns that were recommended by their lecturers;

(ii) their perceptions of the teaching patterns that were recommended by their lecturers;

(iii) the teaching patterns of their lecturers;

(iv) their perceptions of the teaching patterns of their lecturers;

(v) their perceptions of the teaching patterns of their "pre-college" science teachers; and

(vi) their own judgement of the teaching patterns appropriate for the teaching of elementary science.

Finally, Part F reports the findings for the teachers' attribution of their teaching patterns to:

(i) the actual, and recommended teaching patterns of the lecturers;

(ii) their perceptions of the teaching patterns of their "pre-college" science teachers; and

(iii) other influences.

PART A:

TEACHER-PERCEPTIONS OF LECTURER-RECOMMENDATIONS

What are the individual teacher-perceptions of the transactions that were recommended by his/her science lecturer/lecturers for the functional and structural aspects of elementary science teaching? (Question 7)

The individual teacher-perceptions of the percentages of lesson time recommended by his/her science lecturer/lecturers for the functional and structural aspects of elementary science teaching are outlined in Tables 12a and 12b respectively. Profiles of these results are shown in Appendix J. As these profiles represent teacher-perceptions of the recommended teaching patterns of 5 different science lecturers they are, understandably, varied.

The ranges in teacher-perceptions of the amounts of lesson time recommended for functional transactions varied most for the following transactions:

(i) information dissemination about the subject matter of science - a range of 0% to 16% of the total lesson time;

(ii) intellectualization about the subject matter of science - 6% to 40%;

(iii) operation about the subject matter of science - 5% to 60%; and

(iv) operation about sociation - 1% to 40% (see Table 12a and Figure 32).

For structural transactions, teacher-perceptions of the amounts of lesson time recommended by the lecturers showed wide ranges for 8 of the 9 transactions - all except: the teacher as audience to the whole class 0% to 10% (Table 12b and Figure 32). The structural transaction with the highest range was: the teacher as the target of individual pupils - 2% to 39% of the total lesson time.

TABLE 12a

TEACHER-PERCEPTIONS OF LECTURERS' FUNCTIONAL RECOMMENDATIONS

	% TIME									
	INFORMATION DISSEMINATION			INTELLECTUALIZATION			OPERATION			OTHER
TEACHERS:	SC.	SOC.	ORG.	SC.	SOC.	ORG.	SC.	SOC.	ORG.	
G 1	5	0	5	9	0.5	0.5	40	10	30	-
R 2	8	2	5	15	5	5	40	5	15	-
O 3	16	2	2	25	3	2	48	1	1	-
U 4	10	2	3	15	5	5	30	15	15	-
P 5	3	2	10	15	5	5	25	10	25	-
6	5	2	3	30	10	10	20	5	15	-
1 7	10	10	5	15	5	5	30	10	10	-
Mean, Group 1	8.1	2.9	4.7	17.7	4.8	4.6	33.3	8	15.9	-
8	5	3	2	10	5	5	50	10	10	-
G 9	15	5	5	15	5	5	20	10	20	-
10	4	4	12	10	10	20	5	15	20	-
R 11	6	5	4	20	9	6	30	12	8	-
O 12	5	5	10	10	5	5	50	5	5	-
13	7.5	7.5	15	6	7	7	30	10	10	-
U 14	9	3	3	15	5	5	45	10	5	-
P 15	10	5	5	20	5	5	40	5	5	-
16	8	1	1	20	2	3	60	2	3	-
17	3	1	1	36	2	2	53	1	1	-
2 18	0	1	1	6	6	6	38	40	2	-
19	10	5	5	40	10	10	15	2.5	2.5	-
20	10	5	5	15	5	10	30	5	15	-
Mean, Group 2	7.1	3.9	5.3	17.2	5.9	6.9	35.9	9.8	8.0	-
Mean, all teachers	7.5	3.5	5.1	17.4	5.5	6.1	34.9	9.2	10.8	-

SC. = SCIENCE

SOC. = SOCIATION

ORG. = ORGANIZATION

TABLE 12b

TEACHER-PERCEPTIONS OF LECTURERS' STRUCTURAL RECOMMENDATIONS

	% TIME									
	EMITTER			TARGET			AUDIENCE			OTHER
TEACHERS:	IND. PUP.	MULT. PUP.	WHL. CLASS	IND. PUP.	MULT. PUP.	WHL. CLASS	IND. PUP.	MULT. PUP.	WHL. CLASS	
G 1	1	2	0	19	38	10	10	20	0	-
R 2	5	10	3	10	10	5	15	40	2	-
O 3	15	15	10	10	30	8	5	5	2	-
U 4	15	15	10	20	15	8	5	10	2	-
P 5	5	15	10	10	25	5	5	20	5	-
6	7	15	5	12	40	10	1	5	5	-
1 7	5	10	5	10	30	10	10	10	10	-
Mean, Group 1	7.6	11.7	6.1	13.0	26.9	8.0	7.3	15.7	3.7	-
8	5	10	20	10	10	10	5	20	10	-
G 9	15	10	20	10	10	10	5	10	10	-
10	10	8	4	20	12	3	30	10	3	-
R 11	8	10	8	10	18	6	12	22	6	-
O 12	5	10	5	15	30	15	5	10	5	-
13	20	10	10	20	5	10	10	5	10	-
U 14	5	5	3	20	20	5	20	15	7	-
15	8	20	25	2	30	5	0	10	0	-
P 16	1	5	25	15	35	5	4	10	0	-
17	1	2	2	39	18	3	20	10	5	-
18	10	10	20	20	20	10	3.3	3.3	3.3	-
2 19	5	10	5	10	40	10	5	10	5	-
20	10	10	10	20	20	5	10	10	5	-
Mean, Group 2	7.9	9.2	12.1	16.2	20.6	7.5	10.0	11.2	5.3	-
Mean, all teachers	7.8	10.1	10	15.1	22.8	7.7	9.0	12.8	4.7	-

IND. PUP. = INDIVIDUAL PUPIL
MULT. PUP. = MULTIPLE PUPIL
WHL. CLASS = WHOLE CLASS

<u>What are the averaged teacher-perceptions of the transactions that were recommended by the science lecturers?</u> (Question 8).

The averaged teacher-perceptions of the transactions that were recommended by the lecturers were as follows:

<u>For functional transactions</u> (Table 12a and Figure 32), the averaged perceptions were that: the <u>highest</u> amount of lesson time (34.9%) was recommended by the lecturers for <u>operation about the subject matter</u>, followed by:

(i) <u>intellectualization about the subject matter</u> - 17.4%; and

(ii) <u>operation about organization</u> - 10.8%.

For the other 6 transactions the averaged perceptions were that: <u>less than 10%</u> of the lesson time was recommended to be spent on each with the <u>lowest</u> amount of lesson time being recommended for <u>information dissemination about sociation</u> (perceived recommendation - 3.5%).

<u>For structural transactions</u> (Table 12b and Figure 32), the averaged teacher-perceptions revealed that the <u>highest</u> amount of lesson time was recommended for <u>the teacher as the target of multiple pupils</u> - 22.8%; followed by:

(i) <u>the teacher as the target of individual pupils</u> - 15.1%;

(ii) <u>the teacher as audience to multiple pupils</u> - 12.8%; and

(iii) <u>the teacher emitting to multiple pupils</u> - 10.1%.

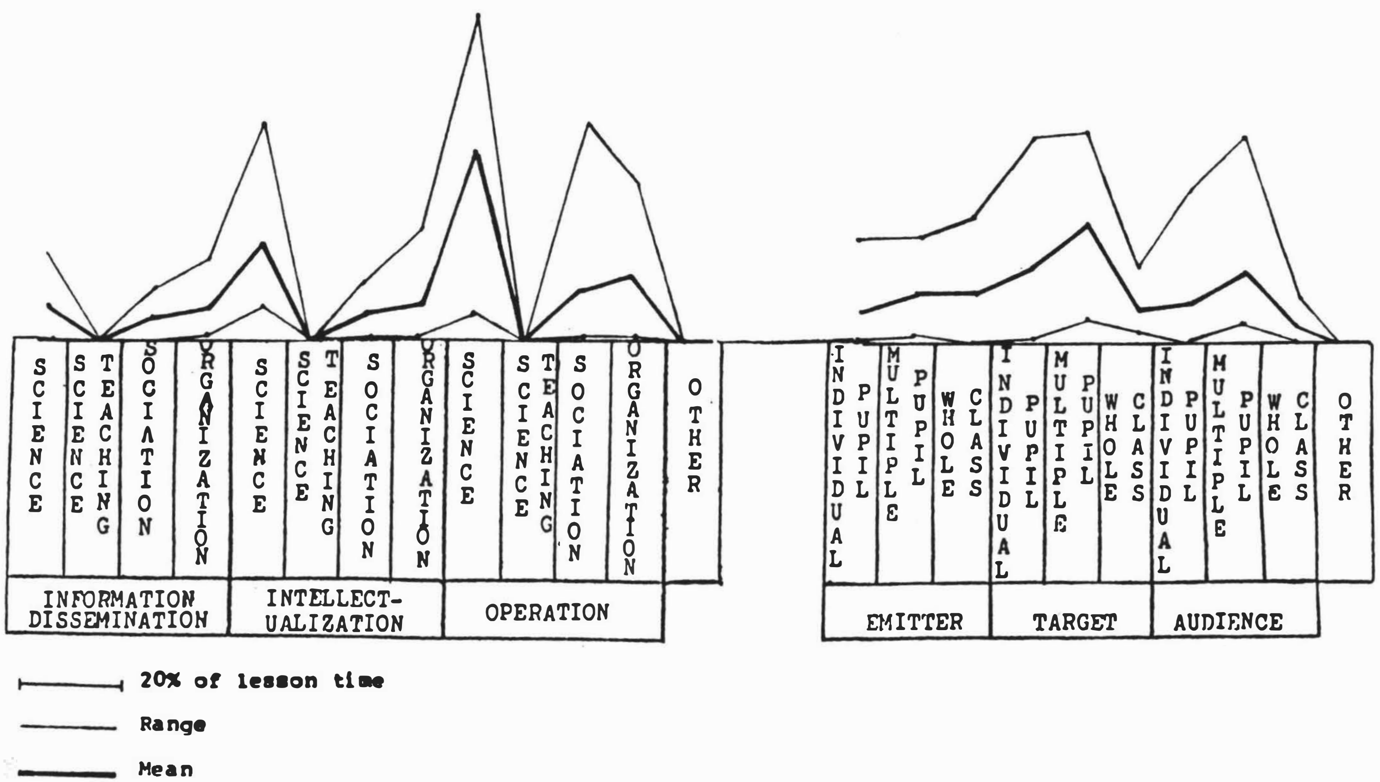
For the other 5 structural transactions the averaged perceptions were that: <u>10% or less</u> of the lesson time was recommended to be spent on each with the <u>lowest</u> amount of lesson time being recommended for <u>the teacher as audience to the whole class</u> - 4.7%.

Figure 32

Teacher-perceptions of Lecturer-recommendations: Range and Mean

a. Functional Transactions

b. Structural Transactions



On average, how do the teachers who received massed curriculum training and those who received spaced curriculum training perceive the pattern of teaching that was recommended by their respective lecturers? (Question 9)

Group 1 (teachers who received spaced curriculum training) was taught by lecturers 1 & 5. The averaged (group) perceptions of the amounts of lesson time recommended by these 2 lecturers for functional and structural aspects of elementary science teaching are to be found in Tables 12a and 12b; and Figure 33 respectively.

When averaged, the results showed that for functional transactions (Table 12a and Figure 33), the perceptions of group 1 were that: the highest amount of lesson time was recommended by lecturers 1 and 5 for - operation about the subject matter of science (33.3%) followed by:

(i) intellectualization about the subject matter of science (17.7%); and

(ii) operation about organization (15.9%).

For the other 6 transactions group 1 perceived that less than 10% of the lesson time was recommended to be spent on each with the lowest amount of lesson time being recommended for - information dissemination about sociation (2.9%).

For structural transactions (Table 12b and Figure 33), group 1 perceived that the highest amount of lesson time was recommended for - the teacher as the target of multiple pupils (26.9%), followed by:

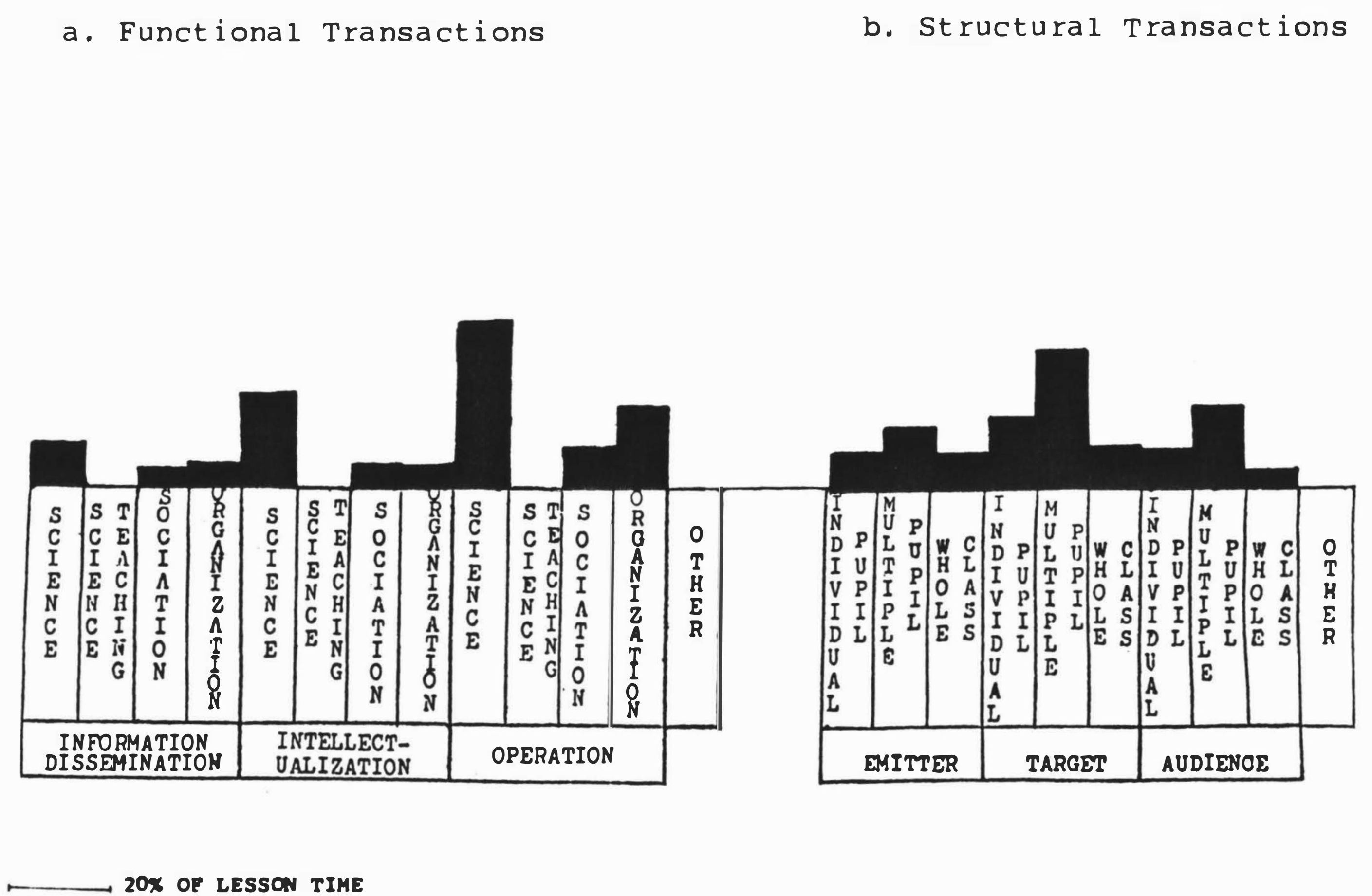
(i) the teacher as audience to multiple pupils (15.7%);

(ii) the teacher as the target of individual pupils (13%); and

(iii) the teacher emitting to multiple pupils (11.7%).

Figure 33

Perceived Lecturer-recommendations: Group 1



For the other 5 structural transactions, the averaged perceptions of group 1 were that: less than 10% of the lesson time was recommended for each with the lowest amount of lesson time being recommended for - the teacher as audience to the whole class (3.7%).

Group 2 (teachers who received massed curriculum training) was taught by 4 of the 5 lecturers - lecturers 1-4. The averaged group-perceptions of the amounts of lesson time recommended by these 4 lecturers for the functional and structural aspects of elementary science teaching are to be found in Tables 12a and 12b; and Figure 34 respectively.

For functional transactions (Table 12a and Figure 34), the results showed that the averaged perceptions of group 2 were that: the highest amount of lesson time was recommended for operation about the subject matter of science (35.9%), followed by - intellectualization about the subject matter of science (17.2%).

For the other 7 functional transactions the averaged perceptions of group 2 were that: less than 10% of the lesson time was recommended for each with the lowest amount of time being recommended for information dissemination about sociation (3.9%).

For structural transactions (Table 12b and Figure 34), the averaged perceptions of group 2 were that: the highest amount of lesson time was recommended for the teacher as the target of multiple pupils (20.6%), followed by:

(i) the teacher as the target of individual pupils (16.2%);

(ii) the teacher emitting to the whole class (12.1%); and

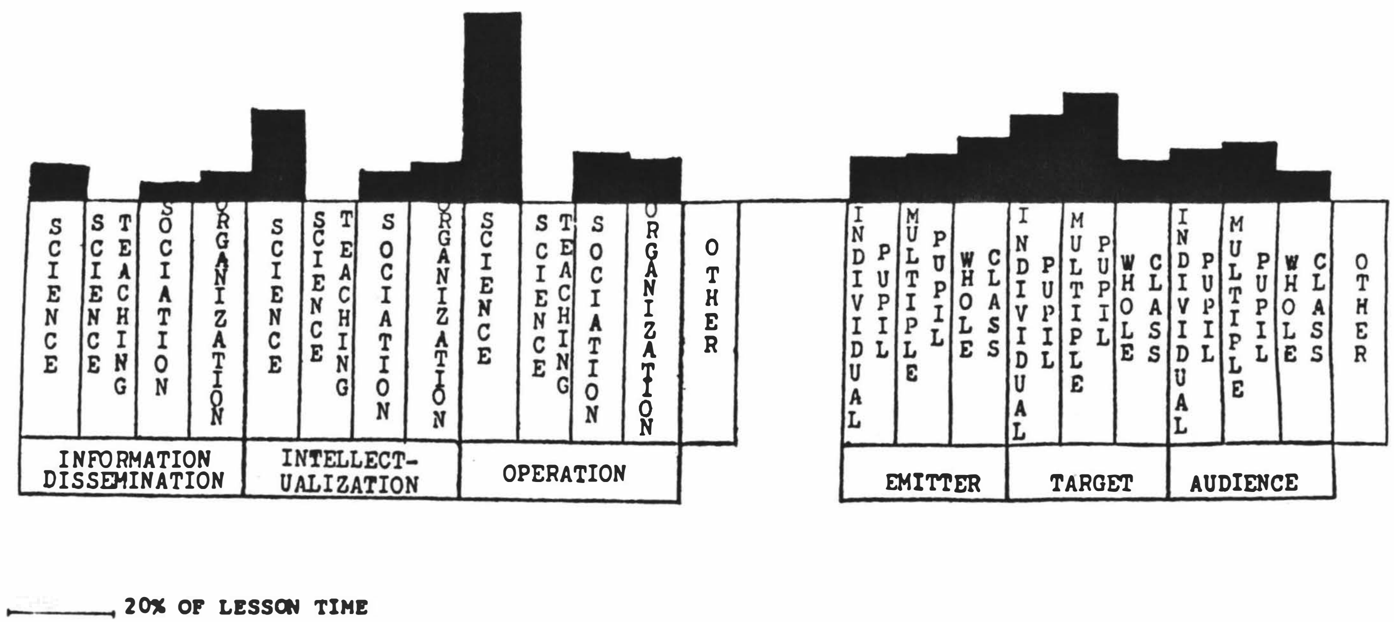
(iii) the teacher as audience to multiple pupils (11.2%).

Figure 34

Perceived Lecturer-recommendations: Group 2

a. Functional Transactions

b. Structural Transactions



For the other 5 structural transactions the averaged perceptions of group 2 were that: 10% or less of the lesson time was recommended for each with the lowest amount of lesson time being recommended for - the teacher as audience to whole class (5.3%).

How do the averaged teacher-perceptions of the recommendations of the lecturers compare with the averaged lecturer-recommendations? (Question 10)

When averaged, the results revealed that:

(i) Teacher-perceptions of the amounts of lesson time recommended for functional and structural transactions were very similar to the averaged recommendations of the lecturers (Figure 35).

There were close resemblances between the teachers' overall perceptions of the percentages of lesson time recommended by the science lecturers and the averaged lecturer-recommendations for 8 of the 9 functional transactions.

The functional transaction which showed the greatest difference between actual and peceived recommendations was: intellectualization about the subject matter of science (recommendation - 23.74% of the lesson time, perceived recommendation - 17.4%). See Tables 12a and 10a respectively.

(ii) Averaged teacher-perceptions of the percentages of lesson time recommended by the science lecturers also bore close resemblances to the averaged lecturer-recommendations for 8 of the 9 structural transactions (Figure 35).

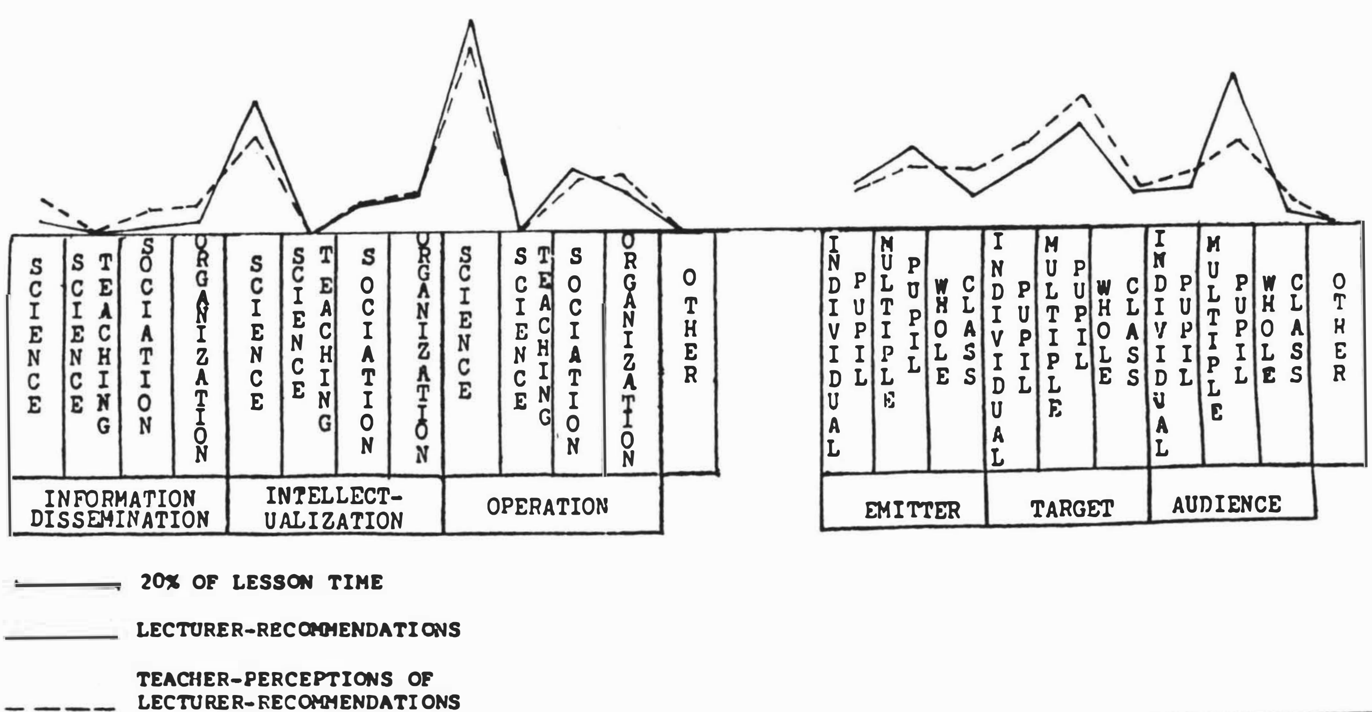
For one transaction - the teacher as audience to multiple pupils - the averaged recommendation of the

Figure 35

Perceived versus Actual Lecturer-recommendations: All Teachers

a. Functional Transactions

b. Structural Transactions



science lecturers was 27% of the lesson time while the teachers' overall perception of this recommended time was 12.8% of the lesson time - see Tables 10b and 12b respectively.

How do the lecturer-recommendations as perceived by teachers who received spaced curriculum training and those who received massed curriculum training compare with the averaged lecturer-recommendations for these groups? (Question 11)

Group 1 was taught by lecturers 1 and 5. For group 1 there were close resemblances between the averaged lecturer-recommended times and the averaged group-perceptions of these times for 6 of the 9 functional transactions (Figure 36).

For 1 functional transaction the averaged perception of group 1 was appreciably higher than the averaged lecturer-recommendation - operation about organization (perceived time - 15.9%, recommended time - 6%).

For 2 functional transactions the averaged perceptions of group 1 were appreciably lower than the averaged recommendations of their lecturers:

(i) intellectualization about science (perceived time - 17.7%, recommended time - 26.6%); and

(ii) operation about sociation (perceived time - 8%, recommended time - 21.5%). See Tables 12a and 10a respectively.

For structural transactions the averaged perceptions of group 1 also closely resembled the averaged lecturer-recommendations for 6 of the 9 transactions (Figure 36).

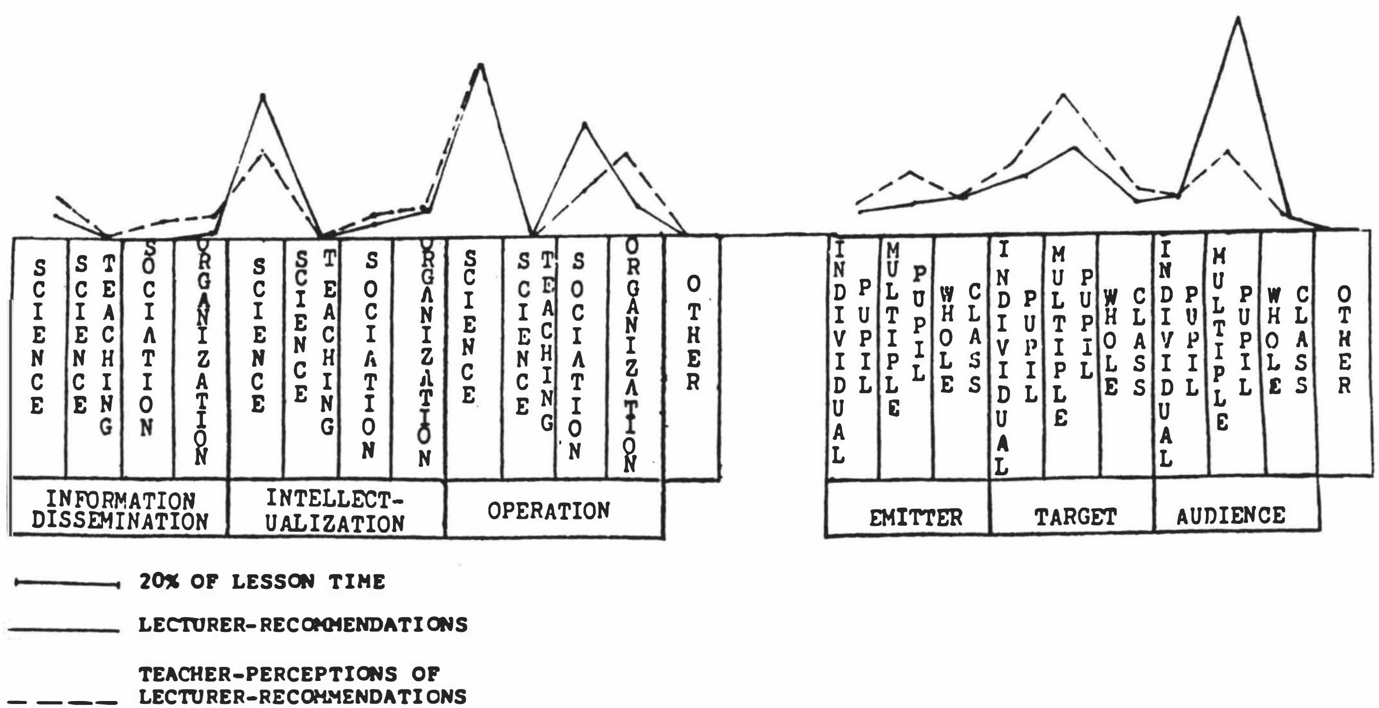
For 2 structural transactions the averaged perceptions of group 1 were appreciably higher than the averaged recommendations of their lecturers: -

Figure 36

Perceived versus Actual Lecturer-recommendations: Group 1

a. Functional Transactions

b. Structural Transactions



(i) the teacher emitting to multiple pupils (perceived time - 11.7% of the lesson time, recommended time - 7.5%); and

(ii) the teacher as the target of multiple pupils (perceived time - 26.9%, recommended time - 15%).

For 1 structural transaction the averaged perception of group 1 was appreciably lower than the averaged lecturer-recommendation - the teacher as audience to multiple pupils (perceived time - 15.7% of the lesson time, recommended time - 40%).

For group 2 there were close resemblances between the averaged recommendations of their lecturers and the averaged group-perceptions for 8 of the 9 functional transactions (Figure 37).

For one functional transaction - intellectualization about the subject matter of science - the averaged perception of group 2 was appreciably lower than the averaged lecturer-recommendation (perceived time - 17.2%, recommended time - 23.4%).

For structural transactions (Figure 37) the averaged perceptions of group 2 bore close resemblances to the averaged recommendations of their lecturers in 5 of the 9 cases.

For 2 structural transactions the averaged perceptions of group 2 were slightly higher than the averaged recommendations of their lecturers:

(i) the teacher emitting to the whole class (perceived time - 12.1%, recommended time - 7.25%); and

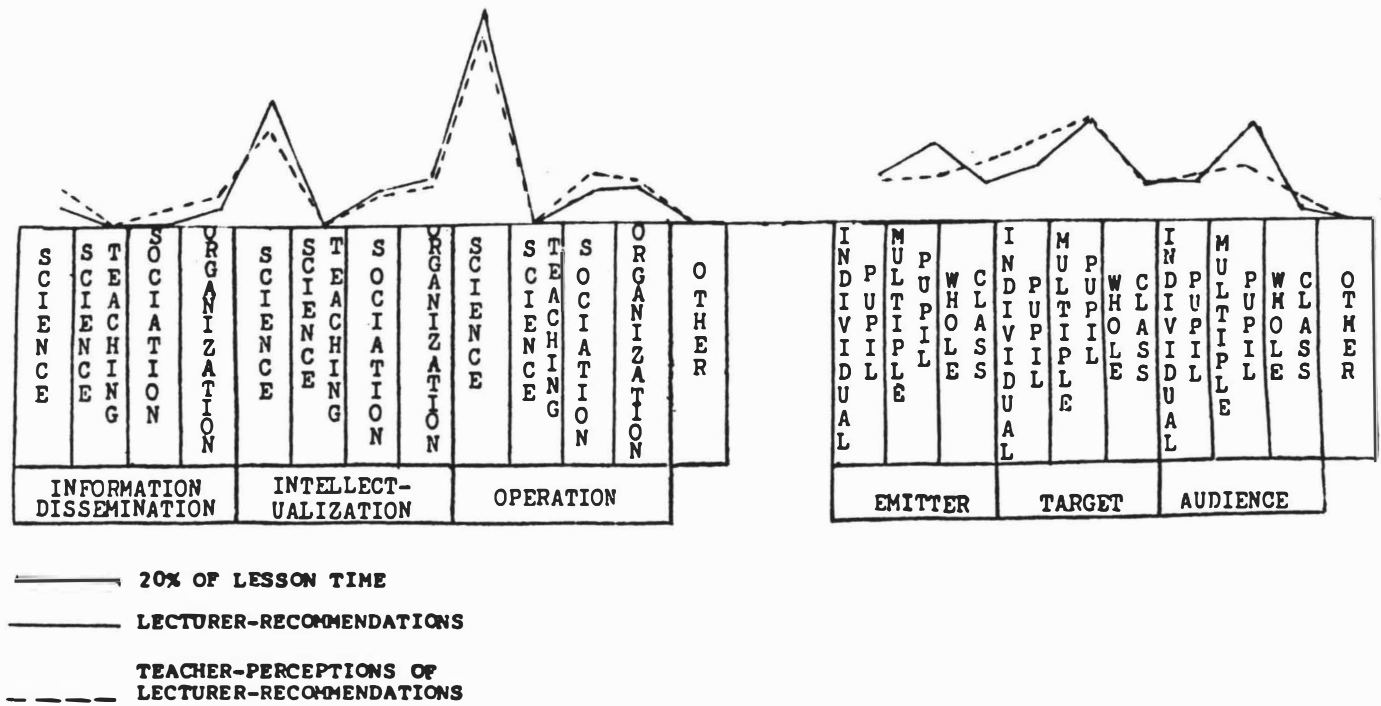
(ii) the teacher as the target of individual pupils (perceived time - 16.2%, recommended time - 11.25%).

Figure 37

Perceived versus Actual Lecturer-recommendations: Group 2

a. Functional Transactions

b. Structural Transactions



For 2 structural transactions the averaged perceptions of group 2 were appreciably lower than the averaged recommendations of their lecturers:

(i) the teacher emitting to multiple pupils - (perceived time - 9.2%, recommended time - 16.25%); and

(ii) the teacher as audience to multiple pupils (perceived time - 11.2%, recommended time - 18.75%). See Tables 12a and 10a respectively.

PART B

TEACHER-PERCEPTIONS OF ACTUAL LECTURER-TRANSACTIONS

What are the individual teacher-perceptions of the actual transactions of his/her science lecturer/lecturers? (Question 12)

The individual teacher-perceptions of the percentages of lesson time spent during the teaching sessions of his/her lecturer/lecturers on the functional and structural aspects of science teaching are to be found in Tables 13a and 13b respectively. Profiles of these results are shown in Appendix K.

Examination of the individual teacher-perceptions of the teaching patterns of the lecturers revealed wide ranges in the amounts of lesson time perceived to be spent on certain functional and all structural aspects of science teaching (Figure 38).

The functional transaction with the widest range was operation about science teaching - a range of 2% to 70% of the total lesson time. The functional transactions with the lowest ranges were:

TABLE 13 a

TEACHER-PERCEPTIONS OF LECTURERS' FUNCTIONAL TRANSACTIONS

	% TIME												
	INFORMATION DISSEMINATION				INTELLECTUALIZATION				OPERATION				OTHER
TEACHERS:	SC.	SC. TCH.	SOC.	ORG.	SC.	SC. TCH.	SOC.	ORG.	SC.	SC. TCH.	SOC.	ORG.	
G 1	50	5	15	5	3	-	2	-	13	2	-	5	-
R 2	10	15	5	10	3	10	2	5	5	20	5	10	-
O 3	15	30	3	2	2	15	2	1	10	19	0.5	0.5	-
U 4	15	30	10	15	1	5	2	2	7	9	2	2	-
P 5	15	5	5	5	20	20	5	5	8	2	5	5	-
6	2	10	2	6	2	6	2	10	5	45	5	5	-
1 7	10	5	5	5	10	5	5	5	35	5	5	5	-
													-
Mean Group 1	16.7	14.2	6.4	6.9	5.9	8.7	2.9	4	11.9	14.6	3.2	4.6	-
8	4	4	1	1	5	10	3	2	20	30	10	10	-
G 9	10	5	5	5	10	5	5	5	20	20	5	5	-
10	2	6	6	6	3	5	6	6	3	7	10	40	-
R 11	5	5	8	2	8	8	7	7	10	15	15	10	-
12	2	8	1	9	-	4	-	1	50	15	-	10	-
O 13	3	17	5	5	1	10	4	5	5	20	5	20	-
14	20	3	7	10	20	4	8	8	5	5	5	5	-
U 15	3	2	10	5	5	10	5	10	30	10	5	5	-
P 16	20	2	5	13	1	-	-	-	40	5	-	14	-
17	2	2	0.5	0.5	1	2	1	1	10	70	8	2	-
18	4	1	2	3	3	10	10	7	5	20	30	5	-
2 19	5	10	-	5	-	5	-	5	10	60	-	-	-
20	7	4	4	5	15	15	5	5	15	10	5	10	-
Mean Group 2	6.7	5.3	4.2	5.3	5.5	6.8	4.1	4.8	17.2	22.1	7.5	10.5	-
Mean, all teachers:	10.2	8.4	4.9	5.9	5.7	7.5	3.7	4.5	15.3	19.5	6	8.4	-

SC. = SCIENCE

SC. TCH. = SCIENCE TEACHING

SOC. = SOCIATION

ORG. = ORGANIZATION

TABLE 13b

TEACHER-PERCEPTIONS OF LECTURERS' STRUCTURAL TRANSACTIONS

	% TIME									
	EMITTER			TARGET			AUDIENCE			OTHER
TEACHERS:	IND. PUP.	MULT. PUP.	WHL. CLASS	IND. PUP.	MULT. PUP.	WHL. CLASS	IND. PUP.	MULT. PUP.	WHL. CLASS	
G 1	1	1	15	-	3	55	-	10	15	-
R 2	5	1	5	5	4	5	30	35	10	-
O 3	8	10	30	7	10	9	5	20	1	-
U 4	5	5	20	10	15	20	5	10	10	-
P 5	10	10	20	5	10	5	5	30	5	-
6	10	25	15	5	10	10	5	15	5	-
1 7	5	5	5	10	25	10	10	20	10	-
Mean, Group 1	6.3	8.1	15.7	6	11.0	16.3	8.6	20	8	-
8	2	10	3	10	50	1	3	20	1	-
G 9	15	25	15	5	15	5	5	10	5	-
10	18.3	15.3	20.3	8	9	10	7	9	3	-
R 11	10	8	2	20	10	4	20	22	4	-
12	3	3	40	10	10	15	2	2	15	-
O 13	3	15	15	3	15	15	4	10	20	-
U 14	1	5	50	2	7	30	2	3	-	-
15	10	5	30	5	30	10	5	5	-	-
P 16	-	10	30	4	40	3	3	10	-	-
17	10	5	2	30	15	3	20	10	5	-
18	3	10	10	5	20	30	2	10	10	-
2 19	15	10	30	5	5	15	-	5	15	-
20	10	15	15	10	20	5	10	10	5	-
Mean, Group 2	7.7	10.5	20.2	9	18.9	11.2	6.4	9.7	6.4	-
Mean, all teachers	7.2	9.7	18.6	7.9	16.2	13	7.2	13.3	6.9	-

IND. PUP. = INDIVIDUAL PUPIL

MULT. PUP. = MULTIPLE PUPIL

WHL. CLASS = WHOLE CLASS

(i) intellectualization about sociation and

(ii) intellectualization about organization

both with ranges of 0% to 10% (Table 13a).

The structural transaction with the highest range was: the teacher as the target of the whole class - a range of 1% to 55%. The structural transaction with the lowest range was: the teacher emitting to individual pupils - 0% to 18.5% (Table 13b).

What is the year-one teachers' overall perception of the teaching pattern of the lecturers? (Question 13).

The averaged teacher-perceptions of the lecturers' transactions were as follows:

For Functional transactions (Table 13a and Figure 38), the averaged perceptions of the teachers were that: the highest amount of lesson time was spent during the lecturers' teaching sessions on operation about the subject matter - 34.8% (subject matter of science teaching - 19.5%, subject matter of science - 15.3%), followed by:

(i) information dissemination about the subject matter - 18.6% (science teaching - 8.4%, science - 10.2%); and

(ii) intellectualization about the subject matter - 13.2% (science teaching - 7.5%, science - 5.7%).

For the other 6 functional transactions the averaged perceptions of the teachers showed that less than 10% of the lesson time was spent on each with the lowest amount of time being spent on intellectualization about sociation - 3.7%.

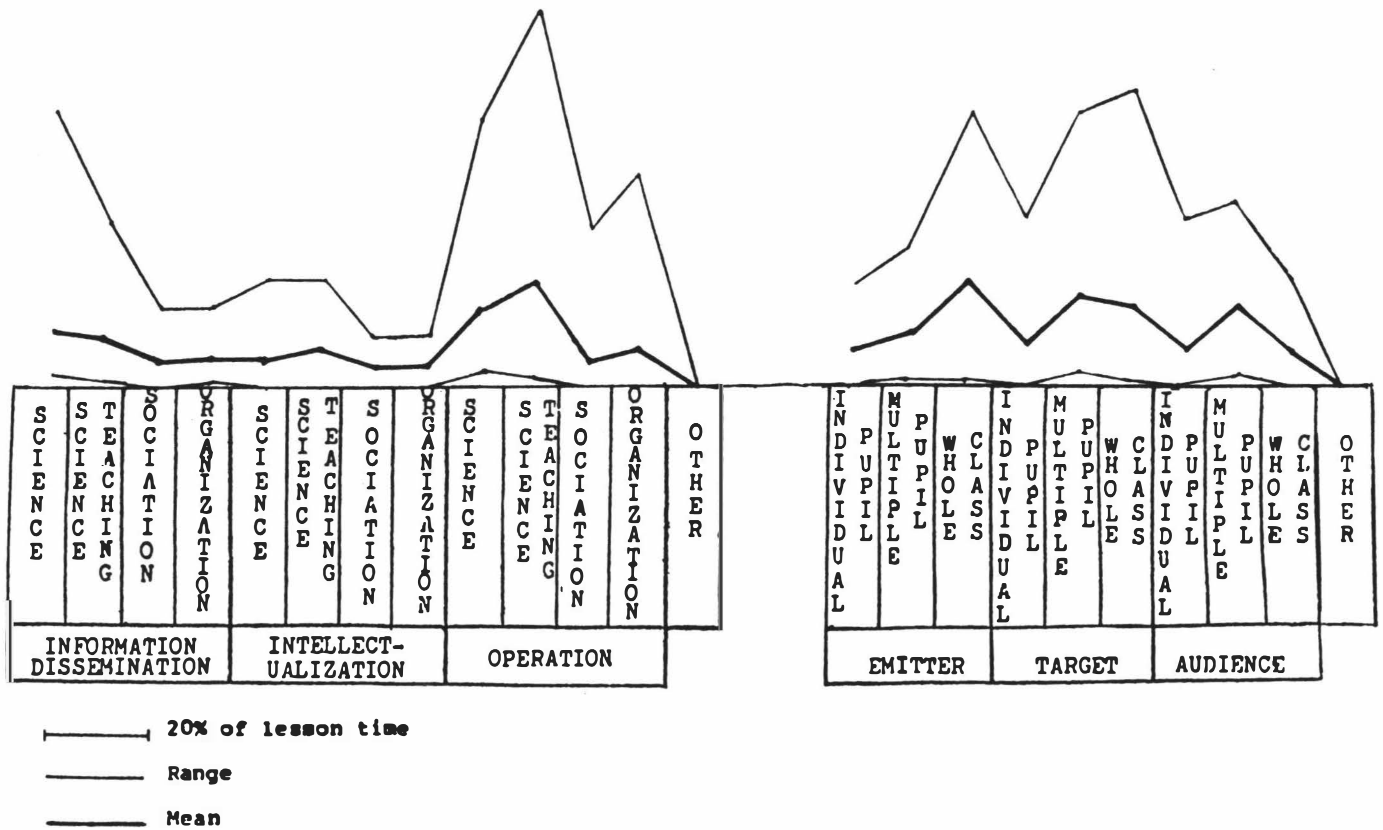
For structural transactions (Table 13b and Figure 38) the averaged perceptions of the teachers were that: the highest amount of lesson time was spent by the lecturers emitting to the whole class - 18.6%, followed by:

Figure 38

Teacher-perceptions of Lecturer-transactions: Range and Mean

a. Functional Transactions

b. Structural Transactions



(i) <u>the lecturers as the targets of multiple pupils</u> - 16.2%;

(ii) <u>the lecturers as audience to multiple pupils</u> - 13.3%; and

(iii) <u>the lecturers as the targets of the whole class</u> - 13%.

For the other 5 structural transactions the averaged perceptions of the teachers were that: <u>less than 10%</u> of the lesson time was spent by the lecturers on each with the <u>lowest</u> amount of time being spent by the lecturers' <u>being audience to the whole class</u> - 6.9%.

<u>On average, how do the teachers who received spaced curriculum training and those who received massed curriculum training perceive the actual teaching patterns of their respective lecturers?</u> (Question 14).

<u>Group 1</u> was taught by lecturers 1 and 5. Their averaged perceptions of the amounts of lesson time spent by lecturers 1 and 5 on the functional and structural aspects of science teaching are to be found in Tables 13a and 13b; and Figure 39 respectively.

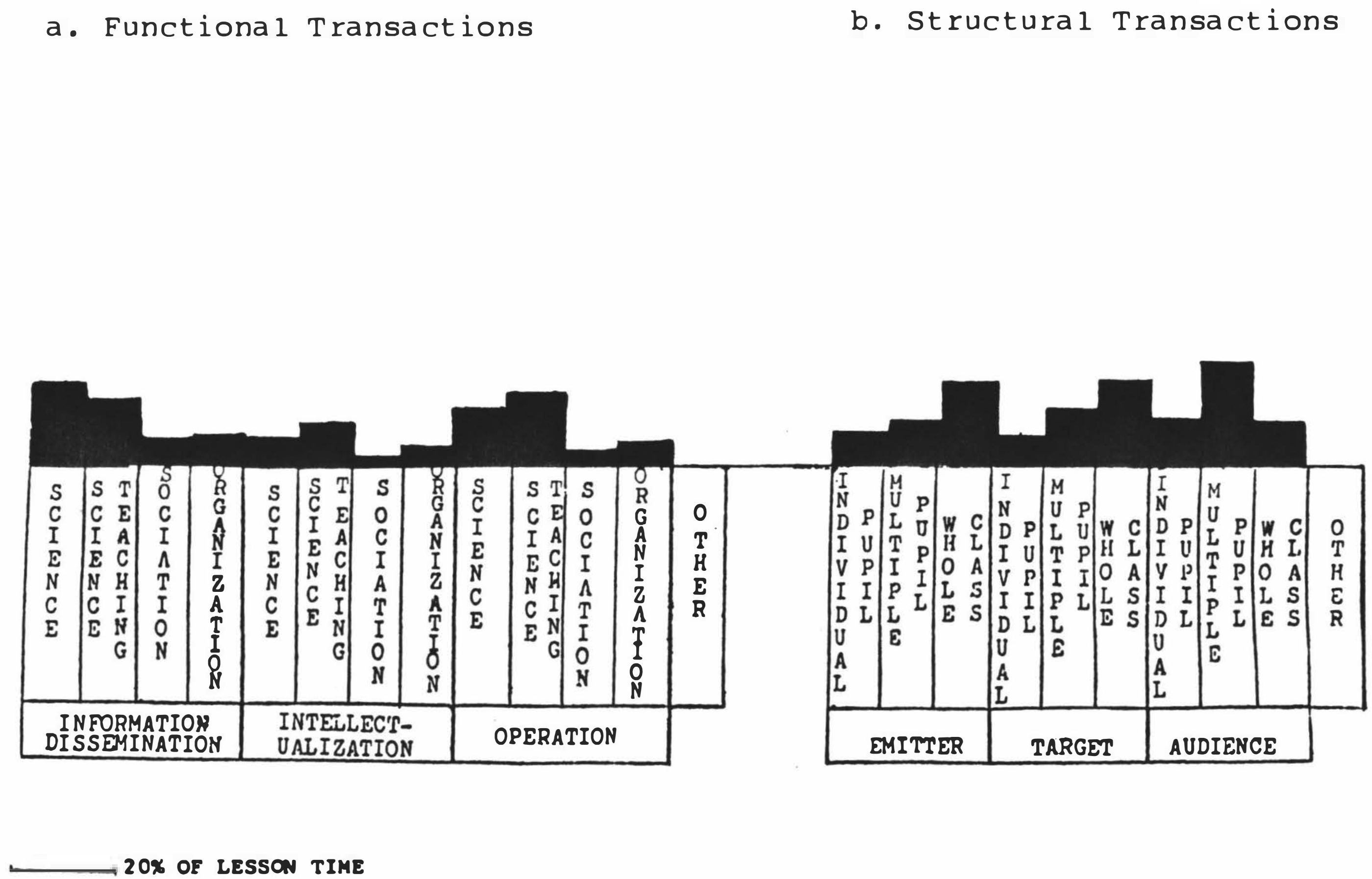
The results showed that for <u>functional transactions</u> (Table 13a and Figure 39) the averaged perceptions of group 1 were that: the <u>highest</u> amount of lesson time was spent during the sessions of their lecturers on <u>giving information about the subject matter</u> - 30.9% (science teaching - 14.2%, science - 16.7%), followed by:

(i) <u>operation about the subject matter</u> - 26.5% (science teaching - 14.6%, science - 11.9%); and

(ii) <u>intellectualization about the subject matter</u> - 14.6% (science teaching - 8.7%, science - 5.9%).

Figure 39

Perceived Lecturer-transactions: Group 1



For the other 6 functional transactions the averaged perceptions of group 1 were that: less than 10% of the lesson time was spent on each with the least amount of time being spent on intellectualization about sociation - 2.9%.

For structural transactions (Table 13b and Figure 39) the averaged perceptions of group 1 were that: the highest amount of lesson time was spent by the lecturers' being audience to multiple pupils - 20%, followed by:

(i) the lecturers as the targets of the whole class - 16.3%;

(ii) the lecturers emitting to the whole class - 15.7%; and

(iii) the lecturers as the targets of multiple pupils - 11%.

For the other 5 structural transactions the averaged perceptions of group 1 were that: less than 10% of the lesson time was spent by their lecturers on each with the lowest amount of time being spent on the lecturers' being the targets of individual pupils - 6%.

Group 2 was taught by 4 of the 5 lecturers (lecturers 1 - 4). Their averaged perceptions of the amounts of lesson time spent by these lecturers on the functional and structural aspects of science teaching are to be found in Tables 13a and 13b; and Figure 40 respectively.

The results showed that for functional transactions (Table 13a and Figure 40), the averaged perceptions of group 2 were that: the highest amount of lesson time was spent during the teaching sessions of their lecturers on operation about the subject matter - 39.3% (science teaching - 22.1%, science - 17.2%), followed by:

(i) intellectualization about the subject matter - 12.3% (science teaching - 6.8%, science - 5.5%);

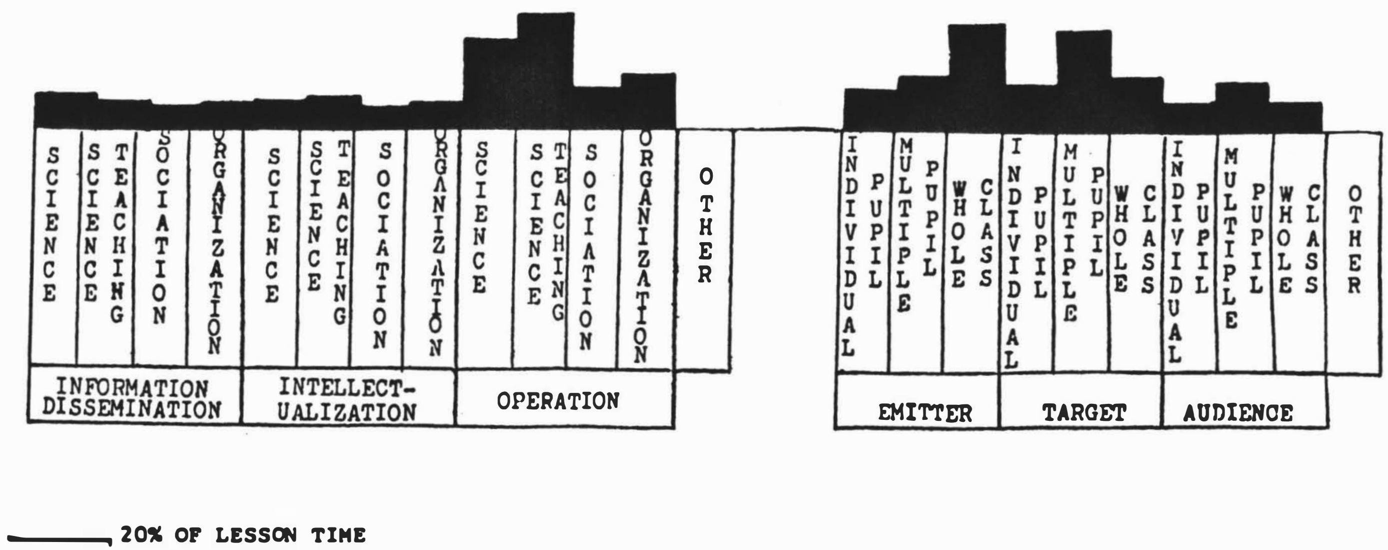
(ii) information dissemination about the subject matter - 12% (science teaching - 5.3%, science 6.7%; and

Figure 40

Perceived Lecturer-transactions: Group 2

a. Functional Transactions

b. Structural Transactions



(iii) operation about organization - 10.5%.

For the other 5 functional transactions the averaged perceptions of group 2 were that: less than 10% of the lesson time was spent on each with the lowest amount of time being spent on intellectualization about sociation - 4.1%.

For structural transactions (Table 13b and Figure 40), the averaged perceptions of group 2 were that: the highest amount of lesson time was spent by their lecturers emitting to the whole class - 20.2%, followed by:

(i) the lecturers as the targets of multiple pupils - 18.9%;

(ii) the lecturers as the targets of the whole class - 11.2%; and

(iii) the lecturers emitting to multiple pupils - 10.5%.

For the other 5 structural transactions the averaged perceptions of group 2 were that: less than 10% of the lesson time was spent by the lecturers on each with the lowest amount of time being spent on:

(i) the lecturers' being audience to individual pupils and

(ii) being audience to the whole class - both 6.4%.

How does the teachers' overall perception of the actual teaching pattern of the lecturers compare with the overall teaching pattern of the lecturers? (Question 15).

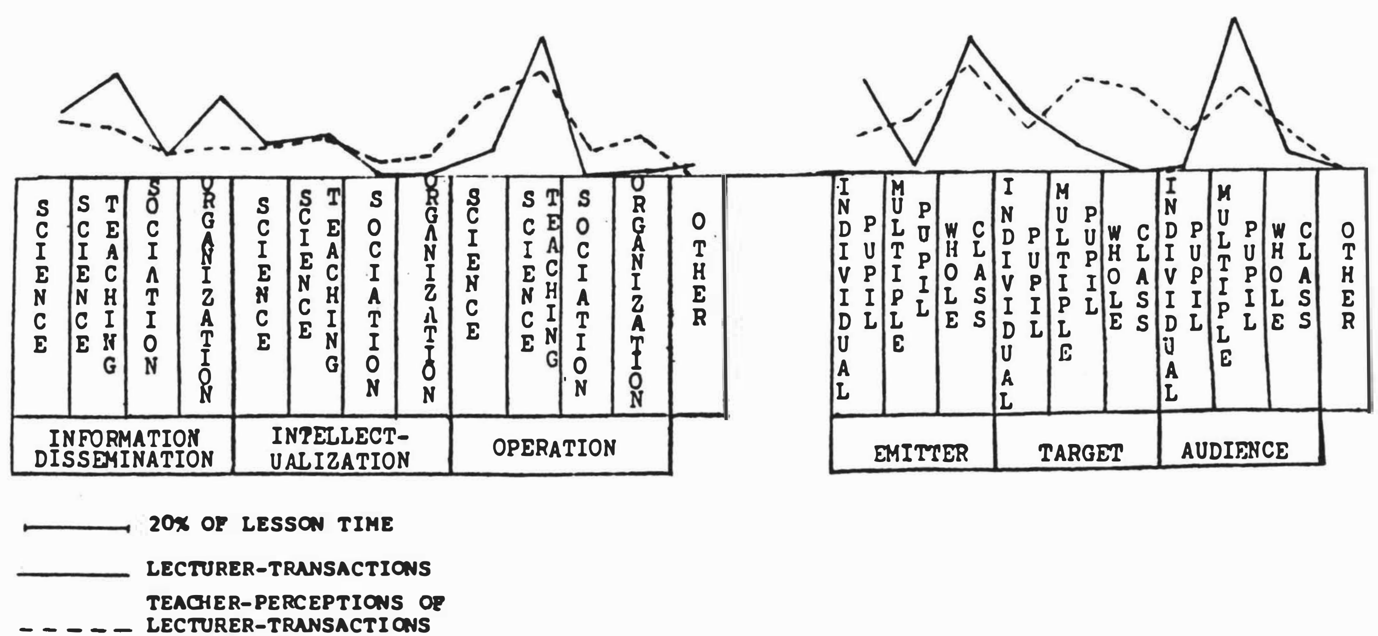
For functional transactions (Figure 41), the results showed that the overall (averaged) perceptions of the teachers bore close resemblances to the averaged transactions which took place during the lecturers' teaching sessions in 6 cases, and differed appreciably from the averaged transactions of the lecturers in 6 cases.

Figure 41

Perceived versus Actual Lecturer-transactions: All Teachers

a. Functional Transactions

b. Structural Transactions



For 3 functional transactions the averaged perceptions of the teachers were appreciably higher than the averaged times spent during their lecturers' teaching sessions:

(i) operation about the subject matter of science: perceived time - 15.3% of the lesson time, lecturers' time - 3.9%;

(ii) operation about sociation: perceived time - 6%, lecturers' time - 0%; and

(iii) operation about organization: perceived time - 8.4%, lecturers' time - 1.1% (Tables 13a and 11a respectively).

Also, for 3 functional transactions the averaged perceptions of the teachers were appreciably lower than the averaged times spent during the lecturers' teaching sessions:

(i) information dissemination about the subject matter of science teaching: perceived time - 8.4%, lecturers' time - 20.7%;

(ii) information dissemination about organization: perceived time - 5.9%, lecturers' time - 15.2%;

(iii) operation about the subject matter of science teaching: perceived time - 19.5%, lecturers' time - 25.6%.

Despite these variations, however, the teachers did perceive that, during the teaching sessions of the lecturers, the highest amount of lesson time was spent on operation about science teaching, and that less than 10% of the lesson time was spent on:

(i) information dissemination about sociation;
(ii) intellectualization about science;
(iii) intellectualization about science teaching;
(iv) intellectualization about sociation;
(v) intellectualization about organization;
(vi) operation about sociation; and
(vii) operation about organization.

For structural transactions (Figure 41) the averaged perceptions of the teachers showed appreciable variations from the averaged times of the lecturers for 6 of the 9 transactions.

For 4 structural transactions the averaged perceptions of the teachers were appreciably higher than the averaged times of the lecturers (Tables 13b and 11b respectively):

(i) the teacher emitting to multiple pupils: perceived time - 9.7%, lecturers' time - 1.7%;

(ii) the teacher as the target of multiple pupils: perceived time - 16.2%, lecturers' time - 5.3%;

(iii) the teacher as the target of the whole class: perceived time - 13%, lecturers' time - 0.1%;

(iv) the teacher as audience to individual pupils: perceived time - 7.2%, lecturers' time - 1.2%.

For 2 structural transactions the averaged perceptions of the teachers were appreciably lower than the averaged times of the lecturers:

(i) the teacher emitting to individual pupils: perceived time - 7.2%, lecturers' time - 19.2%;

(ii) the teacher as audience to multiple pupils: perceived time - 13.3%, lecturers' time - 28.9%.

How do the averaged teaching patterns of the lecturers of teachers who received spaced curriculum training and those who received massed curriculum training compare with the respective group-perceptions of these transactions? (Question 16).

Group 1 received their training over a period of 2 years.

They were taught by *lecturers 1 and 5. The amounts of lesson time spent by lecturers 1 and 5 on the functional and structural aspects of science teaching are to be found in Tables 11a and 11b respectively.

For group 1, the averaged group-perceptions of the amounts of time spent on functional transactions during the teaching sessions of lecturers 1 and 5 showed close resemblances to the averaged transactions of these lecturers in 7 cases and varied significantly in 5 cases. (Figure 42).

For 2 functional transactions the times perceived by group 1 were significantly higher than the averaged times of lecturers 1 and 5:

(i) <u>information dissemination about science</u> - group perception - 16.7%, lecturers' time - 10.6%;

(ii) <u>operation about science</u> - group-perception - 11.9%, lecturers' time - 3.7%.

For 3 functional transactions the times perceived by group 1 were appreciably lower than the averaged times of lecturers 1 and 5:

(i) <u>information dissemination about science teaching</u> - group perception - 14.2%, lecturers' time - 20%;

(ii) <u>information dissemination about organization</u> - group-perception - 6.9%, lecturers' time - 11.2%; and

(iii) <u>operation about science teaching</u> - group perception - 14.6%, lecturers' time - 26.0%.

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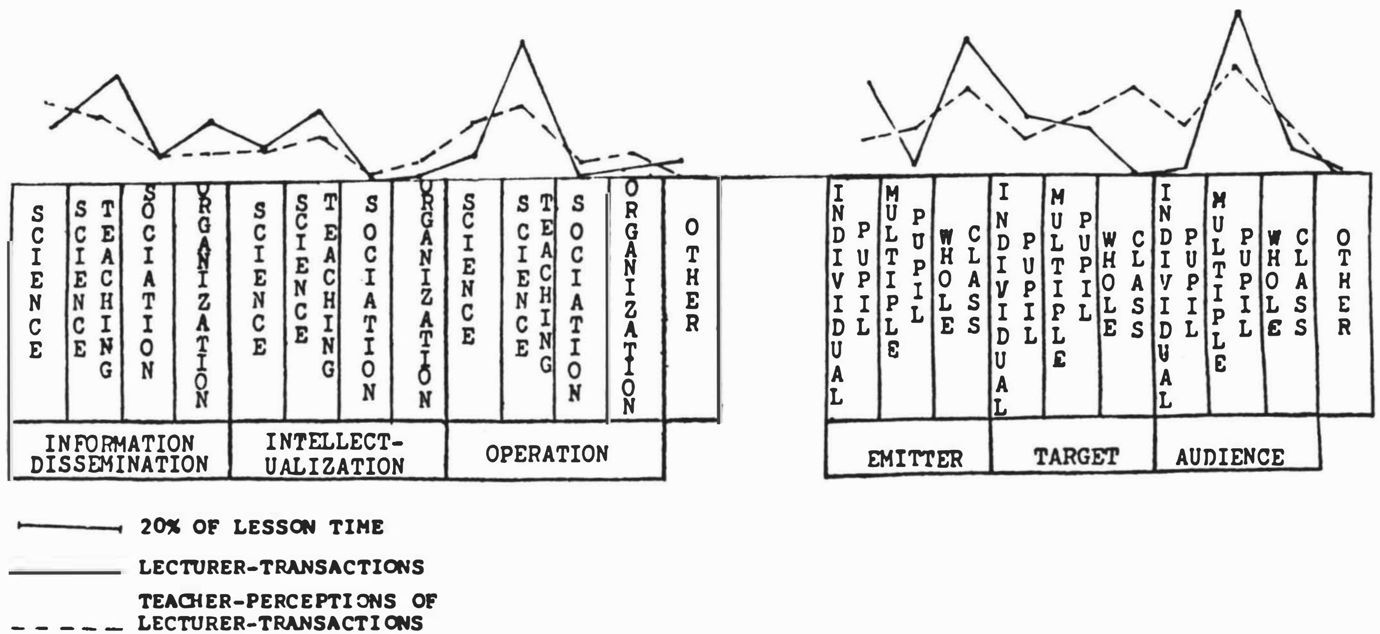
* Group 1 (science-specialists), who were taught by lecturers 1 and 5, received their science curriculum training over a period of 2 years. Since this study was conducted during the final 6 weeks of their curriculum training, the patterns of teaching used "on" these teachers were obtained by interviewing lecturers 1 and 5. Both lecturers reported that their average teaching patterns for the science-specialists were the same as their average functional and structural patterns for non-science-specialists -- obtained from the researchers' observation and analysis of teaching sessions and record-in Tables 11a and 11b respectively.

Figure 42

Perceived versus Actual Lecturer-transactions: Group 1

a. Functional Transactions

b. Structural Transactions



<u>For structural transactions</u> (Figure 42), the averaged group-perceptions of the structural times of lecturers 1 and 5 varied significantly from the averaged times of these lecturers in 6 of the 9 cases.

For 3 structural transactions the perceived times of group 1 were significantly higher than the averaged amounts of lesson time spent by lecturers 1 and 5:

(i) <u>the teacher emitting to multiple pupils</u>: group-perception - 8.1%, lecturers' time - 2.1%.

(ii) <u>the teacher as the target of the whole class</u>: group-perception - 16.3%, lecturers' time - 0.2%;

(iii) <u>the teacher as audience to individual pupils</u>: group perception - 8.6%, lecturers' time - 1.7%.

For 3 structural transactions the times perceived by group 1 were appreciably lower than the amounts of lesson time spent by lecturers 1 and 5 on these transactions:

(i) <u>the teacher emitting to individual pupils</u>: group-perception - 6.3%, lecturers' time - 17.6%;

(ii) <u>the teacher emitting to the whole class</u>: group-perception - 15.7%, lecturers' time - 25.6%; and

(iii) <u>the teacher as audience to multiple pupils</u> - perceived time of group 1 - 20%, lecturers' time - 28.8%.

Despite the disparities between the group-perceptions of the structural behaviours of lecturers 1 and 5, and the averaged structural behaviours of these lecturers, the members of group 1 did perceive that:

(i) The <u>highest</u> amount of lesson time for structural transactions was spent by the 2 lecturers <u>as audience to multiple pupils</u> (group-perception - 20%, lecturers' time - 28.8%.

(ii) More than 15% of the lesson time was spent by the lecturers <u>emitting to the whole class</u> (groups-perception - 15.7%, lecturers' time - 25.6%).

(iii) More time was spent by the lecturers emitting to the whole class than:

- emitting to multiple pupils;
- being the targets of individual pupils;
- being the targets of multiple pupils;
- being audience to individual pupils; and
- being audience to the whole class (Figure 42).

Group 2 was taught by lecturers 1 - 4. The averaged amounts of time spent during the teaching sessions of these lecturers on the functional and structural aspects of science teaching are to be found in Tables 11a and 11b respectively.

For functional transactions (Figure 43), the averaged perceptions of the members of Group 2 showed close resemblances to the averaged times spent during the teaching sessions of lecturers 1 - 4 in 6 cases and showed appreciable variations in 6 cases.

For 3 functional transactions the averaged perceptions of group 2 were appreciably higher than the averaged times spent during their lecturers' teaching sessions:

(i) operation about the subject matter of science: perceived time - 17.2%, lecturers' time - 4.8%;

(ii) operation about sociation: perceived time - 7.5%, lecturers' time - 0%;

(iii) operation about organization: perceived time - 10.5%, lecturers' time - 1.0%.

For 3 functional transactions the averaged perceptions of group 2 were appreciably lower than the averaged amounts of time spent during their lecturers' teaching sessions:

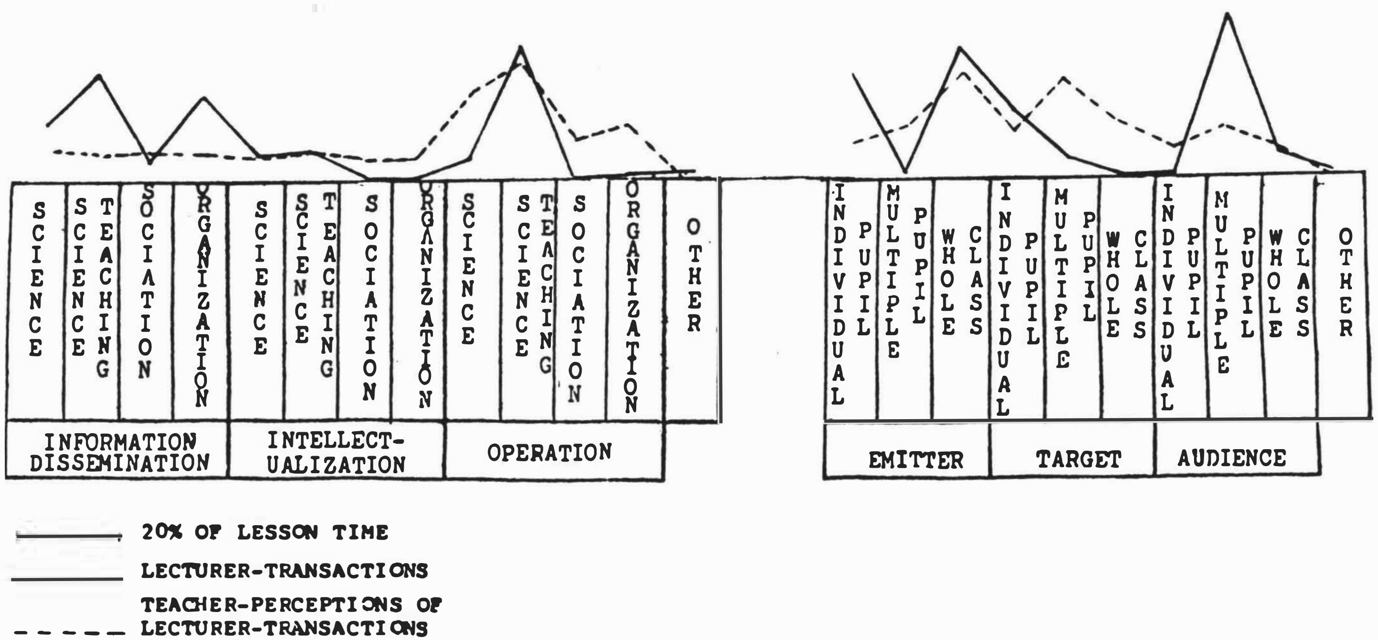
(i) information dissemination about the subject matter of science: perceived time - 6.7%, lecturers' time - 12.3 %;

Figure 43

Perceived versus Actual Lecturer-transactions: group 2

a. Functional Transactions

b. Structural Transactions



(ii) information dissemination about the subject matter of science teaching: perceived time - 5.3%, lecturers' time - 21.1%;

(iii) information dissemination about organization: perceived time - 5.3%, lecturers' time - 17.1%.

For structural transactions (Figure 43), the averaged perceptions of group 2 showed appreciable variations from the averaged times of their lecturers for 6 of the 9 transactions. However, group 2 did perceive that:

(i) More time was spent by their lecturers emitting to the whole class than:

- emitting to individual pupils, and
- emitting to multiple pupils.

(ii) More time was spent by their lecturers as audience to multiple pupils than:

- as audience to individual pupils, and
- as audience to the whole class.

(iii) Less than 10% of the lesson time was spent by their lecturers:

- as audience to individual pupils, and
- as audience to the whole class.

PART C

TEACHER-PERCEPTIONS OF THE TEACHING PATTERNS OF THEIR "PRE-COLLEGE" SCIENCE TEACHERS

What are the individual teacher-perceptions of the instructional patterns of their science teachers prior to Teachers College? (Question 17).

Individual teacher-perceptions of the instructional times of their "pre-college" science teachers are to be found in Table 14. Graphic representations of these results are to be found in Appendix L.

The results showed wide ranges in teacher-perceptions of the instructional behaviours of their "pre-college" science teachers for certain functional and structural transactions (Figure 44).

The functional transaction with the widest range was - information dissemination about the subject matter of science - a range of 10% to 95% of the total lesson time.

The functional transaction with the lowest range was operation about sociation - 0% to 5%.

The structural transaction with the widest range was the teacher emitting to the whole class - 20% to 100%.

The structural transactions with the lowest ranges were:

(i) the teacher as the target of individual pupils - 0% to 10%;

(ii) the teacher as audience to individual pupils - 0% to 10%; and

(iii) the teacher as audience to the whole class - 0% to 10%.

What are the overall teacher-perceptions of the transactional times of their science teachers prior to Teachers College? (Question 18).

The overall teacher-perceptions of the functional and structural transactional times of their "pre- college" science teachers are to be found in Tables 14a and 14b; and Figure 44 respectively.

TABLE 14a

TEACHER-PERCEPTIONS OF "PRE-COLLEGE" TEACHERS' FUNCTIONAL TRANSACTIONS

		% TIME									
		INFORMATION DISSEMINATION			INTELLECTUALIZATION			OPERATION			OTHER
TEACHERS:		SC.	SOC.	ORG.	SC.	SOC.	ORG.	SC.	SOC.	ORG.	
G	1	50	20	10	2	3	0	3	2	10	-
R	2	40	10	10	5	0	5	20	5	5	-
O	3	65	2	3	8	1	1	16	2	2	-
U	4	30	15	15	10	2	3	15	5	5	-
P	5	60	10	10	6	2	2	8	1	1	-
	6	45	10	5	20	3	7	5	2	3	-
1	7	40	5	5	30	5	5	6	2	2	-
Mean, Group 1		47.1	10.3	8.3	11.6	2.3	3.3	10.4	2.7	4	-
	8	30	5	15	20	5	5	10	5	5	-
G	9	10	5	5	10	5	5	40	5	15	-
	10	20	10	10	20	10	10	10	5	5	-
R	11	30	20	10	15	10	5	2	4	4	-
O	12	60	5	15	8	1	1	7	1	2	-
	13	25	5	10	10	10	10	20	5	5	-
U	14	30	10	10	32	3	5	5	2	3	-
	15	30	10	20	5	3	2	20	5	5	-
P	16	95	0	0	5	0	0	0	0	0	-
	17	60	5	5	5	2	3	14	3	3	-
	18	80	0	20	0	0	0	0	0	0	-
2	19	35	5	10	20	5	0	25	0	0	-
	20	15	5	10	20	5	10	15	5	15	-
Mean, Group 2		40.0	6.5	10.8	13.1	4.5	4.3	12.9	3.1	4.8	-
Mean, all teachers		42.5	7.9	9.9	12.6	3.8	3.8	12.1	2.9	4.5	-

SC. = SCIENCE
SOC. = SOCIATION
ORG. = ORGANIZATION

TABLE 14b

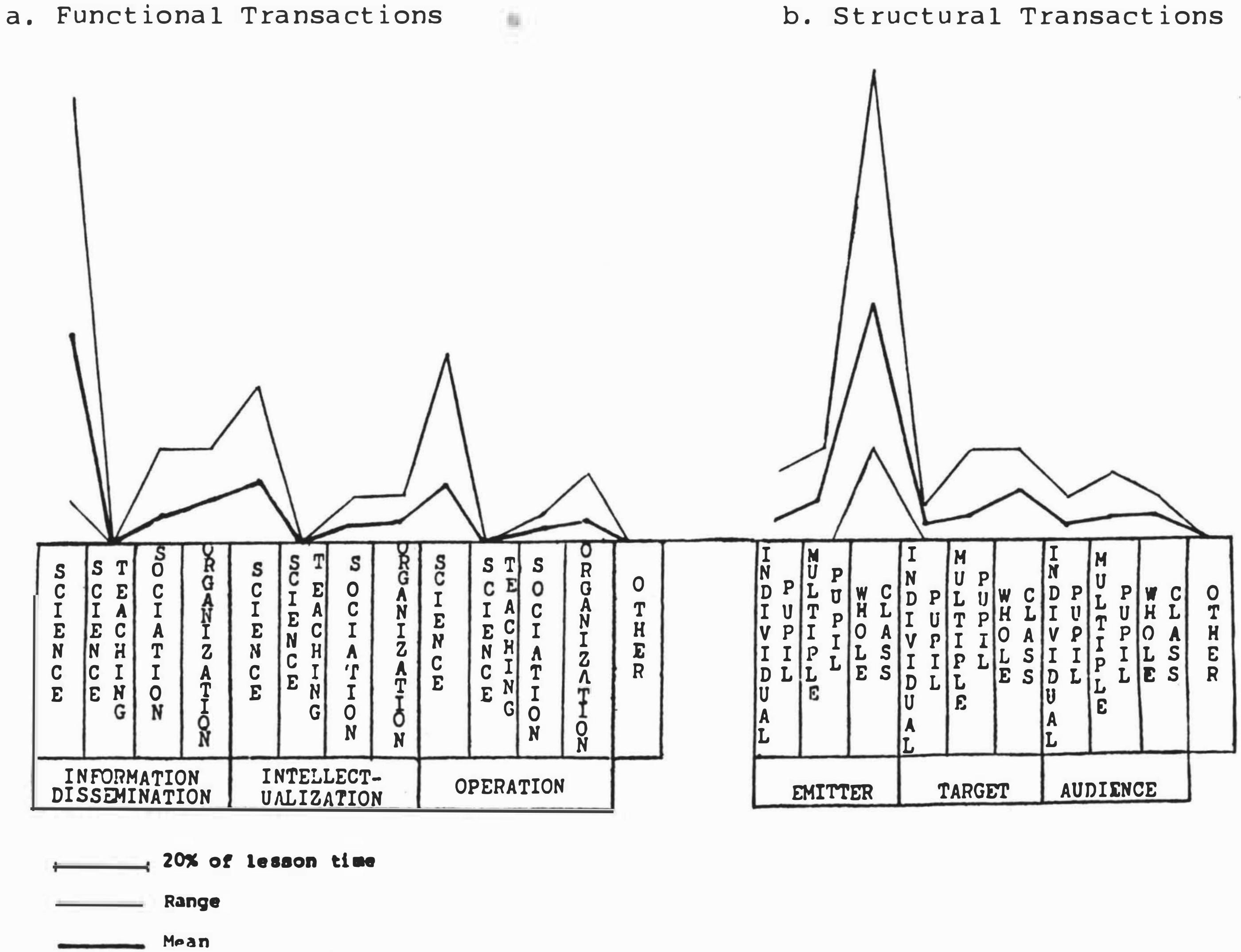
TEACHER-PERCEPTIONS OF "PRE-COLLEGE" TEACHERS' STRUCTURAL TRANSACTIONS

		% TIME									
		EMITTER			TARGET			AUDIENCE			OTHER
	TEACHERS:	IND. PUP.	MULT. PUP.	WHL. CLASS	IND. PUP.	MULT. PUP.	WHL. CLASS	IND. PUP.	MULT. PUP.	WHL. CLASS	
G	1	15	10	40	5	5	5	10	5	5	-
R	2	7	20	45	2	5	10	1	5	5	-
O	3	4	10	70	0.5	4	9	0.5	1	1	-
U	4	10	10	30	5	15	15	5	5	5	-
P	5	8	6	60	1	2	10	1	2	10	-
	6	10	10	30	8	8	20	2	2	10	-
1	7	8	10	50	1	5	10	1	5	10	-
	Mean, Group 1:	8.9	10.9	46.4	3.2	6.3	11.3	2.9	3.6	6.5	-
	8	3	10	50	1	10	10	1	5	10	-
G	9	10	15	20	5	20	5	5	15	5	-
	10	15	15	20	5	10	15	10	5	5	-
R	11	6	15	45	2	9	10	2	6	5	-
	12	2	4	60	6	4	10	2	2	10	-
O	13	7	7.5	20	7	7.5	20	6	15	10	-
U	14	0	3	65	3	8	15	2	4	0	-
	15	6	8	70	1	2	10	1	2	0	-
P	16	1	4	90	0	0	5	0	0	0	-
	17	2	5	78	0.5	1	10	0.5	1	2	-
	18	0	0	100	0	0	0	0	0	0	-
2	19	5	20	40	0	20	5	0	5	5	-
	20	10	10	25	10	15	10	5	5	10	-
	Mean, Group 2:	5.2	8.9	52.5	3.1	8.2	9.6	2.7	5.0	4.8	-
	Mean, all teachers:	6.5	9.6	50.4	3.2	7.5	10.2	2.7	4.5	5.4	-

IND. PUP. = INDIVIDUAL PUPIL
MULT. PUP. = MULTIPLE PUPIL
WHL. CLASS = WHOLE CLASS

Figure 44

Teacher-perceptions of School Teachers' Transactions: Range and Mean



The results showed that, for functional transactions, the averaged perceptions of the teachers were that:

(i) 42.5% of the lesson time was spent on information dissemination about the subject matter of science;

(ii) 12.6% of the lesson time was spent on intellectualization about the subject matter of science;

(iii) 12.1% of the lesson time was spent on operation about science;

(iv) Less than 10% of the lesson time was spent on each of the other 6 functional transactions with the least amount of time being spent on operation about sociation - 2.9% .

The averaged perceptions of the teachers showed that the structural transaction on which the highest amount of lesson time was spent during the teaching sessions of their "pre-college" science teachers was:

- the teacher emitting to the whole class - 50.4%; followed by
- the teacher as the target of the whole class - 10.2%.

For the other 7 structural transactions the averaged teacher-perceptions were that: less than 10% of the lesson time was spent on each with the least amount of time being spent on the teacher as audience to individual pupils - 2.7%.

On the average, how do the teachers who received spaced curriculum training and those who received massed curriculum training perceive the instructional patterns of their science teachers prior to Teachers College? (Question 19)

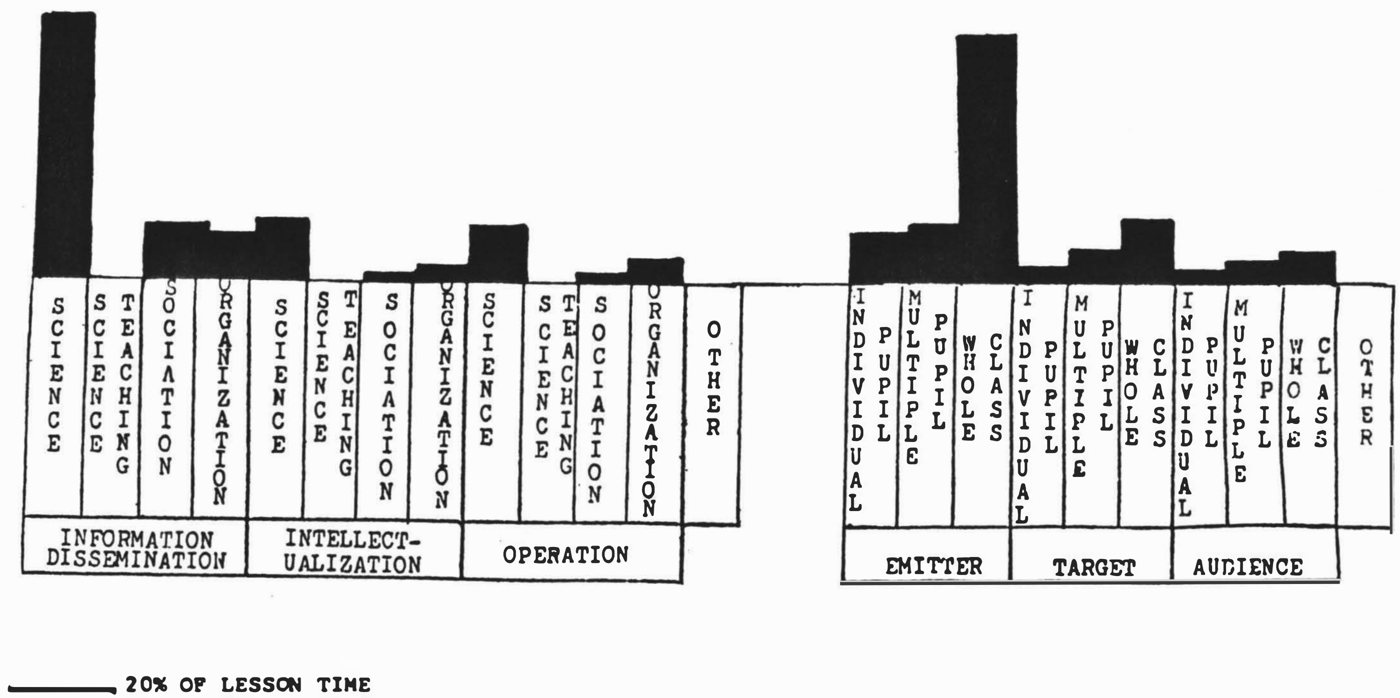
For Group 1 (teachers who received spaced curriculum training) the results showed that for functional transactions (Table 14a and Figure 45), the averaged perceptions of the group were that: the highest amount of lesson time was spent during the teaching sessions of the "pre-college" science teachers on information dissemination about the subject matter of science - 47.1%, followed by:

Figure 45

Perceived School Teachers' Transactions: Group 1

a. Functional Transactions

b. Structural Transactions



(i) intellectualization about the subject matter of science - 11.6%;

(ii) operation about the subject matter of science - 10.4%; and

(iii) information dissemination about sociation - 10.3%.

For the other 5 functional transactions the averaged perceptions of group 1 were that: less than 10% of the lesson time was spent on each with the least amount of time being spent on intellectualization about sociation" - 2.3%.

For structural transactions (Table 14b and Figure 45), the averaged perceptions of group 1 were that: the highest amount of lesson time was spent by their "pre-college" science teachers emitting to the whole class -46.4%, followed by:

(i) the teachers as the targets of the whole class - 11.3%; and

(ii) the teachers emitting to multiple pupils - 10.9%.

For the other 6 structural transactions the averaged perceptions of group 1 were that: less than 10% of the lesson time was spent on each with the least amount of time being spent by the teachers as audience to individual pupils - 2.9%.

Group 2:

For functional transactions (Table 14a and Figure 46.1), the averaged group-perceptions were that, during the sessions of their "pre-college" science teachers, the highest amount of time was spent on information dissemination about the subject matter of science - 40%, followed by:

(i) intellectualization about science - 13.1%;

(ii) operation about science - 12.9%; and

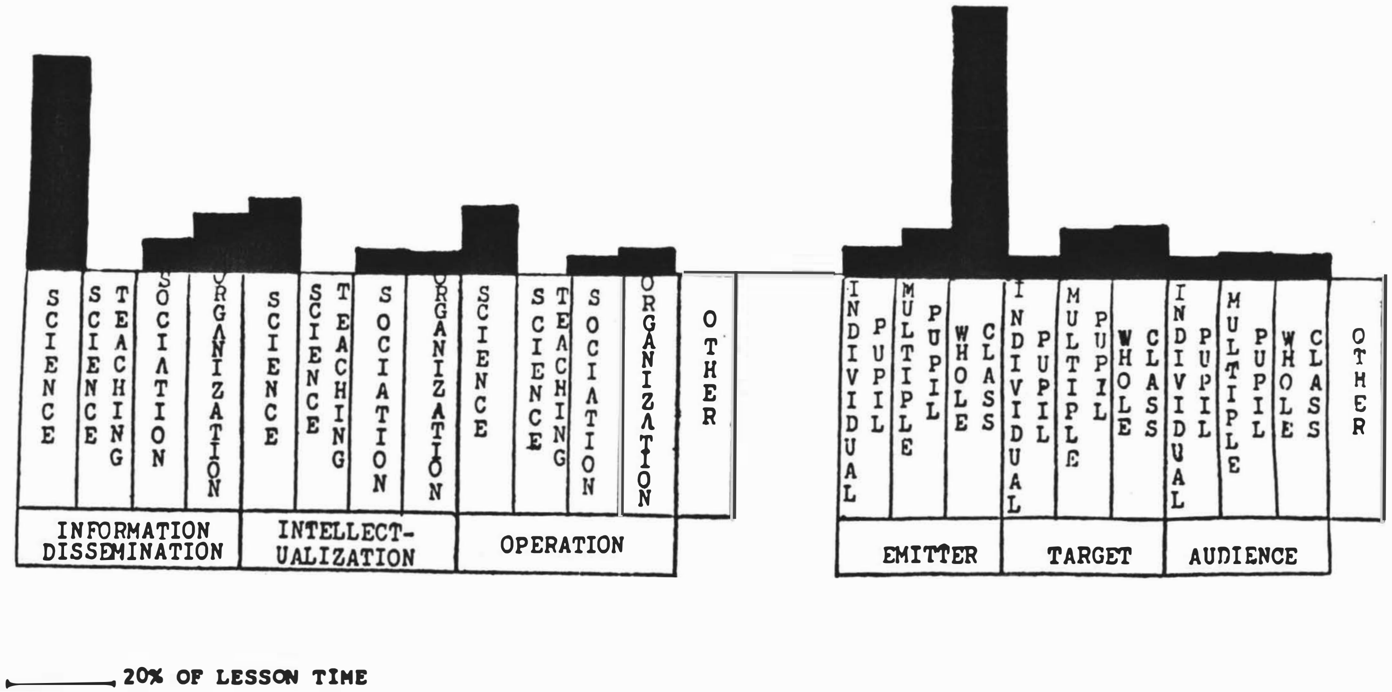
(iii) information dissemination about organization - 10.8%.

Figure 46.1

Perceived School Teachers' Transactions: Group 2

a. Functional Transactions

b. Structural Transactions



For the other 5 functional transactions the averaged perceptions of group 2 were that: less than 10% of the lesson time was spent on each with the least amount of time being spent on - operation about sociation - 3.1%.

For structural transactions (Table 14b and Figure 46.1), the averaged group-perceptions were that: 52.5% of the lesson time was spent by the teachers emitting to the whole class while less than 10% of the lesson time was spent on each of the other 8 transactions with the least amount of time being spent by the teachers as audience to individual pupils - 2.7%.

How do the averaged teaching patterns of the "pre-college" science teachers as perceived by the "massed-trained" teachers and by the "spaced - trained" teachers compare with each other? (Question 20)

Compared with each other the averaged group perceptions of the patterns of teaching employed by their "pre-college" science teachers were almost identical (Figure 46.2). The averaged perceptions of groups 1 and 2 revealed that for functional transactions the highest amount of lesson time was spent on information dissemination about the subject matter of science (47.1% and 40% for groups 1 and 2 respectively), followed by:

(i) intellectualization about science (11.6% and 13.1% respectively), and

(ii) operation about science (10.4% and 12.9% respectively), while less than 10% of the lesson time was spent on

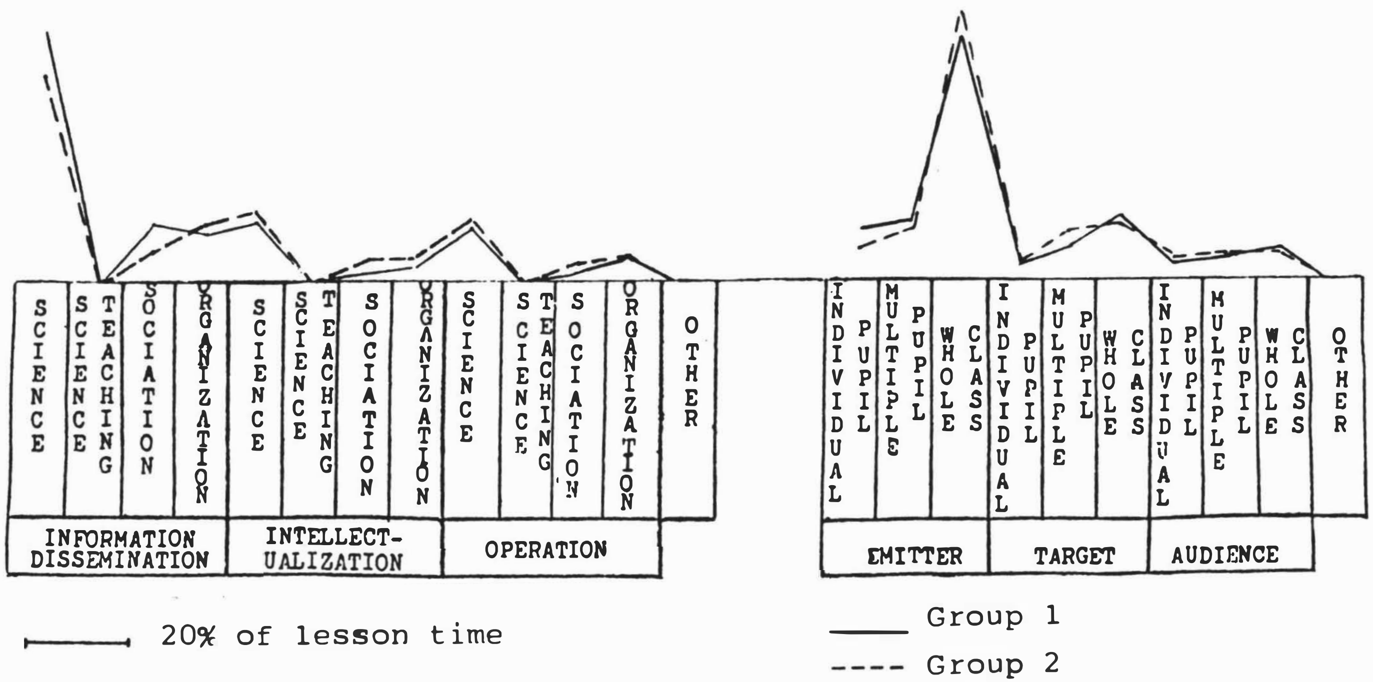
- intellectualization about sociation,
- intellectualization about organization,
- operation about sociation, and
- operation about organization.

Figure 46.2

Perceived School Teachers' Transactions: Groups 1 and 2

a. Functional Transactions

b. Structural Transactions



For structural transactions the averaged perceptions of groups 1 and 2 were that: the highest amount of lesson time was spent by their "pre-college" teachers emitting to the whole class (46.4% and 52.5% for groups 1 and 2 respectively), followed by:

(i) the teachers as the targets of the whole class (11.3% and 9.6% respectively); and

(ii) the teachers emitting to multiple pupils (10.9% and 8.9% respectively).

For the other 6 structural transactions the averaged perceptions of both groups of teachers were that: less than 9% of the lesson time was spent on each with the least amount of time being spent by the teachers as audience to individual pupils (2.9% and 2.7% respectively).

PART D

TEACHER-PERCEPTIONS OF THE INSTRUCTIONAL PATTERNS APPROPRIATE FOR THE TEACHING OF ELEMENTARY SCIENCE

What are the individual teacher-perceptions of the teaching patterns that are appropriate for the teaching of elementary science? (Question 21).

Individual teacher-perceptions of the transactional times that are appropriate for the teaching of elementary science are to be found in Tables 15a and 15b. Graphic representations of these results are to be found in Appendix M.

The results showed wide ranges in idividual teacher-perceptions of the functional and structural times that are appropriate for elementary science teachers - Figure 47.

TABLE 15a

FIRST-YEAR TEACHERS: RECOMMENDED FUNCTIONAL TIME

	% TIME									
	INFORMATION DISSEMINATION			INTELLECTUALIZATION			OPERATION			OTHER
TEACHERS:	SC.	SOC.	ORG.	SC.	SOC.	ORG.	SC.	SOC.	ORG.	
G 1	11	2	2	15	9	1	35	15	10	-
R 2	10	5	5	10	5	5	40	10	10	-
O 3	16	2	2	27	1	2	45	2	3	-
U 4	6	4	5	10	7	8	20	20	20	-
P 5	10	12	8	10	5	5	30	10	10	-
6	5	2	3	20	10	20	20	5	15	-
1 7	10	10	5	15	5	5	35	10	5	-
Mean, Group 1	9.7	5.3	4.3	15.3	6.0	6.6	32.1	10.3	10.4	-
G 8	5	3	2	10	5	5	60	5	5	-
9	5	5	10	10	5	5	40	10	10	-
R 10	7	8	15	10	15	25	2	3	15	-
11	8	6	6	20	9	16	15	10	10	-
O 12	2	2	6	8	3	4	60	5	10	-
U 13	10	5	5	15	10	5	35	10	5	-
14	7	4	4	22	10	3	25	20	5	-
P 15	10	5	5	15	3	2	60	0	0	-
16	30	5	5	15	2.5	2.5	30	5	5	-
17	2	1	2	20	2	3	65	3	2	-
2 18	1	2	2	5	5	5	40	40	0	-
19	15	5	5	25	10	5	20	10	5	-
20	10	5	5	15	10	10	25	5	15	-
Mean, Group 2	8.6	4.2	5.5	14.6	7.0	7.0	36.7	9.7	6.7	-
Mean, all teachers	9.0	4.7	5.0	14.9	6.6	6.8	35.1	9.9	8.0	-

SC. = SCIENCE
SOC. = SOCIATION
ORG. = ORGANIZATION

TABLE 15b

FIRST-YEAR TEACHERS: RECOMMENDED STRUCTURAL TIME

		% TIME									
		EMITTER			TARGET			AUDIENCE			OTHER
TEACHERS:		IND. PUP.	MULT. PUP.	WHL. CLASS	IND. PUP.	MULT. PUP.	WHL. CLASS	IND. PUP.	MULT. PUP.	WHL. CLASS	
G	1	5	10	10	30	10	5	15	10	5	-
R	2	5	5	1	5	10	3	15	55	1	-
O	3	4	10	45	3	5	15	3	5	10	-
U	4	15	15	10	15	15	8	10	10	2	-
P	5	5	10	15	10	20	10	5	20	5	-
	6	5	10	5	15	40	10	5	10	0	-
1	7	5	10	10	15	30	10	5	10	5	-
Mean, Group 1		6.3	10.0	13.7	13.3	18.6	8.7	8.3	17.1	4.0	-
	8	5	5	10	10	30	15	5	15	5	-
G	9	15	15	20	10	10	10	5	5	10	-
	10	10	5	10	30	5	3	20	15	2	-
R	11	10	6	8	10	10	10	20	14	12	-
O	12	5	10	5	10	40	10	5	10	5	-
	13	20	10	10	20	10	5	10	10	5	-
U	14	10	12.5	8	22	25	7	8	7.5	0	-
	15	10	10	15	10	20	15	0	20	0	-
P	16	5	30	20	13	10	9	2	10	1	-
	17	5	5	1	15	15	2	40	15	2	-
	18	3	1	20	8	2	50	4	2	10	-
2	19	15	5	20	10	10	20	0	10	10	-
	20	10	15	10	15	15	15	5	10	5	-
Mean, Group 2:		9.5	10.0	12.1	14.1	15.5	13.2	9.5	11.0	5.2	-
Mean, all Teachers:		8.4	9.9	12.7	13.8	16.6	11.6	9.1	13.1	4.8	-

IND. PUP. = INDIVIDUAL PUPIL
MULT. PUP. = MULTIPLE PUPIL
WHL. CLASS = WHOLE CLASS

The functional transaction with the widest range was - operation about science - a range of 2% to 65% of the total lesson time, while the functional transaction with the lowest range was - information dissemination about sociation - 1% to 12%.

The structural transaction with the widest range was: the teacher as audience to multiple pupils - 2% to 55%. The one with the lowest range was - the teacher as audience to the whole class - 0% to 12%.

What is the overall teacher-perception of the instructional pattern that is appropriate for the teaching of elementary science? (Question 22).

The averaged teacher-perceptions of the amounts of lesson time that should be spent on the functional and structural aspects of elementary science teaching are to be found in Tables 15a and 15b; and Figure 47 respectively.

The results showed that for functional transactions, the averaged recommendations of the teachers were that: the highest amount of lesson time should be spent on operation about science - 35.1%, followed by:

(i) intellectualization about science - 14.9%.

For the other 7 functional transactions the averaged recommendations of the teachers were that: less than 10% of the lesson time should be spent on each with the least amount of time being spent on information dissemination about sociation - 4.7%.

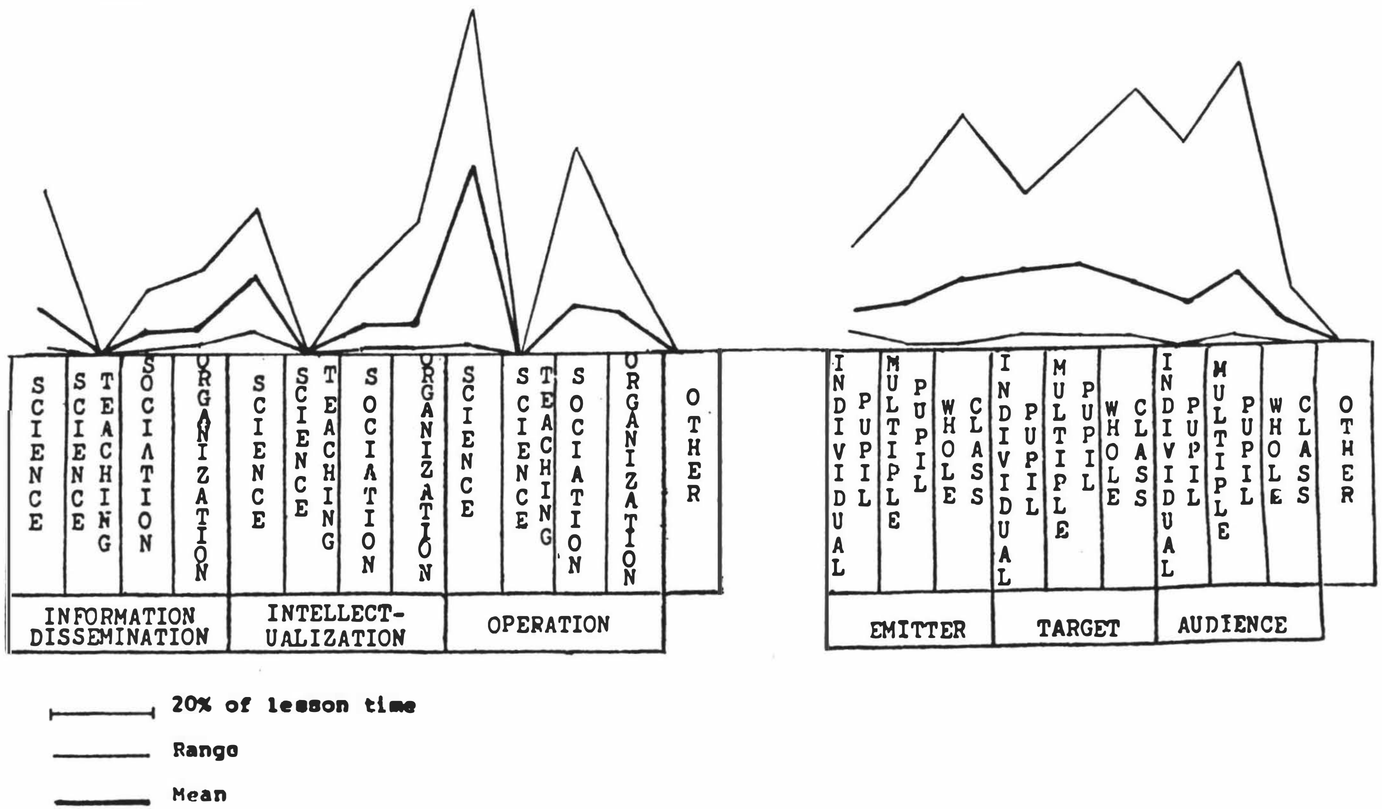
For structural transactions, the averaged recommendations of the teachers were that: the highest amount of lesson time should be spent by the teacher as the target of multiple pupils - 16.6%, followed by:

Figure 47

Teacher-recommendations: Range and Mean

a. Functional Transactions

b. Structural Transactions



(i) <u>the teacher as the target of individual pupils</u> - 13.8%;

(ii) <u>the teacher as audience to multiple pupils</u> - 13.1%;

(iii) <u>the teacher emitting to the whole class</u> - 12.7%; and

(iv) <u>the teacher as the target of the whole class</u> - 11.6%.

For the other 4 structural transactions the averaged recommendations of the teachers were that: <u>less than 10%</u> of the lesson time should be spent on each with the <u>least</u> amount of time being spent by the teacher <u>as audience to the whole class</u> - 4.8%.

<u>On average, how do the teachers who received spaced curriculum training and those who received massed curriculum training perceive the instructional pattern that is appropriate for the teaching of elementary science?</u> (Question 23)

<u>Group 1</u>:

For functional transactions (Table 15a and Figure 48), the averaged recommendations of group 1 were that: the highest amount of lesson time should be spent on <u>operation about science</u> - 32.1%, followed by:

(i) <u>intellectualization about science</u> - 15.3%;

(ii) <u>operation about organization</u> - 10.4%; and

(iii) <u>operation about sociation</u> - 10.3%.

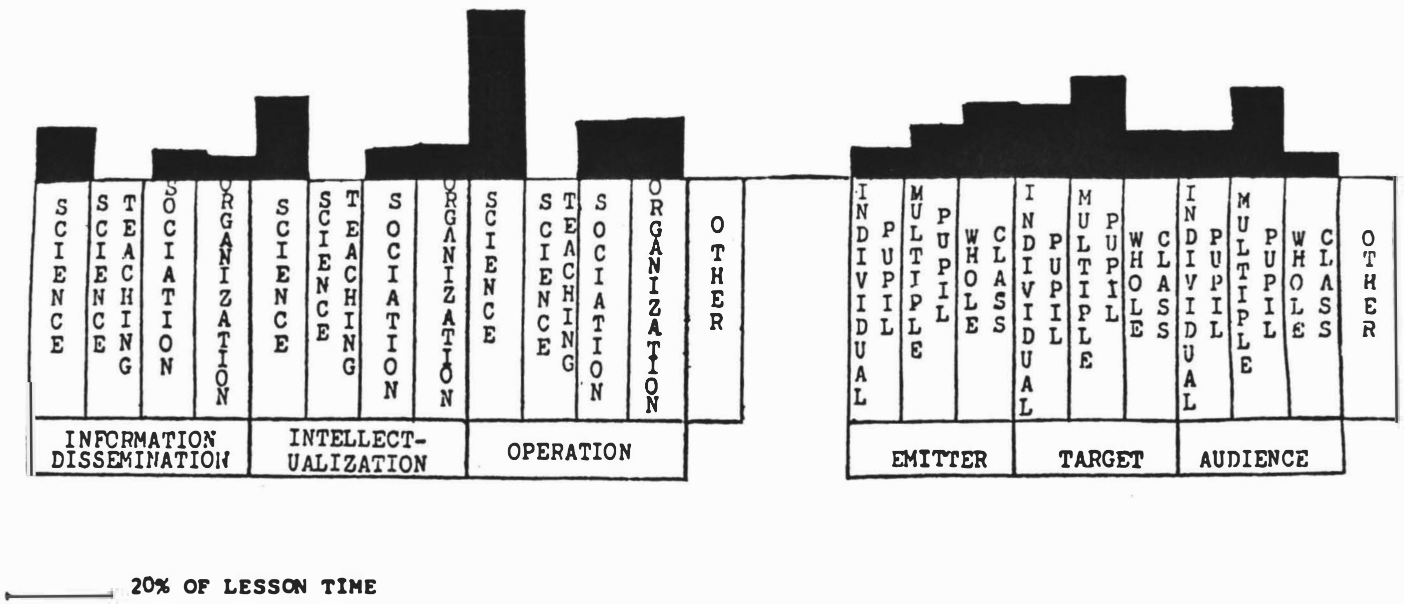
For the other 5 functional transactions the averaged recommendations of group 1 were that: <u>less than 10%</u> of the lesson time should be spent on each with the <u>least</u> amount of time being spent on <u>information dissemination about organization</u> - 4.3%.

Figure 48

Recommended Transactions: Group 1

a. Functional Transactions

b. Structural Transactions



For structural transactions (Table 15b and Figure 48), the averaged recommendations of group 1 were that: the highest amount of lesson time should be spent by the teacher as the target of multiple pupils - 18.6%, followed by:

(i) the teacher as audience to multiple pupils - 17.1%;

(ii) the teacher emitting to the whole class - 13.7%;

(iii) the teacher as the target of individual pupils - 13.3%; and

(iv) the teacher emitting to multiple pupils - 10%.

For the other 4 structural transactions the averaged recommendations of group 1 were that: less than 10% of the lesson time should be spent on each with the least time being spent by the teacher as audience to the whole class - 4%.

Group 2:

For functional transactions (Table 15a and Figure 49), the averaged recommendations of group 2 were that: the highest amount of lesson time should be spent on

- operation about science - 36.7%, followed by
- intellectualization about science - 14.6%.

For the other 7 functional transactions the averaged recommendations of group 2 were that: less than 10% of the lesson time should be spent on each with the least amount of time being spent on information dissemination about sociation - 4.2%.

For structural transactions (Table 15b and Figure 49), the averaged recommendations of group 2 were that: the highest amount of lesson time should be spent by the teacher as the target of multiple pupils - 15.5%, followed by:

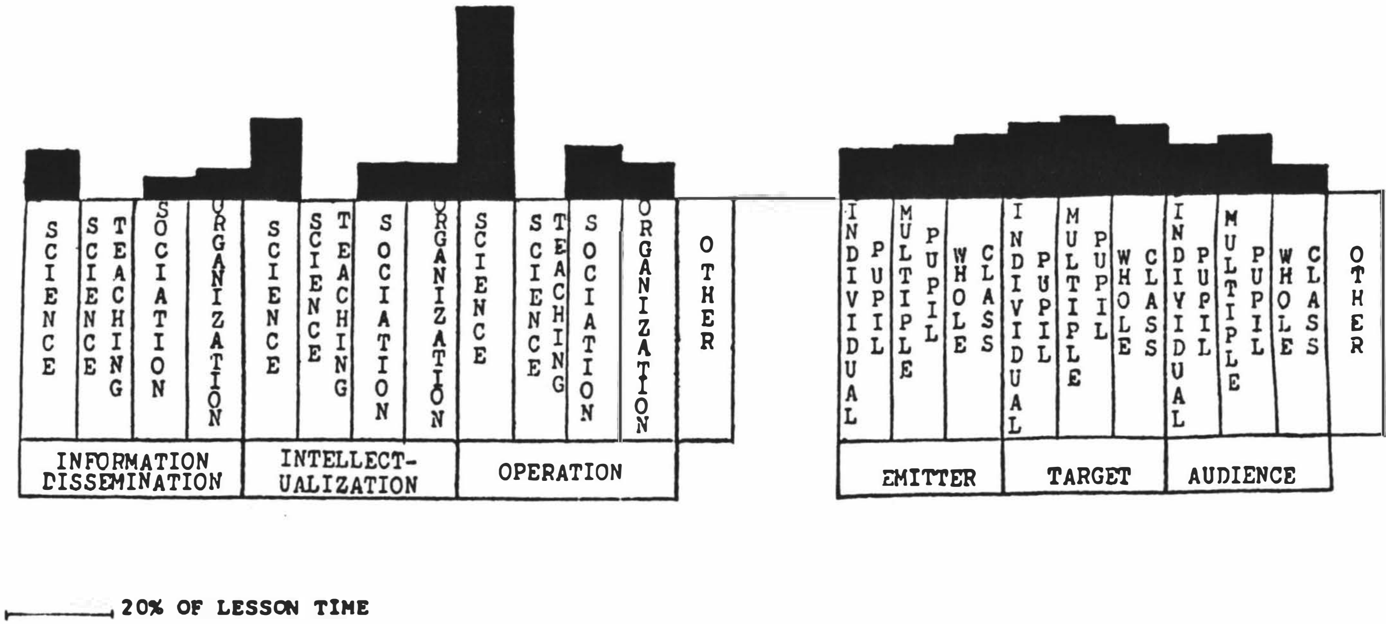
(i) the teacher as the target of individual pupils - 14.1%;

Figure 49

Recommended Transactions: Group 2

a. Functional Transactions

b. Structural Transactions



(ii) the teacher as the target of the whole class - 13.2%;

(iii) the teacher emitting to the whole class - 12.1%;

(iv) the teacher as audience to multiple pupils - 11%; and

(v) the teacher emitting to multiple pupils - 10%.

For the other 3 structural transactions the averaged recommendations of group 2 were that: less than 10% of the lesson time should be spent on each with the least amount of time being spent by the teacher as audience to the whole class - 5.2%.

How do the recommended teaching patterns of the teachers who received spaced curriculum training and those who received massed curriculum training compare with each other? (Question 24).

For functional transactions, the averaged amounts of lesson time recommended by group 1 were very similar to the averaged recommendations of group 2 - Table 15a and Figure 50.

The functional transaction with the widest range in recommended times was - operation about science, where the averaged recommendation of group 1 was 32.1% of the lesson time and the averaged recommendation of group 2 was 36.7%.

For structural transactions (Table 15b and Figure 50), the averaged amounts of lesson time recommended by group 1 were similar to the recommended times of group 2 for 7 of the 9 transactions.

The structural transaction with the widest range in recommended times was

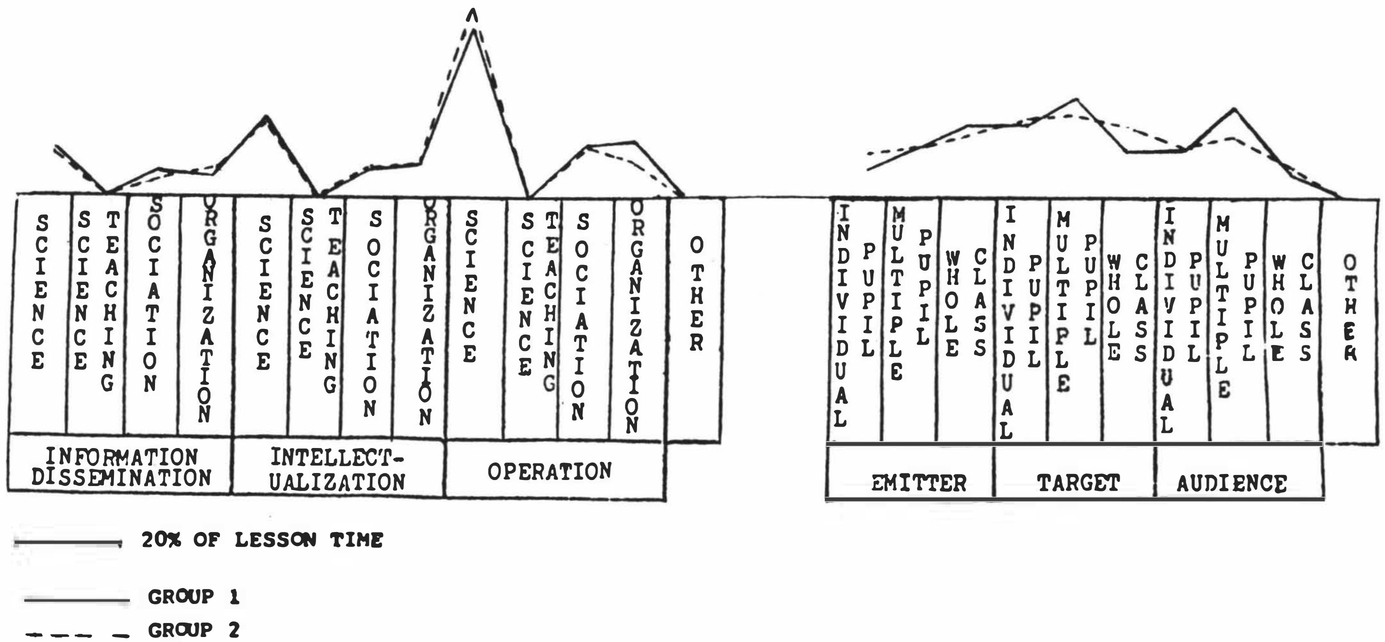
- the teacher as audience to multiple pupils - (averaged recommendation of group 1 - 17.1%, averaged recommendation of group 2 - 11%), followed by

Figure 50

Recommended Transactions: Groups 1 and 2

a. Functional Transactions

b. Structural Transactions



- <u>the teacher as the target of the whole class</u> (averaged recommendation of group 1 - 8.7%, averaged recommendation of group 2 - 13.2%).

<u>Is the overall teacher-perception of the teaching pattern that is appropriate for the teaching of elementary science most similar to:</u>

(i) <u>The averaged teaching pattern that was recommended by the lecturers for the teaching of elementary science?</u>

(ii) <u>their averaged perception of the teaching pattern that was recommended by the lecturers?</u>

(iii) <u>the averaged teaching pattern of the lecturers?</u>

(iv) <u>their averaged perception of the teaching pattern of the lecturers?</u> or

(v) <u>their averaged perception of the teaching pattern of the school science teachers?</u> (Question 25).

When profiles of the averaged recommendations of the year-one teachers were superimposed over the above listed patterns (Figure 51) the results showed that <u>for both functional and structural transactions</u> the overall teacher-perception of the pattern of teaching that is appropriate for the teaching of elementary science was most similar to <u>the overall teacher-perception of the teaching pattern that was recommended by the lecturers for the teaching of elementary science</u> (Figure 51: a_2 and b_2). It must be mentioned too that the overall functional and structural recommendations of the teachers also closely resembled:

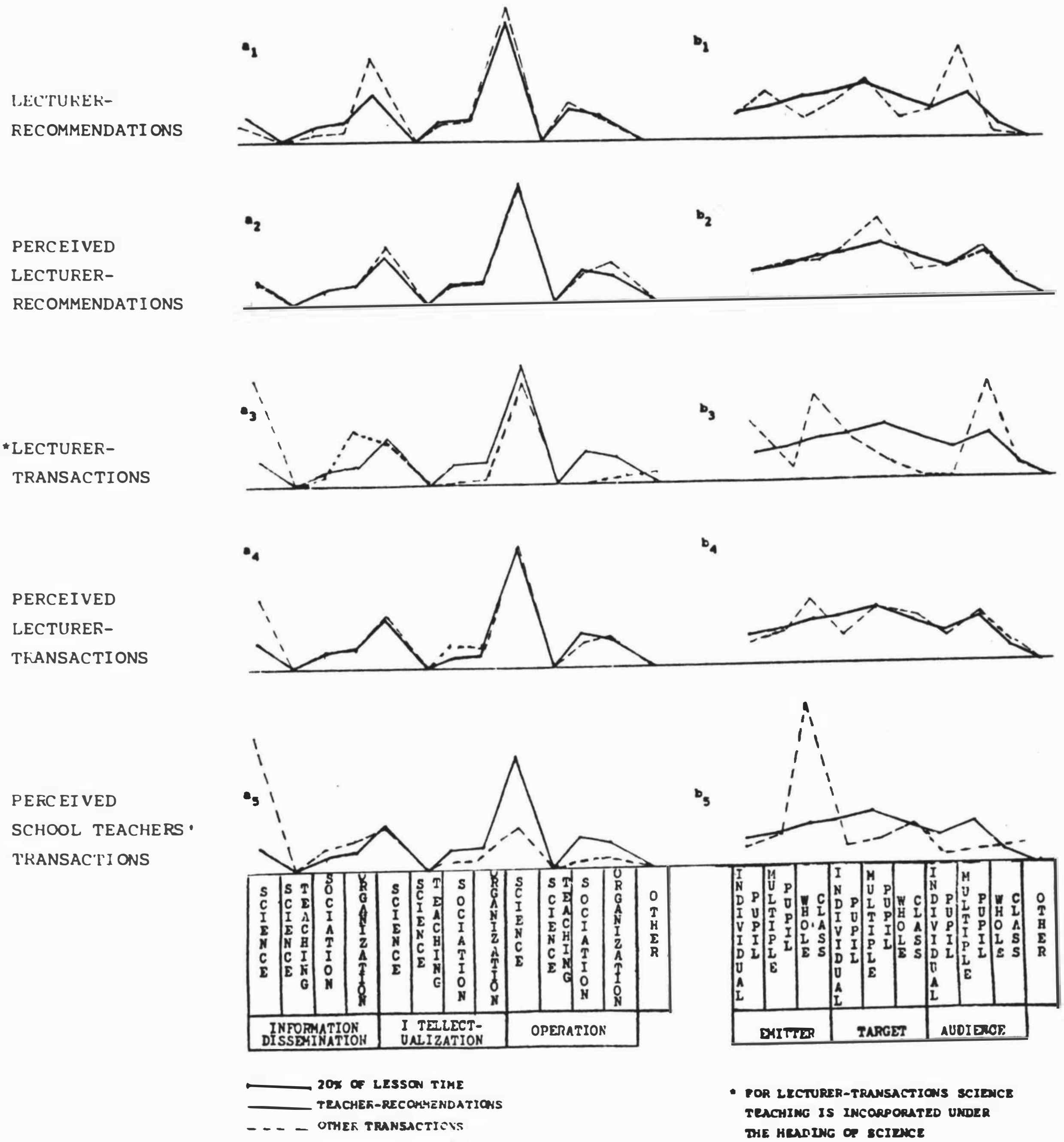
(i) <u>their overall perception of the actual teaching pattern of the lecturers</u> (Figure 51: a_4 and b_4); and

(ii) <u>the overall recommendations of the lecturers</u> (Figure 51: a_1 and b_1).

FIGURE 51

RECOMMENDED TRANSACTIONAL PATTERN VIS-Á-VIS ALTERNATIVES: ALL TEACHERS

a. Functional Transactions b. Structural Transactions



* FOR LECTURER-TRANSACTIONS SCIENCE TEACHING IS INCORPORATED UNDER THE HEADING OF SCIENCE

The teaching profiles which the overall recommendations of the teachers resembled least were:

(i) the profiles of their averaged perceptions of the teaching patterns of their "pre-college" science teachers; and

(ii) the overall lecturer-transactions. Figure 51.

Are the averaged recommendations of the teachers who received spaced curriculum training and those who received massed curriculum training most similar to:

(i) The averaged teaching patterns that were recommended by their lecturers for the teaching of elementary science?

(ii) their averaged perceptions of the teaching patterns that were recommended by their lecturers?

(iii) the averaged teaching patterns of their lecturers?

(iv) their averaged perceptions of the teaching patterns of their lecturers? or

(v) their averaged perceptions of the teaching patterns of their school science teachers? (Question 26).

The results for this question revealed that, for both groups of teachers, the averaged recommendations for the functional and structural behaviours that are appropriate for the teaching of elementary science were most similar to the group-perceptions of the teaching patterns that were recommended by their respective lecturers for the teaching of elementary science (Figure 52: a_2 and b_2; and Figure 53: a_2 and b_2 respectively). The results also showed that the averaged recommendations of both groups of teachers also resembled:

(i) the group-perceptions of the teaching patterns of their respective lecturers, and

(ii) the averaged recommendations of their respective lecturers.

FIGURE 52

RECOMMENDED TRANSACTIONAL PATTERN VIS-À-VIS ALTERNATIVES: GROUP 1

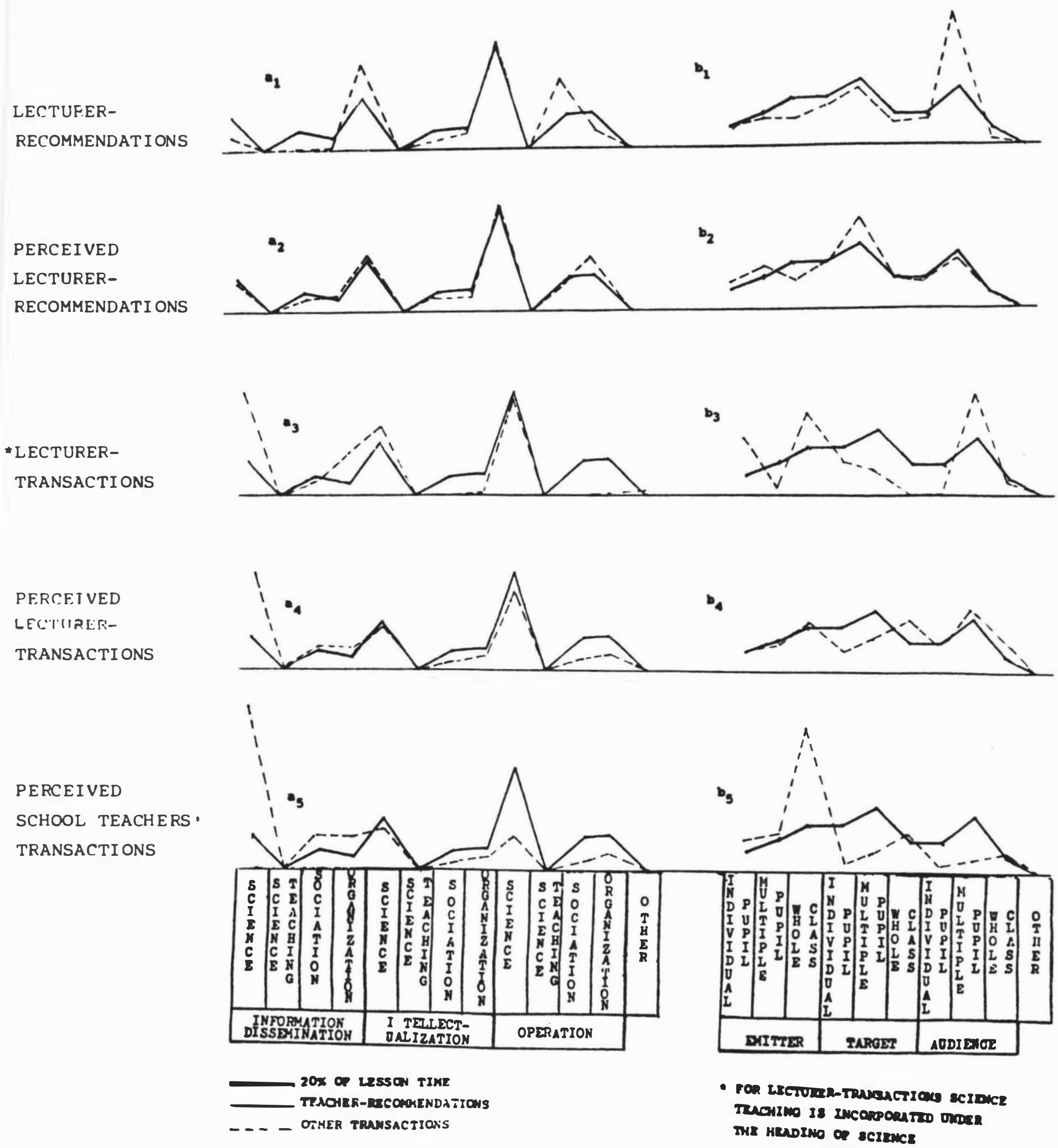
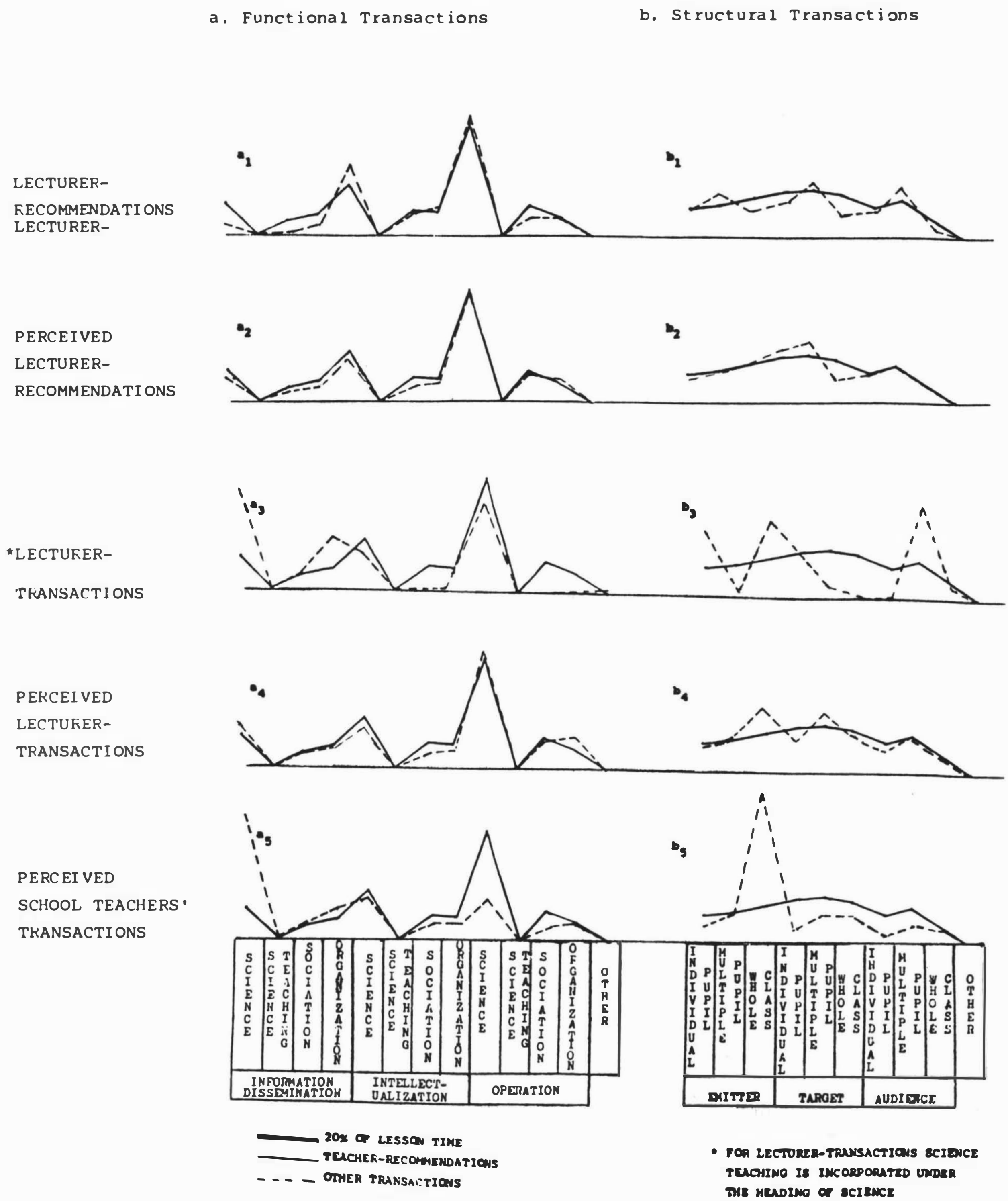


FIGURE 53

RECOMMENDED TRANSACTIONAL PATTERN VIS-A-VIS ALTERNATIVES: GROUP 2



The teaching patterns which the averaged recommendations of both groups of teachers resembled least were:

(i) their respective averaged perceptions of the teaching patterns of their "pre-college" science teachers; and

(ii) the averaged transactional patterns of their respective lectuers.

PART E

FIRST-YEAR TEACHERS: ACTUAL TEACHING PATTERNS

What are the actual teaching patterns of the individual teachers? (Question 27)

The average amounts of lesson time spent by each teacher on the functional and structural aspects of elementary science teaching are to be found in Tables 16a and 16b respectively. Profiles of these results are to be found in Appendix F. Examination of the average amounts of lesson time spent on functional transactions during the teaching sessions of the individual teachers revealed narrow ranges for 6 of the 9 transactions (Figure 54).

The functional transaction with the widest range was - operation about science - a range of 17.7% to 84.7% of the lesson time. The functional transactions with the lowest ranges were:

(i) operation about sociation - 0% to 0.05%;

(ii) intellectualization about sociation - 0% to 0.2%; and

(iii) intellectualization about organization - 0% to 1.4%.

TABLE 16a

FIRST-YEAR TEACHERS: AVERAGED FUNCTIONAL TIME

		% TIME									
		INFORMATION DISSEMINATION			INTELLECTUALIZATION			OPERATION			OTHER
TEACHERS:		SC.	SOC.	ORG.	SC.	SOC.	ORG.	SC.	SOC.	ORG.	
G	1	12.3	2.8	25.7	3.6	0	0.7	48.8	0	3.1	3
R	2	23.6	4.2	9.6	1.3	0	0.1	50.7	0	4.5	6.0
O	3	40.4	4.1	17.5	5.5	0	0.05	28.8	0.05	2.4	1.2
U	4	1.0	0.4	12.2	0	0	0.1	84.7	0	1.4	0.2
P	5	9.6	6.9	23.0	4.3	0.2	0.4	50.3	0	3.5	1.8
	6	24.4	1.8	14.0	4.5	0	0.1	47.3	0	3.8	4.1
1	7	25.4	4.3	15.5	7.2	0	0.1	40.7	0	4.4	2.4
Mean, Group 1		19.5	3.5	16.79	3.8	0.03	0.2	50.2	0.01	3.3	2.67
	8	44.0	1.5	12.1	3.6	0	0	31.5	0	1.3	6.0
G	9	18.5	2.8	31.2	2.05	0	0.3	32.1	0	9.1	3.9
	10	16.9	5.4	27.7	0.55	0.05	1.4	38.8	0	6.0	3.2
R	11	20.9	1.45	25.3	3.65	0	0	37.2	0.05	5.8	5.65
	12	10.3	0.5	21.1	2.1	0	0.5	54.0	0	6.8	4.7
O	13	33.0	3.0	7.3	1.5	0	0.05	47.4	0	6.7	1.0
	14	2.2	0.7	21.3	0	0	0.3	72.0	0	2.6	0.9
U	15	22.9	2.0	25.9	4.7	0	0	29.8	0	11.6	3.1
	16	22.4	1.0	19.0	4.6	0	0.2	40.2	0	6.9	5.7
P	17	6.8	1.4	16.3	0.2	0	0.05	70.35	0	3.8	0.9
	18	13.7	5.3	23.8	0.6	0	0.2	41.0	0	5.6	9.8
2	19	20.1	11.4	15.0	2.4	0	0.1	54.9	0	5.4	0.7
	20	43.75	6.8	17.1	2.3	0	0.05	17.7	0	9.9	2.4
Mean, Group 2		21.19	2.56	20.24	2.2	0.004	0.24	43.6	0.004	6.27	3.69
Mean, all teachers		20.60	2.89	19.03	2.73	0.01	0.24	45.92	0.01	5.2	3.33

SC. = SCIENCE

SOC. = SOCIATION

ORG. = ORGANIZATION

TABLE 16b

FIRST-YEAR TEACHERS: AVERAGED STRUCTURAL TIME

		% TIME									
		EMITTER			TARGET			AUDIENCE			OTHER
TEACHERS:		IND. PUP.	MULT. PUP.	WHL. CLASS	IND. PUP.	MULT. PUP.	WHL. CLASS	IND. PUP.	MULT. PUP.	WHL. CLASS	
G	1	17.0	2.8	9.8	12.0	3.2	0.2	0.3	52.4	1.3	1.0
R	2	7.1	0.4	16.3	6.3	2.0	0	0.3	61.0	0.3	6.3
O	3	18.5	2.6	24.1	12.95	5.8	1.3	0.95	26.3	7.3	0.25
U	4	4.7	2.4	1.5	2.6	2.4	0	0	86.2	0.2	0
P	5	12.5	7.9	12.2	4.2	2.0	0.7	0.3	58.2	2.0	0
	6	9.7	4.6	17.0	9.5	2.8	0.05	0.3	50.0	5.7	0.34
1	7	6.4	3.1	21.4	12.6	1.7	1.3	2.7	44.8	6.0	0
Mean, Group 1		10.8	3.4	14.6	8.6	2.84	0.5	0.7	54.13	3.3	1.13
	8	9.4	0.4	32.1	11.1	3.9	0.05	0.85	33.0	8.8	0.4
G	9	11.35	5.8	24.2	8.25	3.3	0.05	0.25	41.2	3.3	2.3
	10	17.1	2.8	11.2	8.6	5.0	1.1	2.4	46.5	4.7	0.6
R	11	12.2	3.5	19.3	8.0	3.9	0.5	0.5	44.6	6.6	0.9
	12	7.1	6.0	12.1	6.6	1.5	0.1	1.0	61.0	2.6	2.0
O	13	6.8	0.6	30.0	3.7	1.0	0.3	0	56.6	0	1.0
	14	5.4	3.1	14.3	1.6	0.9	0	0	73.6	1.1	0
U	15	9.5	2.0	25.5	11.3	3.4	0.1	0.6	31.1	14.6	1.9
P	16	15.2	1.5	10.6	12.0	5.0	0.2	0.5	48.8	5.1	1.1
	17	3.8	0.6	14.8	2.2	0.8	0	0.4	75.3	0.9	1.2
	18	7.2	1.7	18.6	2.3	2.9	2.2	0.8	51.5	2.9	9.9
2	19	8.4	2.2	16.0	5.5	3.8	0.1	0.1	63.2	0.7	0
	20	10.7	1.6	26.8	20.1	0.5	0	1.1	32.9	6.3	0
Mean, Group 2		9.6	2.5	19.6	7.8	2.8	0.4	0.6	50.7	4.4	1.6
Mean, all teachers		9.9	2.8	17.8	8.1	2.8	0.4	0.7	52.0	4.0	1.5

IND. PUP. = INDIVIDUAL PUPIL

MULT. PUP. = MULTIPLE PUPIL

WHL. CLASS = WHOLE CLASS

There were also narrow ranges in 6 of the 9 structural transactions of the year-one teachers (Figure 54).

The structural transaction with the widest range was - the teacher as audience to multiple pupils - a range of 26.3% to 86.2% of the lesson time.

The structural transactions with the lowest ranges were:

(i) the teacher as the target of multiple pupils - 0.5% to 5.8%;

(ii) the teacher as audience to individual pupils - 0% to 2.7%; and

(iii) the teacher as the target of the whole class - 0% to 2.2%.

What is the averaged teaching pattern of the year-one teachers? (Question 28).

For functional transactions (Table 16a and Figure 54), the averaged results revealed that during the teaching sessions of the teachers, the highest amount of lesson time was spent on - operation about science - 45.92%, followed by:

(i) information dissemination about science - 20.6 %; and

(ii) information dissemination about organization - 19.03%.

Less than 6% of the lesson time was spent on each of the other 6 functional transactions with the least amount of time being spent on:

(i) intellectualization about sociation - 0.01%; and

(ii) operation about sociation - also 0.01%.

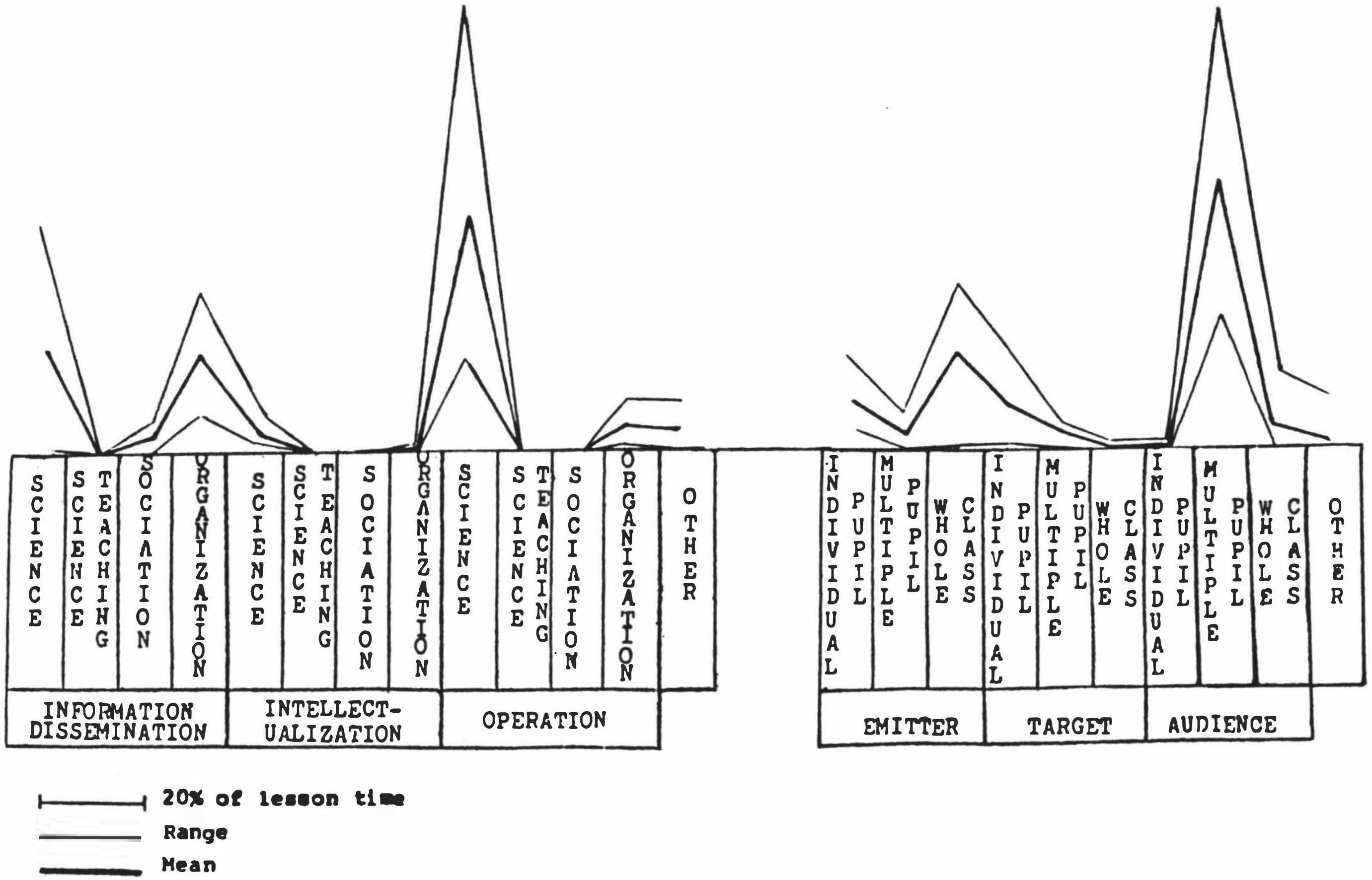
For structural transactions (Table 16b and Figure 54), the teachers spent an average of 52.0% of the lesson time as audience to multiple pupils, followed by 17.8% of the lesson time emitting to the whole class.

Figure 54

Teacher-transactions: Range and Mean

a. Functional Transactions

b. Structural Transactions



On each of the other 7 structural transactions the teachers spent an average of less than 10% of the lesson time with the least amount of time being spent as the targets of the whole class - 0.4%.

What are the averaged teaching patterns of the teachers who received spaced curriculum training and those who received massed curriculum training? (Question 29).

Group 1

The averaged functional transactions (Table 16a and Figure 55) of group 1 (spaced-trained teachers) showed that the highest amount of lesson time was spent on:

- operation about science - 50.2%, followed by:

(i) information dissemination about science - 19.5%; and

(ii) information dissemination about organization - 16.79%.

Less than 4% of the lesson time was spent on each of the other 6 functional transactions with the least amount of time being spent on operation about sociation - 0.01%.

The averaged structural behaviours of the members of group 1 (Table 16b and Figure 55) showed that the highest amount of lesson time was spent as audience to multiple pupils - 54.13%, followed by:

(i) emitting to the whole class - 14.6%; and

(ii) emitting to individual pupils - 10.8%.

On each of the other 6 structural transactions the members of group 1 spent an average of less than 10% of the lesson time with the least amount of time being spent as the targets of the whole class - 0.5%.

Figure 55

Teacher-transactions: Group 1

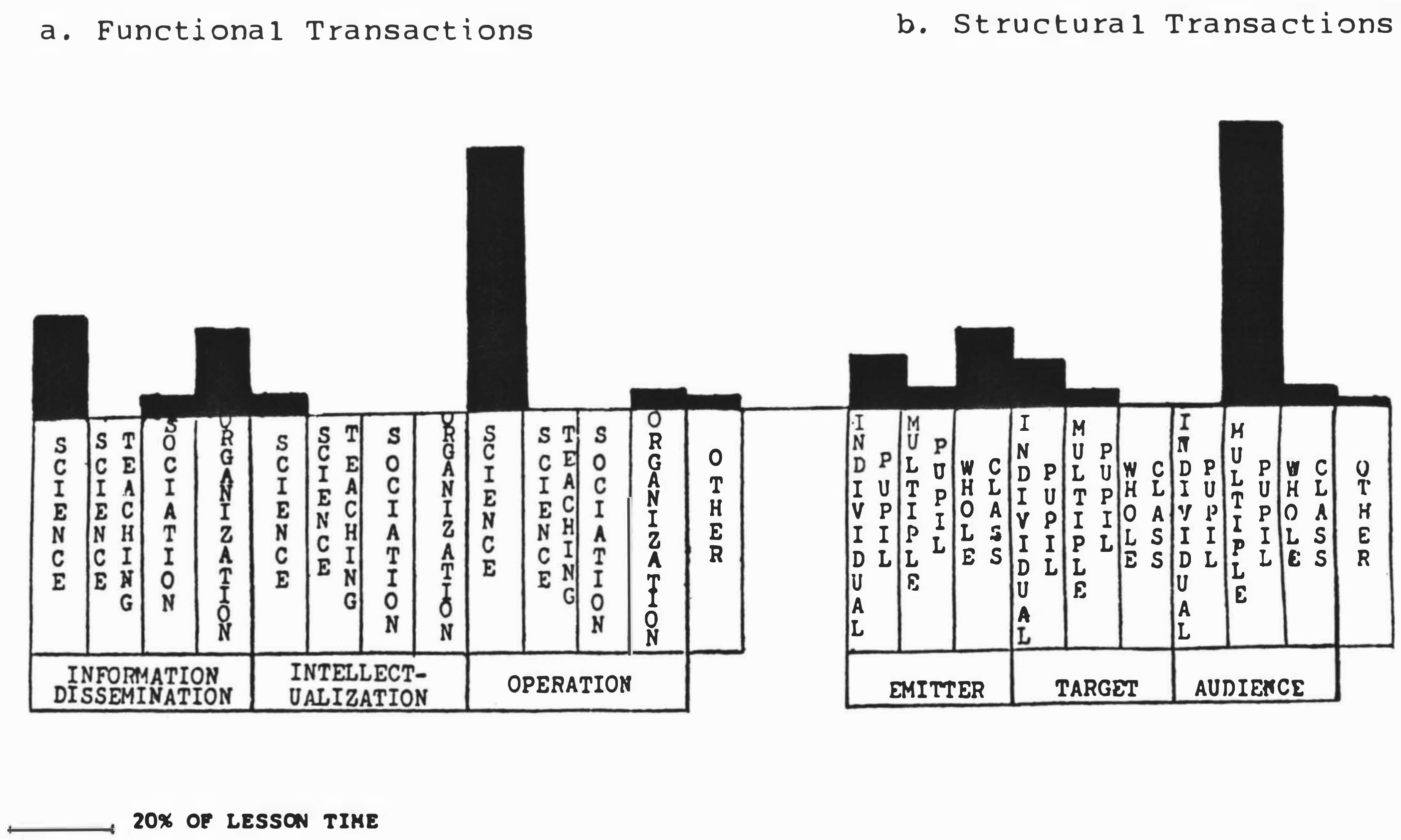
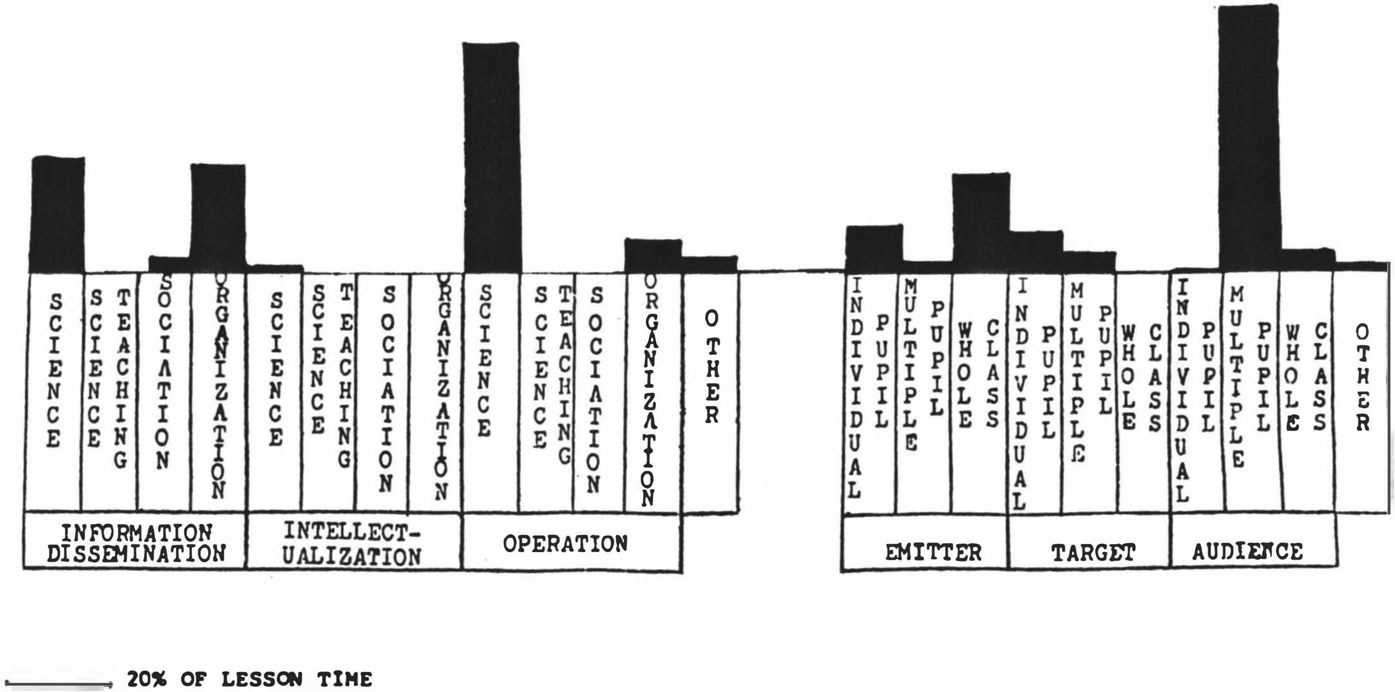


Figure 56

Teacher- transactions: Group 2

a. Functional Transactions

b. Structural Transactions



Group 2:

For functional transactions (Table 16b and Figure 56), the averaged results showed that, during the teaching sessions of the members of group 2, the highest amount of lesson time was spent on operation about science - 43.6%, followed by:

(i) information dissemination about science - 21.19%; and

(ii) information dissemination about organization - 20.24%.

Less than 7% of the lesson time was spent on each of the other 6 functional transactions with the least amount of time being spent on:

(i) intellectualization about sociation - 0.004%; and

(ii) operation about sociation - also 0.004%.

For structural transactions (Table 16b and Figure 56), the averaged results revealed that the members of group 2 spent the highest amount of lesson time as audience to multiple pupils - 50.7%, followed by:

- emitting to the whole class 19.6%.

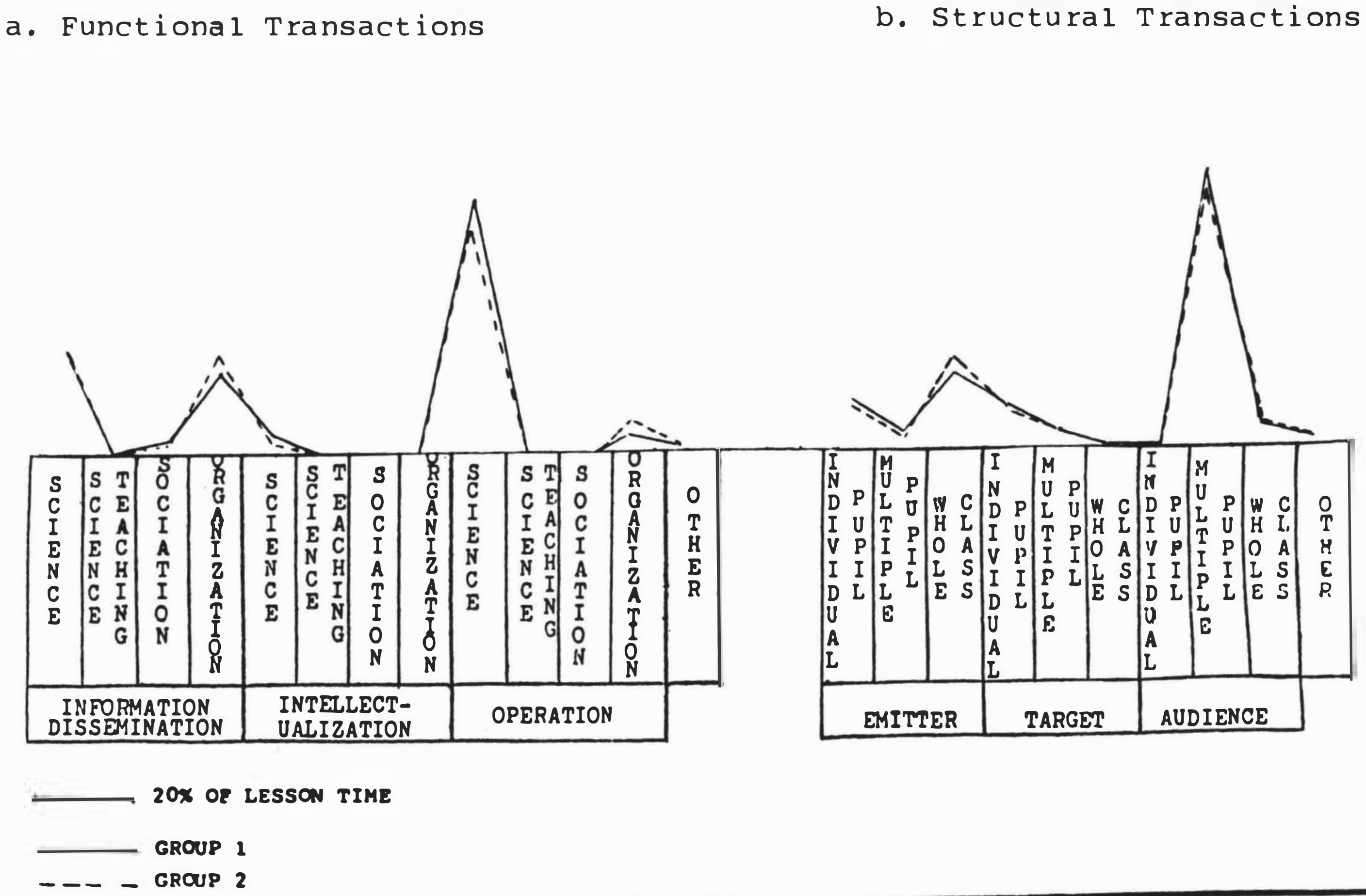
On each of the other 7 structural transactions the members of group 2 spent an average of less than 10% of the lesson time with the least amount of time being spent as the targets of the whole class - 0.4%.

How do the averaged teaching patterns of the teachers who received spaced curriculum training and those who received massed curriculum training compare with each other? (Question 30).

The results for this question showed that the averaged teaching patterns of both groups of teachers were almost identical for both functional and structural transactions (Figure 57).

Figure 57

Teacher-transactions: Groups 1 and 2



For the functional transactions of both groups of teachers the highest amount of lesson was spent on - operation about science, followed by:

(i) information dissemination about science; and

(ii) information dissemination about organization; with less than 10% of the lesson time being spent on the other 6 transactions (Table 16a).

For structural transactions both groups of teachers spent the highest amount of lesson time as audience to multiple pupils, followed by:

(i) emitting to the whole class; and

(ii) emitting to individual pupils; with less than 10% of the lesson time being spent on the other 6 transactions, and the least amount of time being spent as the targets of the whole class (Table 16b).

Is the overall teaching pattern of the teachers most similar to:

(i) the averaged teaching pattern that was recommended by the lecturers for the teaching of elementary science?

(ii) their averaged perceptions of the teaching patterns that were recommended by the lecturers?

(iii) the averaged teaching pattern of the lecturers?

(iv) their averaged perceptions of the actual teaching patterns of the lecturers?

(v) their averaged perceptions of the teaching patterns of their science teachers prior to Teachers College? or

(vi) their averaged perceptions of the instructional patterns that are appropriate for the teaching of elementary science? (Question 31).

The results for this question revealed that the averaged teaching pattern of the teachers was most similar to the averaged teaching pattern of the lecturers for both functional and structural transactions - Figure 58: a_3 and b_3.

The averaged amounts of lesson time spent on 2 functional transactions during the lecturers' teaching sessions were appreciably higher than the averaged times spent during the teaching sessions of the teachers:

(i) information dissemination about the subject matter (lecturer-time -- 32.5%, teacher-time -- 20.6 %); and

(ii) intellectualization about the subject matter (lecturer-time -- 14.7%, teacher-time -- 2.73%). However, the averaged amount of lesson time spent during the teaching sessions of the teachers was appreciably higher than that of the lecturers for - operation about the subject matter (teacher-time -- 45.92%, lecturer-time -- 29.5%). See Tables 11a and 16a. In this respect the teacher-time was closest to the averaged recommendation of the lecturers.

For structural transactions (Tables 11b and 16b) the averaged amounts of lesson time spent by the lecturers were appreciably higher than that spent by the teachers for 2 transactions:

(i) emitting to individual pupils - (lecturer-time --19.2%, teacher-time-- 9.9%); and

(ii) emitting to the whole class (lecturer-time -- 25.9%; teacher-time -- 17.8%). However, the averaged time spent by the teachers was appreciably higher than that of the lecturers for - the teacher as audience to multiple pupils (teacher-time -- 52.0%, lecturer-time -- 28.9%). In this respect the teacher-time was closest to the verbal recommendations of the lecturers.*

* Discussed in Chapter 6.

Are the averaged teaching patterns of the teachers who received massed curriculum training and those who received spaced curriculum training most similar to:

(i) the teaching patterns that were recommended by their respective lecturers for the teaching of elementary science?

(ii) their averaged perceptions of the teaching patterns that were recommended by their lecturers?

(iii) the averaged teaching patterns of their respective lecturers?

(iv) their averaged perceptions of the teaching patterns of their lecturers?

(v) their averaged perceptions of the teaching patterns of their "pre-college" science teachers? or

(vi) their averaged perceptions of the teaching patterns that are appropriate for the teaching of elementary science? (Question 32).

Group 1

The results revealed that the averaged teaching pattern of group 1 was most similar to the averaged teaching pattern of their science lecturers for both functional and structural transactions - Figure 59: a_3 and b_3 respectively.

The averaged times spent during the teaching sessions of the lecturers of group 1 (lecturers 1 and 5) were appreciably higher than that spent during the teaching sessions of the members of group 1 for 2 functional transactions:

(i) information dissemination about the subject matter (lecturer-time --30.6%, teacher-time -- 19.5%); and

(ii) intellectualization about the subject matter (lecturer-time -- 19.5%, teacher-time --3.8%).

FIGURE 58

ACTUAL TRANSACTIONAL PATTERN VIS-À-VIS ALTERNATIVES: ALL TEACHERS

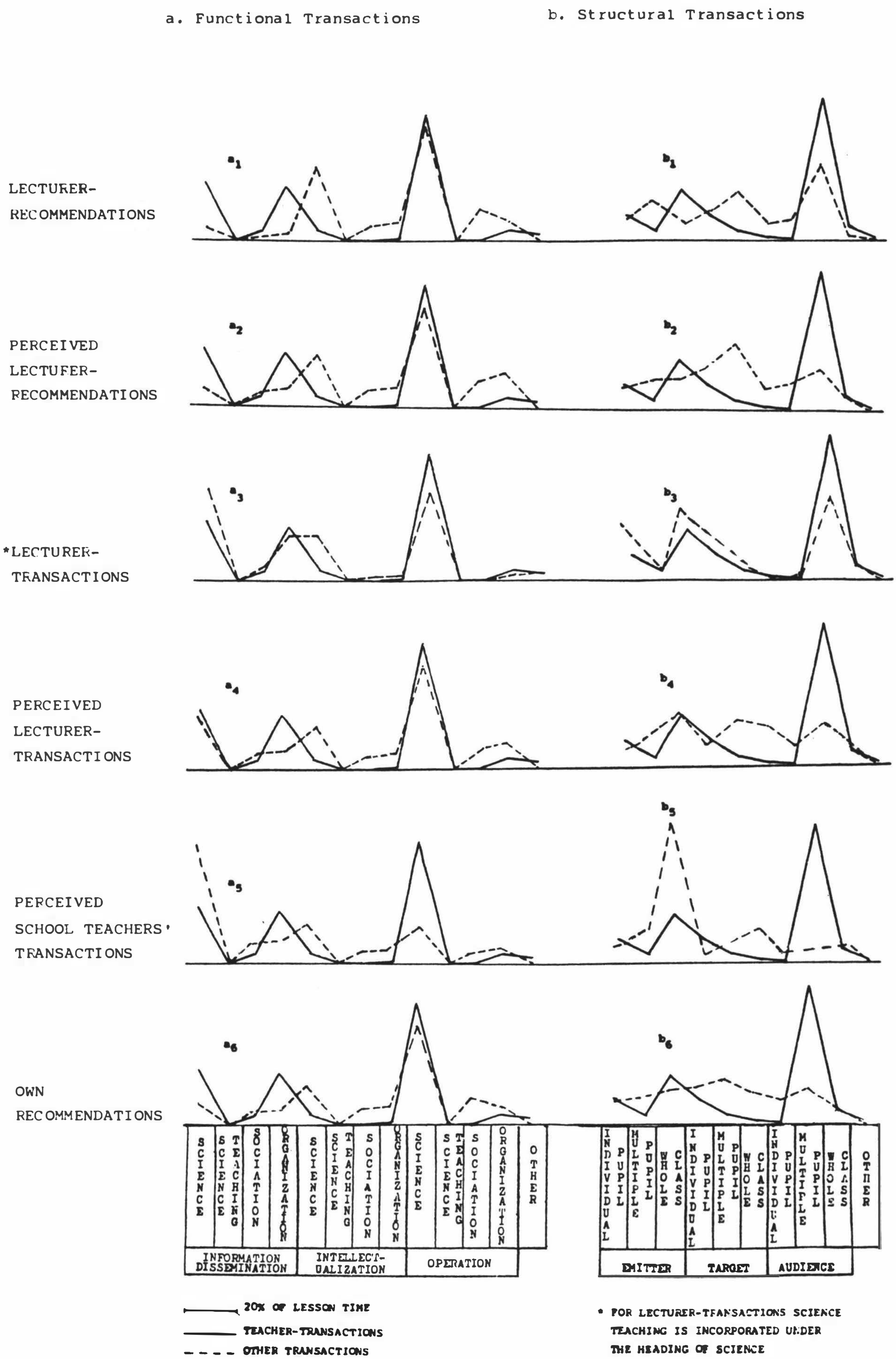
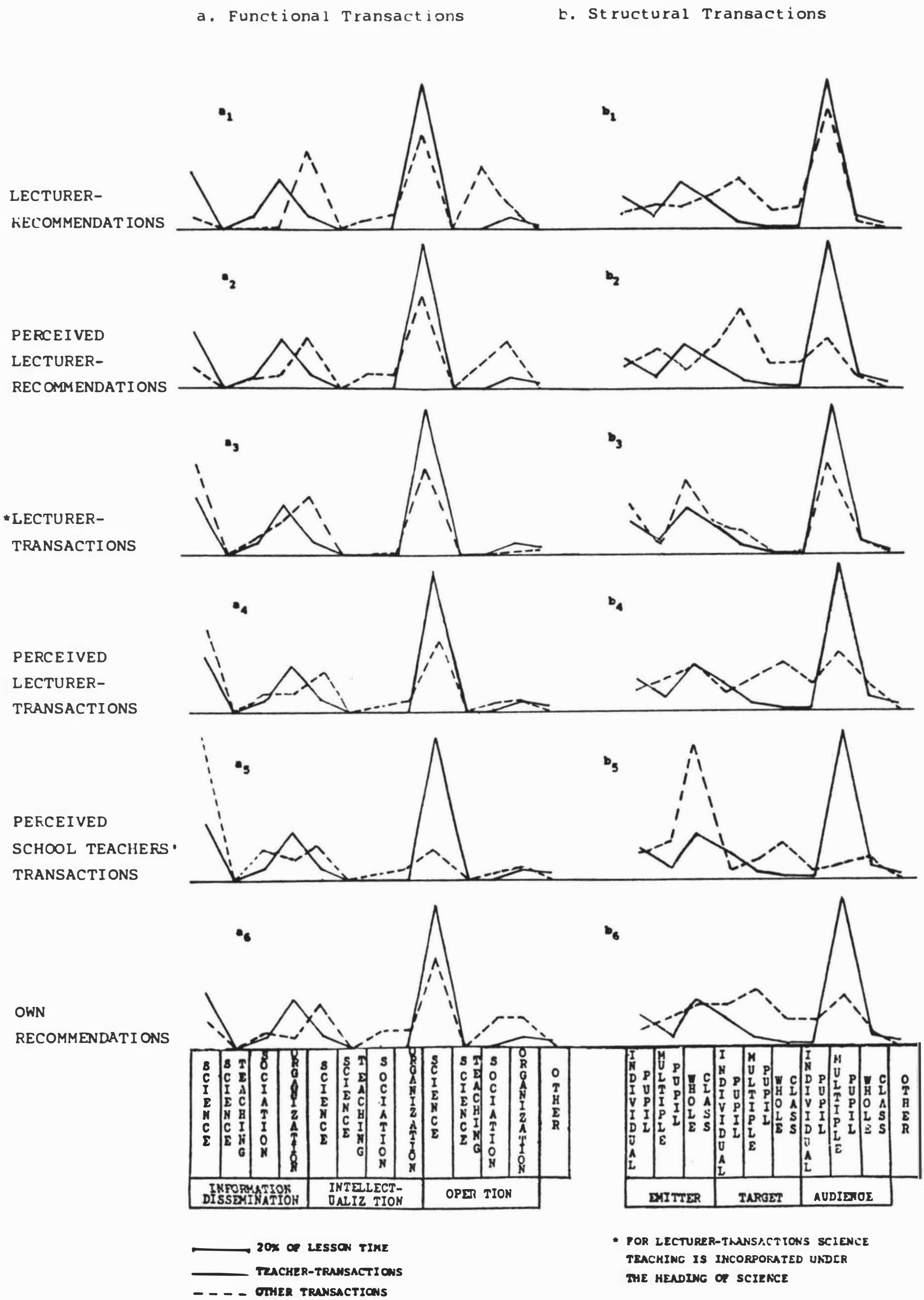


FIGURE 59

ACTUAL TRANSACTIONAL PATTERN VIS-À-VIS ALTERNATIVES: GROUP 1



However, the averaged amount of lesson time spent during the teaching sessions of the members of group 1 on operation about the subject matter was aprpeciably higher than the averaged time spent on this transaction during the teaching sessions of their lecturers (teacher-time -- 50.2%, lecturer-time -- 29.7%). See Tables 11a and 16a.

For structural transactions (Tables 11b and 16b) the averaged amounts of lesson time spent by lecturers 1 and 5 were appreciably higher than that spent by the members of group 1 in 3 cases:

(i) the teacher emitting to individual pupils (lecturer-time -- 17.6%, teacher-time -- 10.8%);

(ii) the teacher emitting to the whole class (lecturer-time -- 25.6%, teacher-time -- 14.6%); and

(iii) the teacher as the target of multiple pupils (lecturer-time -- 8.2%, teacher-time -- 2.84%).

However, the averaged time for the members of group 1 was appreciably higher than that of their lecturers for - the teacher as audience to multiple pupils (teacher-time --54.13%, lecturer-time-- 28.8%). In this respect the teacher-time was closest to the averaged recommendation of lecturers 1 and 5.

Group 2

The results showed that the averaged teaching pattern of the members of group 2 was also most similar to the averaged teaching pattern of their science lecturers (lecturers 1 -4) - Figure 60: a_3 and b_3.

For functional transactions the averaged times spent during the teaching sessions of lecturers 1-4 were appreciably higher than that of group 2 in 2 cases:

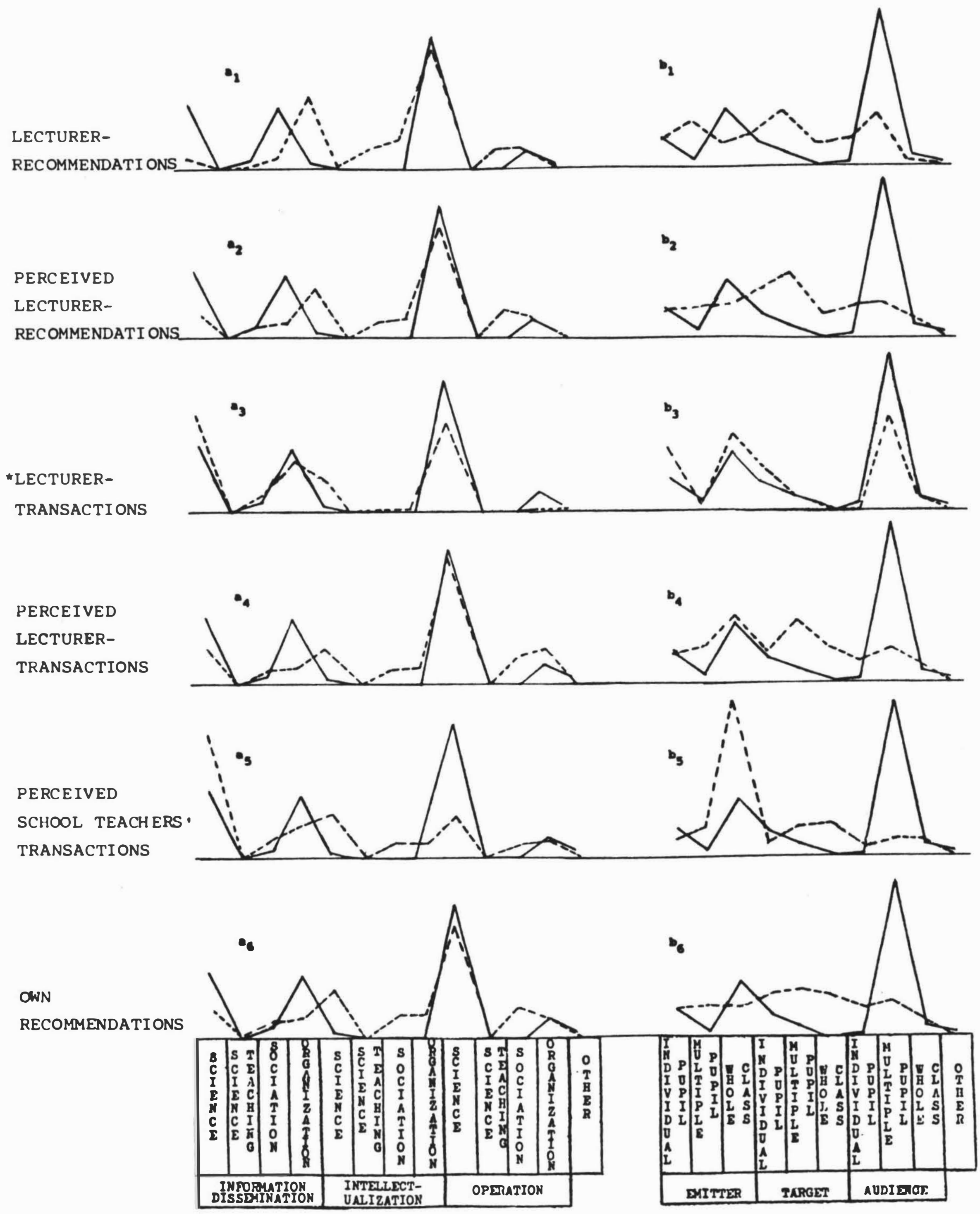
(i) information dissemination about the subject matter (lecturer-time-- 33.4%, teacher-time --21.19%); and

FIGURE 60

ACTUAL TRANSACTIONAL PATTERN VIS-A-VIS ALTERNATIVES: GROUP 2

a. Functional Transactions

b. Structural Transactions



20% OF LESSON TIME
TEACHER-TRANSACTIONS
OTHER TRANSACTIONS

* FOR LECTURER-TRANSACTIONS SCIENCE TEACHING IS INCORPORATED UNDER THE HEADING OF SCIENCE

(ii) intellectualization about the subject matter (lecturer-time -- 11.8%, teacher-time -- 2.2%).

However, the averaged times spent during the teaching sessions of the members of group 2 were appreciably higher than those of their lecturers in 2 cases:

(i) operation about the subject matter (teacher-time -- 43.6%, lecturer-time -- 30.4%); and

(ii) operation about organization (teacher-time -- 6.27%, lecturer-time -- 1.0%).

The averaged amount of lesson time spent during the teaching sessions of the members of group 2 on operation about the subject matter was very similar to:

(i) their averaged perception of the amount of time spent on this transaction by their lecturers,

(ii) the averaged recommendation of their lecturers,

(iii) their averaged perception of their lecturer-recommendation and

(iv) their own (averaged) recommendation for this transaction.(Figure 60).

For structural transactions the averaged times spent by the lecturers of group 2 were appreciably higher than those of group 2 for 3 transactions:

(i) the teacher emitting to individual pupils (lecturer-time -- 20.5%; teacher-time -- 9.6%);

(ii) the teacher emitting to the whole class (lecturer-time -- 25%; teacher-time -- 19.6%); and

(iii) the teacher as the target of individual pupils (lecturer-time --13.1%; teacher-time -- 7.8%).

For 1 structural transaction the averaged time spent by the members of group 2 was significantly higher than that spent by their lecturers: - the teacher as audience to multiple pupils (teacher-time-- 50.7%, lecturer-time-- 29.4%).

Are the averaged teaching patterns of the individual teachers most similar to:

(i) the teaching patterns that were recommended by their respective lecturers for the teaching of elementary science?

(ii) their perceptions of the teaching patterns that were recommended by their respective lecturers?

(iii) the averaged teaching patterns of their lecturers?

(iv) their individual perceptions of the teaching patterns of their lecturers?

(v) their individual perceptions of the teaching patterns of their "pre-college" science teachers? or

(vi) their individual perceptions of the teaching patterns that should be employed for the teaching of elmentary science? (Question 33)

The results for this question were as follows:

Individual teachers: (Appendix N):

Teachers 1 - 7 (group 1) were taught by lecturers 1 and 5. The transactional patterns which the teaching patterns of the members of this group resembled most were:

Teacher:	Functional transactions	Structural transactions
1	averaged lecturer-transactions*	averaged lecturer-transactions
2	averaged lecturer-transactions	averaged lecturer-transactions/own perception of how to teach
3	averaged lecturer-transactions/ own perceptions of lecturer-transactions	averaged lecturer-transactions

* For this question "lecturer-transactions" refers to the averaged transactions of the lecturer/lecturers who taught the individual teachers during their science curriculum training.

Teacher	Functional transactions	Structural transactions
4	-	averaged lecturer-recommendations
5	averaged lecturer-transactions	averaged lecturer-transactions
6	averaged lecturer-transactions	averaged lecturer-transactions
7	averaged lecturer-transactions	averaged lecturer transactions

(See Appendix N, Teachers 1 - 7).

Thus for functional transactions, the teaching patterns of 5 of the 7 members of group 1 (teachers 1, 2, 5, 6 & 7) resembled the averaged teaching pattern of lecturers 1 and 5. For 1 teacher (teacher 3) her averaged functional pattern resembled both averaged lecturer-transactions as well as her own perception of the teaching pattern of her lecturers. For one other teacher (teacher 4) her averaged functional pattern did not closely resemble any of the patterns with which it was compared. However, if a choice had to be made, it was closest to the averaged teaching pattern of lecturers 1 and 5.

For structural transactions, the teaching patterns of 6 of the 7 teachers (teachers 1, 3, 4, 5, 6 and 7) resembled the averaged transactions of their lecturers. For teacher 2, his structural pattern resembled a combination of the averaged transactions of lecturers 1 and 5 and his own perception of the structural pattern that was appropriate for the teaching of elementary science.

Teachers 8, 9, 10 and 11 were taught by lecturer 3. The averaged teaching patterns of each of these teachers resembled most: the averaged functional and structural patterns of their lecturer (Appendix N, Teachers 8-11).

Teachers 12, 13 and 14 were taught by lecturer 1. The transactional patterns which the averaged teaching patterns of each of these teachers resembled most were as follows:

Teacher:	Functional transactions	Structural transactions
12	Own perception of lecturer-transactions	lecturer-transactions
13	lecturer-transactions	lecturer-transactions
14	lecturer-transactions	lecturer-transactions

(See Appendix N, Teachers 12 - 14).

Teachers 15, 16 and 17 were taught by lecturer 2. The transactional patterns which the averaged teaching patterns of each of these teachers resembled most were as follows:

Teacher:	Functional transactions	Structural transactions
15	lecturer-transactions	lecturer-transactions
16	lecturer-transactions	lecturer-transactions
17	lecturer-transactions/ own perception of lecturer-transactions	lecturer-transactions

(See Appendix N, Teachers 15 - 17).

Teachers 18, 19 and 20 were taught by lecturer 4. The transactional patterns which the averaged teaching patterns of each of these teachers resembled most were:

Teachers:	Functional transactions:	Structural transactions
18	lecturer-transactions	lecturer-transactions
19	own perception of lecturer-transactions	lecturer-transactions
20	lecturer-transactions	lecturer-transactions

(See Appendix N, Teachers 18 - 20).

The general picture that emerges here is that:

(i) the overall teaching pattern of the teachers was most similar to the overall teaching pattern of the lecturers for both functional and structural transactions;

(ii) the averaged teaching patterns of both groups of teachers were also most similar to the averaged teaching pattern of their respective lecturers,

(iii) the averaged functional patterns of 15 of the 20 teachers (5 from group 1 and 10 from group 2) were most similar to the averaged functional patterns of their respective lecturers;

(iv) the averaged structural patterns of 18 of the 20 teachers (5 from group 1 and 13 from group 2) were most similar to the averaged structural patterns of their respective lecturers;

(v) the functional patterns of 2 teachers (teacher 3 from group 1 and teacher 17 from group 2) resembled a combination of their lecturer-transactions and their perceptions of the transactions of their lecturers,

(vi) the functional patterns of 2 teachers (teachers 12 and 19 from group 2) resembled their perceptions of the functional transactions of their respective lecturers;

(vii) the functional pattern of 1 teacher (teacher 4 from group 1 remotely resembled the averaged functional pattern of her lecturers - lecturers 1 and 5;

(viii) the structural pattern of 1 teacher (teacher 2 from group 1) resembled a combination of the averaged pattern of his lecturers, and his own perceptions of the structural pattern that "should" be used for the teaching of elementary science;

(ix) the structural pattern of 1 teacher (teacher 4 from group 1) was most similar to the averaged recommendations of her lecturers.

PART F

FIRST-YEAR TEACHERS: ATRRIBUTION OF TEACHING PATTERNS TO SCIENCE CURRICULUM TRAINING

To what extent do the first-year teachers attribute their teaching patterns to:

(i) the way they were taught science at Teachers College,

(ii) the way they were told to teach science at Teacher's College,

(iii) the way they were taught science at Primary School,

(iv) the way they were taught science at Intermediate School

(v) the way they were taught science at High School, and

(vi) some other influence? (Question 34)

Answers for this final question were obtained from Section C of the questinnaire (Appendix H). The results are summarized in Table 17. Individual teacher-ratings for this question are to be found in Appendix I, Section C.

From Table 17 the results reveal that for both groups of teachers (those who received spaced curriculum training and those who received massed curriculum training) teaching patterns of the members were attributed to a variety of factors. These included - the teaching patterns that were recommended by their College lecturers, those that were employed by their lecturers and those that were employed by their science teachers at school. Details were as follows:

(i) 10 of the 20 teachers (4 from group 1 and 6 from group 2) thought that their teaching patterns were at least moderately influenced by training for science teaching;

(ii) 8 teachers (5 from group 1 and 3 from group 2) thought that their teaching patterns were at least moderately influenced by the way science was taught at Teachers College;

(iii) 6 teachers (1 from group 1 and 5 from group 2) perceived that their teaching patterns were at least moderately influenced by the way science was taught at Primary School;

(iv) 5 teachers (1 from group 1 and 4 from group 2) perceived that their teaching patterns were at least moderately influenced by the way science was taught at Intermediate School;

TABLE 17

FIRST-YEAR TEACHERS: ATTRIBUTION OF TEACHING PATTERNS TO PREVIOUS EXPERIENCE

Attribution of teaching pattern to:	Responses and number of Respondents						
	A great deal	Much	A moderate amount	Not very much	Little or none	No response	
1. The way science was taught at Teachers College	1	1	3	1	1	-	gp.1
	1	-	2	8	2	-	gp.2
	2	1	5	9	3	-	gps. 1 & 2
2. The way science was recommended to be taught at Teachers College	1	1	2	2	1	-	gp.1
	1	2	3	4	3	-	gp.2
	2	3	5	6	4	-	gps. 1 & 2
3. The way science was taught at Primary School	-	1	-	2	4	-	gp.1
	1	1	3	1	7	-	gp.2
	1	2	3	3	11	-	gps. 1 & 2
4. The way science was taught at Intermediate School	-	-	1	3	3	-	gp.1
	1	-	3	1	6	2	gp.2
	1	-	4	4	9	2	gps. 1 & 2
5. The way science was taught at High School	-	2	-	2	3	-	gp.1
	-	1	3	4	5	-	gp.2
	-	3	3	6	8	-	gps. 1 & 2
*6. Some other influence	-	1	-	-	-	6	gp.1
	2	2	2	-	1	6	gp.2
	2	3	2	-	1	12	gps. 1 & 2

* Teachers were also required to enter written comments for this final category.

(v) 6 teachers (2 from group 1 and 4 from group 2) thought that their teaching patterns were at least moderately influenced by the way science was taught at High School and

(vi) 7 teachers (1 from group 1 and 6 from group 2) thought that their teaching patterns were at least moderately due to some other influence.

In addition to these results teachers were required to submit written comments about the other factors which they thought influenced their teaching patterns. From these written comments the results showed that the teachers perceived that their patterns of teaching were also influenced by: Their own past experiences, peer teachers, the expectations and policies of the schools, their own experience with their classes and their own personal styles of teaching. Written comments follow.

Some factors to which the first-year teachers attributed their teaching patterns:

(i) Science curriculum training plus experience of class

Teacher 12:

> *My confidence, ability to understand science is influenced by a strong 2ndry and 3ry education in Science so my knowledge of science is high for this level of teaching. College is very much responsible for how I teach science but teaching success is also due to my knowledge and general experience of my class.*

(ii) The expectations of the school

Teacher 20:

> *Influenced greatly by what is expected in the school I'm in, science planning is basically done for me. We are given an outline which I find influences me a lot.*

(iii) The teaching behaviours of peer teachers

Teacher 3

I believe that my method of teaching science is similar to my method of teaching Maths, Language or Social Studies. I think I have acquired this method from watching and teaching with other members of my teaching team as well as having a great deal more contact (than college provided) with teachers and their classes through my mother (a teacher) during my training.

Teacher 5

The way associate teachers teach or from practical situations in a classroom situation - i.e. observing others and their methods.

The setting of objectives was strongly taught at Teachers College but application to a practical situation with unpredictable children was not accounted for.

Also the practical drawbacks found in the classroom such as equipment - sufficient for the class?. The access to basic school supplies and the willingness for these to be used i.e. the school's attitude to the subject.

Teacher 6

Tips etc picked up from other Teachers. Ways they found successful and have passed on. Plus things I have actually seen in practice not just told about and expected to understand and know how they should work.

Teacher 9

Influence of Syndicate leader and other team members in our open plan classroom. We decide on a science unit and each teacher zero's in on a particular area.

Teacher 10:

Most of the method I use in teaching science is due mainly to other teachers whose advice I have sought. They have either just finished doing the same theme and have learnt from their experience and handed it on. Also during assembly time watching how other teachers control and manage the children and the way they manage to get the children to 'discover' for themselves.

Teacher 11

My observation of other teachers and collaborating with them I have been able to attain more insight into the subject and better teaching techniques.

The way I approach science is generally, the same way that I approach other subjects which could be due to my own instincts.

Teacher 13

- *observation of co-operating teacher i.e. in team teaching.*
- *help of friend who took T.C. Science for two years.*

Teacher 17

The only way I felt I learnt a style to teach science was on section. Only with a practicing primary teacher, teaching a science unit. From these people I picked up approach, technique, application, ways and means, and practised with a group of ch'n whereas in college nothing of this nature was even discussed. This practical approach gave a basis on which I could base my way of covering this subject.

(iv) University and work experience

Teacher 16:

Quite a lot of university science type work i.e. setting up and evaluating experiments, mostly in Aluvial hydrology and geomorphology.

Teacher 18:

My own schooling is 25 years behind me - hard to recall the good bits!

Most of the method I use stems from work experience gained prior to entering Teachers College, both as an engineer and as a Technical Officer at University.

(v) Personal style of teaching

Teacher 7

Certain methods have developed after experiencing the classroom situation. Every classroom often demands a different approach.

Teacher 19:

Because I began teaching Science topics very unsure of my ability etc I decided that the best way to tackle the subject was by using an approach that was most 'comfortable' for me. This I have done, and at least I can say that my class and I enjoy science lessons, even if we don't gain a great deal of knowledge from them.

I was given a guide at the beginning of the year, and my science lessons have been a combination of that guide and what I have felt as needs etc at the time.

(vi) A combination of factors

Teacher 1

.... Some of the 'success' experienced is obviously related to training, but it is very hard to work out if the foundation was yours or was it put there by T. Coll. training. I do not want to be unfair to the programme in general.

Some of the areas I felt needed looking at:

1) classroom dynamics
2) Integrated programmes
3) Team teaching
4) problem children in groups

These areas were left to individual education courses at College. I think that although they were invaluable in terms of training, these areas could have been considerably specified in relation to science itself. Too much was left as general knowledge rather than an intimate appreciation of the topics involved. Each one area has resulted in my greatest problems encountered this year and I feel it was more because of the experience and success gained by mastering these problems which led to my success in science teaching, rather than the general knowledge at T. Coll.

Teacher 8

"(Many) factors combined - 1, 2, 3, 4 and 5" (numbers referring to 5 of the 6 categories in Table 17).

Teacher 14

> *The method I now use in teaching science is due to the influence of the other teachers in the team and the policy of the school in choosing subject matter. The fact that teaching of science is integrated and is taught to infants at present, influences the detail, depths and methods used.*

COMMENT

It is noteworthy that 9 of the 20 teachers mentioned that their teaching patterns were influenced by peer teachers. Three of these teachers were from group 1 (teachers 3, 5 and 6) and 6 were from group 2 (teachers 9, 10, 11, 13, 14 and 17).

Two of these 9 teachers (teacher 3 from group 1 and teacher 17 from group 2) indicated specifically that their teaching patterns were influenced by the behaviours of other peer teachers during their training. The indications of the other 7 teachers (2 from group 1 and 5 from group 2) were that their teaching patterns were influenced by the behaviours and advice of associate teachers, or other teachers.

However, it is also noteworthy that 5 of the 9 teachers who indicated that their teaching patterns were influenced by other teachers (teachers 5 and 6 from group 1, and teachers 10, 11, and 17 from group 2) also indicated that their teaching patterns were at least moderately influenced by the way science was recommended to be taught at Teachers College. Also 3 of these teachers (teacher 5 from group 1 and teachers 10 and 11 from group 2) thought that their teaching patterns were moderately influenced by the way science was taught at Teachers College. (Appendix I).

Further, of the 9 teachers who indicated that their teaching patterns were influenced by other teachers:

- 5 teachers (teacher 6 from group 1, and teachers 9, 11, 13 and 17 from group 2) indicated that their teaching patterns were at least moderately influenced by the way science was taught at Primary School;

- 3 teachers (teachers 9, 13 and 17 from group 2) indicated that their teaching patterns were at least moderately influenced by the way science was taught at Intermediate School; and

- 3 teachers (teachers 10, 11 and 13 from group 2) thought that their teaching patterns were moderately influenced by the way science was taught at High School (Appendix I).

The general picture here is that, although the year-one teachers perceived that their teaching patterns were influenced somewhat by science curriculum training they also perceived that their teaching patterns were influenced by a variety of other factors.

A general summary of the results reported in this chapter follows.

SECTION III

SUMMARY OF RESULTS: TEACHING PATTERNS

This section presents a general summary of the results reported in this chapter.

Lecturer-recommendations

For functional transactions, the averaged recommendations of the lecturers were that: the highest amount of lesson time should be spent on operation about the subject matter of science, followed by intellectualization about science, with little time being recommended for information dissemination (about anything).

For structural transactions the averaged recommendations of the lecturers were that: the highest amount of lesson time should be spent by the teachers - dealing with small groups of pupils - firstly, as audience to small groups, secondly, as the targets of small groups, and thirdly, as emitters' to small groups. Next the emphasis was placed on the teachers' dealing with individual pupils, and finally, the least emphasis was placed on the teachers' dealing with the whole class.

The features that were similar for the recommendations of most lecturers were that: little time (10% or less of the lesson time) was recommended for information dissemination (about anything) or the teacher's dealing with the whole class, while a higher percentage of lesson time was recommended for intellectualization about science and the highest amount of lesson time was recommended for:

(i) the teacher as audience to multiple pupils and

(ii) operation about the subject matter of science.

Lecturer-transactions

There were narrow ranges in the averaged teaching patterns of the individual lecturers for 9 of the 12 functional transactions and for 8 of the 9 structural transactions.

The overall teaching pattern of the lecturers revealed that for functional transactions, a relatively high amount of lesson time (over 29%) was spent on information dissemination about the subject matter,* and operation about the subject matter while a moderate amount of lesson time was spent giving information about organization and intellectualizing about the subject matter, and less than 4% of the time was spent on the other 5 functional transactions.

For structural transactions the averaged lecturer-transactions revealed that the highest amount of lesson time was spent as audience to small groups of pupils (28.9%), followed by the lecturers:

- emitting to the whole class,
- emitting to individual pupils,
- as the targets of individual pupils,

while very little lesson time (less than 6%) was spent as the targets of the whole class, as audience to the whole class, or on the other 3 structural transactions.

Lecturer-recommendations versus Lecturer-transactions

The averaged functional transactions which took place during the lecturers' teaching sessions were similar to their averaged recommendations in that:

(i) a relatively high amount of lesson time (more than 29%) was spent on operation about the subject matter;

(ii) a moderate amount of lesson time (more than 14% but less than 27%) was spent on intellectualization about

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* Subject matter = science + science teaching in the case of the actual transactions of the lecturers.

the subject matter, and

(iii) less than 6% of the total lesson time was recommended for and spent on information dissemination about sociation and intellectualization about sociation.

For the lecturers, the averaged amounts of lesson time spent on information dissemination about the subject matter and information dissemination about organization were appreciably higher than their averaged recommendations while the averaged times spent on intellectualization about the subject matter operation about the subject matter and operation about sociation were appreciably lower than their averaged recommendations.

For structural transactions the averaged amounts of lesson time spent by the 5 lecturers as the targets of individual pupils, as audience to multiple pupils, or as audience to the whole class were very similar to their averaged recommendations. Also, the averaged times which they spent as the targets of the whole class, as audience to individual pupils, or as audience to the whole class as well as their averaged recommendations for these transactions were all lower than 7.2% of the lesson time.

Teacher-perceptions of lecturer-recommendations

For functional transactions both groups of teachers perceived that the recommendations of their lecturers were that the highest amount of lesson time should be spent on operation about the subject matter of science; followed by: intellectualization about the subject matter of science and that less than 10% of the lesson time was recommended for all other functional transactions except, in the case of group 1, where it was perceived that 15.9% of the lesson time was recommended for operation about organization.

For structural transactions both groups of teachers perceived that their lecturers recommended that the highest amount of lesson time should be spent by the teacher as the target of small groups of pupils, a moderate amount of lesson time as audience to multiple pupils, and the least amount of time as audience to the whole class.

Teacher-perceptions versus lecturer-recommendations

There were close resemblances between the teachers' overall perceptions of the percentages of lesson time recommended by the lecturers for 8 of the 9 functional transactions and 8 of the 9 structural transactions.

For group 1 there were close resemblances between the averaged lecturer-recommended times and the averaged group-perceptions of these times for 6 of the 9 functional transactions as well as for 6 of the 9 structural transactions.

For group 2 there were close resemblances between the averaged lecturer-recommended times and the averaged group-perceptions for 8 of the 9 functional transactions and 5 of the 9 structural transactions.

Teacher-perceptions of Lecturer-transactions

Group 1

The averaged perceptions of group 1 were that: the highest amount of lesson time was spent during their lecturers' teaching sessions on giving information about the subject matter, followed by: operation about the subject matter, and intellectualization about the subject matter, and that less than 10% of the lesson time was spent on the other 6 functional transactions.

For structural transactions the averaged perceptions of group 1 were that: the highest amount of lesson time was spent by their lecturers as audience to multiple pupils, then as the targets of the whole class, emitting to the whole class and as the targets of multiple pupils, while less than 10% of the lesson time was spent on the other 5 structural transactions.

Group 2

The averaged perceptions of group 2 were that: the highest amount of lesson time was spent during the teaching sessions of their lecturers on operation about the subject matter, followed by: intellectualization about the subject matter, information dissemination about the subject matter, and operation about organization, while less than 10% of the lesson time was spent on the other 5 functional transactions.

For structural transactions the averaged perceptions of group 2 were that: the highest amount of lesson time was spent by their lecturers emitting to the whole class followed by the lecturers: as the targets of multiple pupils, as the targets of the whole class, and emitting to multiple pupils, while less than 10% of the lesson time was spent on the other 5 structural transactions.

Teacher-perceptions of lecturer -transactions versus actual lecturer-transactions

For functional transactions the teachers' overall perceptions of the transactions of the lecturers bore close resemblances to the averaged lecturer-transactions in 6 cases and varied appreciably in 6 of the 12 cases.

For structural transactions the averaged perceptions of the teachers showed appreciable variations from the averaged times of the lecturers for 6 of the 9 transactions.

Group 1

For group 1 the averaged group-perceptions of the amounts of time spent on functional transactions during their lecturers' teaching sessions showed close resemblances to the averaged transactions of their lecturers in 7 cases and varied significantly in 5 cases.

For structural transactions the averaged group-perceptions of the structural times of their lecturers varied significantly from the averaged times of these lecturers in 6 of the 9 cases.

Group 2

For functional transactions the averaged perceptions of group 2 showed close resemblances to the averaged times spent during their lecturers' teaching sessions in 6 cases and showed appreciable variations from the averaged times of their lecturers in 6 cases.

For structural transactions the averaged perceptions of group 2 showed appreciable variations from the averaged times of their lecturers for 6 of the 9 transactions.

Teacher perceptions of their "pre-college" science teachers' transactions:

The averaged teacher-perceptions of the teaching patterns of their "pre-college" science teachers were very similar for both groups of teachers.

For functional transactions, both groups of teachers perceived that the highest amount of lesson time was spent giving information about science, followed by:

(i) intellectualization about science; and
(ii) operation about science; with less than 11% of the lesson time being spent on the other 6 functional transactions.

For structural transactions the averaged perceptions of both groups of teachers were that: the highest amount of lesson time was spent by their "pre-college" teachers firstly, emitting to the whole class; secondly, as the targets of the whole class; and thirdly, emitting to multiple pupils; while less than 9% of the lesson time was spent on the other 6 structural transactions.

Teacher-recommendations

The recommended functional and structural transactions of both groups of teachers were very similar.

For functional transactions, both groups of teachers recommended that the highest amount of lesson time be spent on operation about science, followed by intellectualization about science, with less than 11% of the lesson time being recommended for the other 7 functional transactions.

For structural transactions, both groups of teachers recommended moderate amounts of time (11% to 18.6%) for the teacher:

- emitting to the whole class,
- as the target of individual pupils,
- as the target of multiple pupils, and
- as audience to multiple pupils, while 10% or less of the lesson time was recommended for the teacher's:
  - emitting to individual pupils,
  - emitting to multiple pupils,
  - being audience to individual pupils or
  - being audience to the whole class.

Teacher-recommendations vis-á-vis alternatives:

For both groups of teachers the averaged recommendations for the functional and structural behaviours that are appropriate for the teaching of elementary science were most similar to the group-perceptions of the teaching patterns that were recommended by their lecturers for the teaching of elementary science.

The averaged recommendations of both groups of teachers also resembled the group-perceptions of the teaching patterns of their respective lecturers, and the averaged recommendations of their respective lecturers.

The teaching patterns which the averaged recommendations of both groups of teachers resembled least were their respective perceptions of the teaching patterns of their "pre-college" science teachers, and the averaged teaching patterns of their lecturers.

Teacher-transactions

The averaged teaching patterns of both groups of teachers were almost identical for both functional and structural transactions.

For the functional transactions of both groups of teachers: the highest amount of lesson time was spent on operation about science, followed by: information dissemination about science; and information dissemination about organization, with less than 10% of the lesson time being spent on the other 6 transactions.

For structural transactions both groups of teachers spent the highest amount of lesson time as audience to multiple pupils, followed by: emitting to the whole class; and emitting to individual pupils with less than 10% of the lesson time being spent on the other 6 transactions, and the least amount of time being spent as the targets of the whole class.

Teacher-transaction vis-á-vis alternatives

(i) the overall teaching pattern of the teachers was most similar to the overall teaching pattern of the lecturers for both functional and structural transactions;

(ii) the averaged teaching patterns of both groups of teachers were most similar to the averaged teaching patterns of their respective lecturers.

(iii) The functional patterns of <u>15 of the 20 t</u>eachers were most similar to <u>the averaged functional patterns of their respective lecturers</u>.

(iv) The average structural patterns of <u>18 of the 20</u> teachers were most similar to the averaged <u>structural patterns of their respective lecturers</u>.

<u>Teacher-attribution of teaching patterns to science curriculum training</u>

For both groups of teachers (those who received spaced curriculum training and those who received massed curriculum training) teaching patterns of the members were attributed to various factors including the teaching patterns that were <u>recommended by the college lecturers</u>, those that were <u>employed by the lecturers</u>, those that were <u>employed by their science teachers at school</u> and those that were <u>employed by peer teachers</u>. In some cases teaching patterns were also thought to be influenced by University or work experience, knowledge of the class, and the policies and expectations of the schools.

<u>Comments</u>

(i) Although the lecturers, as a group, recommended a pattern of teaching <u>high</u> in <u>operation about science</u> and <u>teacher-interaction with small groups</u>; and <u>low</u> in <u>information dissemination</u> and <u>teacher-interaction with the whole class</u>; during their own teaching sessions the averaged amounts of time spent on <u>information dissemination about the subject matter</u> and <u>emitting to the whole class</u> were appreciably higher than their averaged recommendations.

(ii) For both groups of teachers, the averaged perceptions of the recommendations of their lecturers bore close resemblances to the averaged recommendations of their lecturers. However, their averaged perceptions of the actual transactions of their lecturers were not as accurate - particularly in the case of structural transactions.

(iii) The recommended teaching patterns of both groups of teachers were very similar to their averaged perceptions of the recommendations of their lecturers.

(iv) The averaged teaching patterns of both groups of teachers were most similar to the averaged teaching patterns of their lecturers. However, in the case of operation about science the averaged teaching patterns of both groups were more in keeping with the averaged "recommendations" of their lecturers.

(v) The averaged profiles for both groups of teachers were very similar for:

(a) their averaged perceptions of the teaching patterns of their "pre-college" science teachers,

(b) their averaged recommendations and

(c) their own (averaged) teaching patterns.

These, and other issues are examined more fully in the following chapter which deals with a discussion of the findings and conclusions of the study.

CHAPTER 6

DISCUSSION AND CONCLUSIONS

This chapter discusses the findings of the study in light of the issues raised in Chapter 2. In the process it takes into account some relevant findings of other studies and certain pertinent theoretical considerations. The chapter also discusses the educational implications of the findings and comments on the limitations of the study. Finally, the conclusions drawn from the study are presented.

Discussion-Teaching Competencies

With respect to massed and spaced preservice training in science teaching and the subsequent teaching competencies of year-one teachers 3 issues were raised in Chapter 2, viz:

(i) use in teaching of competencies presented during training;

(ii) extent of attribution to training of the capability to use such competencies in science teaching;

(iii) extent to which success levels in the various competencies contributed to overall levels of success.

In the field of elementary teacher education much research has been conducted in the area of teacher acquisition and use of specific skills and competencies but few studies have focused on the effects of preservice training on subsequent teaching performance.

Within the confines of the usual short-term focus, previous research into the training of elementary science teachers has shown that training in specific skills and competencies generally results in teacher acquisition and/or use of these skills and competencies in classroom situations (Wilson, 1967; Breit and Butts, 1969; Harris *et al.*, 1970; Newport and McNeill, 1970; Sabulao 1973; Jaus, 1975; Brown, 1977;

Campbell and Okey, 1977; Cotten *et al.*, 1978; Bluhm, 1979; Riley, 1979; Zeitler, 1981). In this respect, the present study, though of longer duration, has proven to be no exception. For both "massed trained" and "spaced trained" teachers, the averaged levels of success in the 47 competencies presented during training was reportedly "high" - in this case, after they had spent 6 months as year-one teachers. Moreover, capability to practise these competencies was also attributed to preservice training. The levels of success indicated by both groups of teachers for the 40 general competencies were, on the average, "partly" attributed to preservice training, while the levels indicated for the 7 personal competencies were "very much" attributed to preservice training by the "spaced trained" teachers and "partly" attributed to preservice training by the "massed trained" teachers.

Over and above this, the year-one teachers also indicated that practising the competencies presented during preservice training did enhance their overall level of success as science teachers. Both groups of teachers indicated that the "high" (averaged) levels of success that they perceived themselves to be experiencing in the 47 competencies had a "high" level of influence on their overall level of success as science teachers.

Thus despite the combined implications of Watson's Principles of Frequency and Recency, and Thorndike's Law of Exercise viz: that learning is enhanced more by massed practice than by spaced practice the present study has shown, at least as far as the teachers themselves perceived their success, that massed curriculum training shows no significant advantage over spaced curriculum training with respect to teacher-use of competencies provided during preservice training. On the contrary, the averaged scores of the "spaced trained" teachers yielded higher mean scores than those of the "massed trained" teachers for:

(i) success levels in the competencies provided during training,

(ii) attribution of these levels of success to training, as well as for

(iii) the influence of these levels of success on their overall level of science teaching.

However, the higher success, attribution and influence mean scores of the "spaced trained" teachers could be possibly due to the fact that the "spaced trained" teachers received science-specialist training in addition to their science curriculum programme whereas the "massed trained" teachers were the non-science-specialists and received only the science curriculum programme.

Clearly, these conclusions can not be carried too far. The only criterion of success employed here has been the teachers' own perceptions of success. Conceivably, these perceptions may have been distorted. Other less subjective criteria might yield different results Again there is no guarantee of correspondence of 'standard' among the teachers. The individual perceptions of standard may have been quite at variance with one another. Finally, the small size of the sample makes generalizations beyond the specific case hazard-ous, if not impossible - an issue germane to the remaining results also.

In the present study it is significant that process skills featured predominantly among the competencies that were most highly attributed to training by the first-year teachers as a group. Among the 10 - 7 pertained to process skills. Of these 7 - one (item 36) involved the evaluation of process skill acquisition in children. Six (items 25, 26, 28, 29, 30, and 32) pertained to the teaching of process skills.

Capability to perform all 7 of these competencies were "very much" attributed to preservice training in science teaching. Success levels in all 7 of these competencies were reportedly "high" and levels of success in all of these 7 competencies were reported to have "high" levels of influence on the overall level of success of the first-year science teachers.

It is also noteworthy that - "teaching pupils to observe (item 26) - was among the 5 competencies whose success levels were reported to have the highest levels of influence on the overall level of success of the year-one teachers. This last observation is not altogether surprising since the New Zealand's Infant to Standard 4 Science Syllabus (which most teachers used) is inquiry-based and process-oriented, and the development of process skills such as "measuring, classifying, inferring, predicting outcomes" and the like, depend predominantly on the pupils' ability to observe.

The other 4 competencies whose success levels were reported to have the highest levels of influence on the science teaching success of the year-one teachers were either concerned with (i) class management and control (items 10 and 11); or (ii) programme and lesson planning (items 13 and 16).

These findings indicate that for both groups of teachers positive transfer* of training was perceived to have occurred with respect to the teaching competencies provided during preservice training. This was however, clearly intended since the overall objectives of the science curriculum training programmes were the same as those of the New Zealand's Primary Science Syllabus - Infants to Standard 4 (page 413). While similar intentions have not always been realized through training programmes, Bronfenbrenner provides an explanation of why they might be expected to be: -

> *The developmental potential of a setting is increased as a function of the number of supportive links existing between that setting and other settings....* (Bronfenbrenner, 1979; p. 215).

* Montgomery (1953) also reported no significant differences between positive transfer in subjects who received practice distributed over different time intervals.

Also, earlier theorists such as Thorndike and Woodworth (1901)* and Gagné (1962), as well as the research findings of Ellis (1958) and Heath (1959) support the idea that positive transfer is enhanced to the extent that elements within the learning situation are the same as the tasks required in the new situation.

If it can be assumed that the perceptions of the teachers of their own success reflected to some extent "real" success, it would appear that the close alignment of the overall objectives of the training programmes to those of the teaching situations into which the graduates of these programmes were subsequently placed, facilitated positive transfer. It must be mentioned too that both programmes of training were competency-based and preservice teachers did not "pass the course" until evidence was shown that the desired competencies had been acquired.

As a final note in this section the results obtained for certain competencies warrant some discussion in their own right.

First, the <u>organizational structures</u> of some schools prevented teacher-use of certain competencies. Two teachers reported that competency in <u>collaborating with the Science Resource Teacher</u> was "not applicable" because there were none. For the same reason, six reported competency in <u>benefitting from collaborating with the Head of Science Department</u> was "not applicable".

Second, because of the <u>organizational practices</u> of some schools some teachers were not required to use certain competencies. Three teachers were not required to <u>write progress reports</u> for members of their science classes because this was done by the team-leader in charge of science. One other teacher (teacher 15) reported never having to <u>exercise her</u>

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* Reported by Bugelski (1956)

own judgement over how to use the science syllabus. In this particular case all science activities were planned by a "science committee" (using the ideas submitted by all members of the team). Following this, the science team-leader presented the "introductory lesson" to all students in "the team-teaching section", after which the other team-teachers took their own particular groups for the (pre-planned) follow-up lessons.

These findings of the influence of what Lundgren (1972) has called "frame factors" are in keeping with the theoretical postulations of Morris (1969); the real-life experience of Kohl (1971); the reports of Hanson and Herrington (1976); and the research findings of Battersby (1981) which each evince that the behaviours of teachers can be circumscribed by the particular organizational or educational demands of the schools.

Third, the developmental level of a class of pupils reportedly prevented the use of certain competencies. Teacher 11, who taught new-entry and infants, reported that helping pupils develop concepts in science (item 24); teaching pupils to hypothesize (item 31); or teaching pupils to experiment (item 32) were "not applicable" to her class level. According to Piaget's theory of "Development and Learning", most pupils at such an age would still be at the pre-operational stage and thus be unable to perform "higher order" process skills such as hypothesizing and experimentation. However, the other teacher who taught new-entry and infants (teacher 5) reported "average" amounts of success for items 24 and 32 and a "low" level of success for item 31.

As a point of interest, teacher 11 had a "well regimented" class where the pupils generally "did as they were told" whereas teacher 5 had a class with "a mind of its own" and given to frequent digressions away from the task at hand. For example during an activity session on "magnetism", instead of separating the objects (prepared beforehand by the teacher) into magnetic and non-magnetic groups all but a few members of this class "went fishing" for magnetic objects within the classroom and proceeded to pull their "catches" (chairs, screws, keys, paper clips, other magnets etc) around the room for the other members to view. Some class members also succeeded in making magnetic boats (made from paper and pins) sail on the surface of water in an a~~q~~quarium as well as "up the sides" of the a~~q~~quarium. Whether a "free" classroom atmosphere is more conducive to experimentation and concept formation in infants is a topic ripe for another research project. However, according to Piaget himself (1964) the research findings of Laurendeau and Pinard have shown that the mental development of children can be "systematically delayed". Teacher 5, incidentally, was a science-specialist and teacher 11 was not.

Fourth, for 1 general competency - using the science teaching kit prepared at Teachers College - the year-one teachers, as a group, were experiencing their lowest levels of success. Exactly why this should have been the case is not known but one probable explanation is that because of the predominantly enquiry-based, "hands-on"* nature of the kit's activities,** the teachers themselves may not have had enough control over the teaching situation as they would have liked. It must be mentioned that the averaged scores of the entire group of teachers indicated that - controlling pupils during science classes - had the highest level of influence on their overall level of success. Next highest in influence were - organizing pupils during science lessons (item 10); planning the science programme (item 13); preparing science activities (item 16); and teaching pupils to observe (item 26). These competencies are vital to the success of any inquiry-oriented teaching which frequently necessitates independent pupil and/or group work.

Finally, it would appear that the teacher's own knowledge and understanding of science were not, they thought, the major factors in determining their success as science teachers.

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* Pupils' hands

** The preparation of a science teaching kit was primarily intended as an exercise to develop the teachers' skills in preparing science activities irrespective of whether or not these activities were subsequently used in the classroom.

Although the averaged scores of both groups of teachers indicated that their own knowledge and understanding of elementary school science had a "high" level of influence on their science teaching success, their own ability to teach science was thought to have a higher level of influence.

Attention now turns to a discussion of the results for pre-service training in science teaching and the subsequent teaching patterns of the year-one teachers.

Discussion - Teaching patterns

Lecturer-recommendations

At the particular Teachers College at which the first phase of the study was conducted, emphasis was placed on preparing teachers for the actual classroom situation. Consequently, the overall objectives of all science curriculum programmes (both massed and spaced) were identical to the overall objectives of the New Zealand's Primary Science Syllabus - Infants to Standard 4 (page 413).

Because of this, it was not surprising that "discovery learning" was emphasized as the desired teaching pattern for the students of these programmes to adopt.

This preference for "discovery" teaching was also evident from the results of the interviews with the sample of science lecturers. The interview results revealed that the science lecturers, as a group, placed the greatest emphasis on operation (doing activities) about science - 39.6% of the lesson time, followed by intellectualization (promoting understanding) about science - 23.74%, while very litte lesson time (less than 3.5%) was recommended for giving information about any transaction.

Similarly, for the teacher's role, the averaged recommendations given by the lecturers favoured the teacher's dealing with small groups of pupils - firstly, as audience to small groups (27% of the lesson time), secondly as the target of small groups (18%); and thirdly as the emitter to small groups (13%). This was followed by the teacher's dealing with individual pupils (11% of the lesson time as the target, 7.9% as the emitter, and 7.1% as audience to individual pupils). Finally the least emphasis was placed on the teacher's dealing with the whole class - whether the teacher was the emitter, the target or audience to the whole class (the averaged recommendations of the lecturers did not exceed 7.4% of the lesson time).

It must be remembered, however, that the use of descriptors from the Adams' Instrument indicating the functional and structural transactions was somewhat artificial when compared with the "conventional wisdom of teaching". The Adams' system was an analytic one with (abstract) categories 'logically' derived according to "structure" and "function".* Operationalization of these categories (i.e. using them in practice) entailed either:

(i) the interpretation of observed behaviours in their terms;

(ii) the translation of reported behaviours into their terms (i.e. perceived and recommended behaviours); or

(iii) in the case of the interviews, educating the interviewee in the meaning of their terms.

The lecturers were therefore required to indicate the specific amounts of lesson time which they thought elementary science teachers should spend on 18 functional and structural transactions, whereas, in the actual training sessions this was not the case. During training, the recommended teaching pattern was couched in other terms. The emphasis was always on "discovery learning" and could be summed up by the following, oft-repeated, injunction : -

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* Discussed in Chapter 3.

Keep your hands off the learning situation as much as possible and let the children find out for themselves.

During training sessions no time limits for example were specified by the lecturers for transactions such as: -

" - information dissemination about organization,
- intellectualization about organization,
- operation about organization,
- information dissemination about sociation,
- intellectualization about sociation, or
- operation about sociation".

However, there was a strong emphasis on transactions which could be classified as:

(i) "operation about science" - doing activities about science;

(ii) "intellectualization about science" - getting children to think, reason, predict, infer, and to answer "how" and "why" questions; and

(iii) "the teacher as audience to small groups of pupils".

Conversely, teachers were enjoined to spend very little time
(i) giving information, and
(ii) dealing with the whole class.

Lecturer-practice

Most of the above "recommendations" were also prominent in the actual teaching patterns of the lecturers. However, because they were vested with the task of training would-be teachers, the lecturers themselves were faced with a dual objective - to provide the teacher-trainees with an instructional experience similar to the one advocated for use in the schools' classrooms while at the same time providing them with as much information as possible about the teaching of science. This they did. The science curriculum training sessions were predominantly activity-based. However, during activity sessions, while the teachers-to-be were occupied with particular activities, the lecturers themselves were busy giving as many "pointers" as possible about the teaching of science - activities that are suitable or unsuitable for children of a particular age group; activities that could be used for motivating a class, or those that could be easily integrated with other subjects; how to change the levels of difficulty of particular tasks; questions that could be used to encourage the development of certain process skills; how to make teaching materials from "junk"; what kinds of responses to expect, or not to expect, from children of different age groups; how to make a particular activity more open-ended etc, etc, etc.

These "pointers" were usually directed at individual students but occasionally they were directed at an entire group of students or at the whole class.

During activity sessions the lecturers were also busy answering students' questions about science teaching and attempting to effect attitude changes in the students. Consequently, the averaged amounts of lesson time spent during the teaching sessions of the lecturers on:

(i) giving information about the subject matter,
(ii) giving information about organization, and
(iii) emitting to the whole class,

were appreciably higher than their averaged recommendations, while the averaged amounts of lesson time spent by the lecturers emitting to small groups or as the targets of small groups were appreciably lower than their recommendations.

It is noteworthy however, that the 32.5% of lesson time that was spent during the teaching sessions of the lectuers on giving information about the subject matter was divided thus : 20.7% - giving information about science teaching, 11.8% - giving information about science.

Additionally, although it may appear as if the lecturers themselves spent a good deal of time giving information about the subject matter, in essence, this was not necessarily the case. According to the instrument used for the analysis of classroom interaction in this study, whenever information was given about the subject matter (etc) it was recorded under information dissemination about the subject matter (etc) irregardless of who was giving the information to whom - lecturer to student, student to lecturer, or student to student. Thus the functional patterns of the lecturers were determined, to a certain extent, by the students whom they taught. So also were their structural transactional patterns - depending on how often they became the targets of individual pupils, of multiple pupils, or of the whole class.

This finding is somewhat in keeping with those of Irwin and Butts (1972) where the instructional behaviours of their teachers were shown to be influenced by the children whom they taught.

It is also noteworthy that all lecturers spent more time emitting to individual pupils than emitting to either the whole class, or to multiple pupils. This could possibly account for the fact that the actual (averaged) amount of lesson time spent by the lecturers emitting to small groups was appreciably lower than their averaged recommendation while the averaged amount of lesson time spent emitting to individual pupils was appreciably higher than their averaged recommendation.

The high (averaged) percentage of lesson time spent by the lecturers emitting to the whole class (25.9% as opposed to a recommended 7.4%) was particularly due to the fact that, preceding every workshop session, there was always a seminar in which the preservice teachers were not divided into groups but were kept as a single unit. Because of this, whenever a lecturer spoke to the seminar group - questioning , giving information, etc - he was automatically emitting to the whole class.

Thus although the lecturers themselves tried to provide the students with a teaching situation similar to their recommendations, the design of the training sessions (seminar + worksshops); and the basic objectives of the programme (equipping students with knowledge as well as skills in science teaching, and effecting attitude changes in the students) also played a part in shaping their teaching patterns.

It must be mentioned too, that the attempts by the lecturers to effect attitude changes in the students proved to be very fruitful. All of the students in the sample reported a more positive attitude towards the teaching of science after science curriculum training than before. The following comments, written by the students at the end of their science curriculum courses, bear testimony to this fact:

Teacher 4:

> *My view of science has changed considerably from a very narrow view, science being 'looking at spiders', to a much broader view, including the development of process skills, attitudes, communication skills.....*

Teacher 3:

> *When I entered the course I thought of Primary Science as a dried up nature table and the non-touchable equipment kept away in the back cupboard. I know now that science can be, and should be a subject that appeals a great deal to all children.*

Teacher 9:

> *Have changed my opinion of Science. It's the first time I've been successful. Process Skills are more meaningful than $CO_2 + H_2O = H_2CO_3$. Science isn't my favourite subject at all but it's nice to know I can teach it and not know much about it.*

Teacher 10:

It's not all Physics and Chemistry; it can be interesting and worthwhile in finding out things I never knew.

Teacher 6:

I feel that the emphasis is now on a process skill approach rather than children being given a whole host of facts being knowledge orientated.

These findings confirm those of Christiansen (1971); Jaus (1975); Campbell and Okey (1977), and Bethel (1981) where it was found that teachers had more positive attitudes toward the teaching of science after training for science teaching.

Attention now turns to the teaching patterns of the year-one teachers.

Teacher-perceptions of lecturer-recommendations

The results of the study revealed that the averaged teacher-perceptions of the patterns of teaching recommended by the lecturers for elementary science teachers were very similar to the (averaged) recommendations made by the lecturers (Figure 35). The perceptions of group 1 showed very close resemblances to the averaged recommendations of their lecturers (lecturers 1 and 5) for 6 of the 9 functional transactions as well as for 6 of the 9 structural transactions (Figure 36). For group 2 the averaged perceptions showed close resemblances to the averaged recommendations of their lecturers (lecturers 1-4) for 8 of the 9 functional transactions and for 5 of the 9 structural transactions.

From these results it is evident that both groups of year-one teachers, to this extent, "received the message" of the training programme even though the "message" was not spelt out by the lecturers in exact percentages of lesson time.

Moreover, these same teachers retained this "message" and were able to reproduce it after they had spent 6 months as year-one teachers.

There are two implications here. Firstly, incidental learning took place. The close alignment of the averaged perceptions of both groups of teachers to the actual (averaged) recommendations of their respective lecturers would suggest that, during the training programmes, the teachers acquired information over and above what was actually said by the lecturers. In other words they were able to ascertain certain values held by the lecturers and reflect them back in the somewhat artificial (time-based) terms of the current study.

Secondly, what ever "message" was learned from the training situation was able to be stored, and reproduced by the teachers after a period of 6 months had elapsed. This finding confirms that of McDougall (1958) where, after a period of 4 months, subjects retained, and were able to apply, underlying principles of previously learned materials although, recall of the general knowledge of the original learning had decreased.

Over and above this finding, Jones and Kohler (1958) found that subjects tend to retain learning materials which are compatible with their own particular beliefs. This phenomenon would appear to be operating in the case of these first-year teachers.

Teacher-recommendations

The findings of this study showed that, for both groups, the averaged perceptions of teaching patterns that should be employed by elementary science teachers closely resembled firstly, their averaged perceptions of the recommendations of their lecturers, secondly, their averaged perceptions of the actual teaching patterns of their lecturers, and thirdly, the averaged recommendations of their respective lecturers

(Figures 52 and 53).

The question then, is whether or not the recommendations of the teachers themselves were the result of science curriculum training or whether the teachers possessed these particular beliefs on entry to the training programme? There are 2 factors which suggest the former. Firstly, it is very significant that the teachers' overall recommendations should resemble both lecturer-recommendations and lecturer-behaviours since this, in effect, constituted the "message" of the training programmes. During all such sessions, although there was a "do as we say" message, there was also a decidedly "do as we're doing" emphasis.

Secondly, it is also highly significant that, of the 3 teaching patterns which the averaged recommendations of both groups of teachers resembled most - the greatest degree of similarity was found between the averaged recommendations of the groups and their averaged perceptions of the recommendations of their respective lecturers.

These two factors coupled with the written comments of the students (already discussed) would suggest that the training programme itself was at least partially responsible for shaping teaching patterns considered desirable by the two groups of teachers.

Teacher-perceptions of lecturer-transactions

Although the averaged perceptions of both groups of teachers showed close resemblances to the averaged functional and structural recommendations of their lecturers, their averaged perceptions of the actual teaching patterns of their lecturers were not as accurate. In the case of group 1, the averaged perceptions showed close resemblances to the averaged transactions of their lecturers for 7 of the 12 functional transactions but varied significantly for 6 of the 9 structural transactions (Figure 42). The same was true for group 2 except that, for functioal transactions, their averaged perceptions were similar to the averaged transactions of their lecturers in only 6 of the 12 cases (Figure 43).

One probable explanation for this phenomenon is that, during training sessions, what the lecturers said may have been more obvious to the individual student than what the lecturers did - particularly during activity sessions. During all such sessions the students worked in groups while the lecturers moved around from group to group sometimes talking to individual group members, sometimes to the entire group and sometimes addressing the whole class. Consequently, the individual teacher's perception of the behaviours of the lecturers would be somewhat circumscribed by his or her own preoccupation with the learning task. Further, whether or not anyone can accurately observe behaviour is likely to be a factor of experience at doing so, or training to do so. A number of researchers in the Flander's tradition, have demonstrated that teachers trained in Flander's Interaction Analysis become more skilled at applying (desirable) Flanders defined behaviours (see Dunkin and Biddle (1974). This is not to imply that role modelling does not and can not take place as some of the later findings will indeed suggest, merely to make the point that role modelling might well be facilitated by systematic training in the modelling process.

Teacher-perceptions of "pre-college" teacher-transactions

The results of the study revealed that both groups of teachers perceived the teaching pattern of their "pre-college" science teachers to be one predominated by:

(i) information dissemination about the subject matter (40 -47.1% of the lesson time) and

(ii) teacher-talk that was addressed to the whole class (46-53%), with relatively little operation about science (10.4-12.9%), or intellectualization about science (11.6-13.1%) (Figure 46.2).

This predominantly teacher-centered approach was particularly marked in the case of the perceptions of Teacher 18 (Appendix L) where 100% of the class time was perceived to have been spent by his "pre-college" science teachers emitting to the whole class. Similarly, this same teacher perceived that his "pre-college" science teachers spent 80% of the lesson time giving infomration about science and 20% giving information about organization. It must be mentioned that this particular teacher received his "pre-college" science teaching some 25 years prior to his entry to Teachers College. The perceptions of some of the more recently-schooled teachers however, were not very markedly different - teachers 3, 5, 12, 16, and 17 (Appendix L).

For both groups of teachers the perceived patterns of teaching that were practiced by their "pre-college" teachers were markedly different from either:

(i) the patterns employed by their respective lecturers,
(ii) those recommended by their lecturers,
(iii) those recommended by the two groups of teachers, and
(iv) those employed by the two groups of teachers.

Moreover, in some respects, the perceived "pre-college" patterns were directly opposite to the recommendations of both lecturers and teachers where the emphasis was on an activity-based pattern of teaching (operation about science) with little information dissemination about science and little emitting to the whole class.

First-year teachers: Actual transactional patterns

Of the 6 teaching patterns with which they were compared, the averaged teaching patterns of both groups of teachers resembled mostly the actual teaching patterns of their respective lecturers. Moreover, on an individual basis:

(i) the (averaged) functional patterns of 15 of the 20 teachers resembled the averaged functional patterns of their respective lecturers; and

(ii) the (averaged) structural patterns of 18 of the 20 teachers resembled the averaged structural patterns of their respective lecturers (Appendix N).

From this it would appear that the teachers modelled the teaching patterns of their respective lecturers.

This is a seemingly strange phenomenon since, for both groups of teachers, their concepts of how elementary science should be taught resembled most closely their perceptions of the recommendations of their lecturers. The question could be asked "why is it that their actual teaching patterns are closer to the teaching patterns employed by their lecturers?"

According to Gagné (1970) concepts are usually acquired by "verbal means" and it is possible to acquire a concept without necessarily acquiring the "operational meaning" of that concept. More precisely he states:

> *Concepts may be aroused by verbal means . . . . In human beings their meanings are almost always based on verbal chains. But to be accurate tools for thinking about and dealing with the real world, concepts must be referable to actual stimulus situations. These provide them with an "operational" meaning that can come no no other way. (p. 179).*

Although it is evident that the year-one teachers acquired the concept of elementary teaching that was recommended by the lecturers, in the actual classroom situation they largely followed the concrete example of the pattern of science teaching employed by their lecturers. However, in some respects, the actual transactions of the teachers were more in keeping with the recommendations of the lecturers. Explanation follows.

The averaged teaching patterns of the two groups of teachers showed appreciable variations from the averaged teaching patterns of their respective lecturers in the following areas:

(i) For functional transactions, less time was spent by both groups of teachers on information dissemination about science and intellectualization about science while more time was spent on operation about science.

(ii) For structural transactions, less time was spent by the two groups of teachers emitting to individual pupils and emitting to the whole class and more time was spent as audience to multiple pupils.

The lower amount of lesson time spent during the teaching sessions of both groups of teachers on information dissemination about science could be accounted for by the fact that the teachers talked less than the lecturers did during activity sessions.

Whereas the objectives of the training programmes necessitated more lecturer-talk, the teachers were not similarly constrained. Hence they were able to adhere more to the recommended "discovery approach" to instruction where activities about the subject matter were strongly advocated. The lower amount of teacher-talk (in the case of the 2 groups of teachers) could also account for the fact that less time was spent by them talking to the whole class and emitting to individual pupils. The relatively high amount of lesson time spent by the two groups of teachers as audience to small groups of pupils was directly due to the "hands-on"* approach with which they conducted their lessons. In using this approach their pupils were allowed to spend the greatest proportion of lesson time on operation about science while the teachers moved around attending to small groups of pupils, clarifying pupils' ideas or answering pupil-questions when requested either by individual pupils or by small groups of pupils.

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* pupils' hands

The lower amount of lesson time spent during the teaching sessions of the 2 groups of teachers on intellectualization about science could probably be due to the age differences in the students who were taught by the lecturers and those who were taught by the teachers - i.e. it could be possible that College students are more capable of intellectualizing about science than are their elementary counterparts. Adams and Biddle (1970) found more intellectualization about relevant matter in grade XI pupils than in grade I pupils.

Nonetheless, a small dilemma does remain. When the science lecturers wanted to educate their teachers about teaching practices, they tended to revert to an information dissemination mode. What is more, on the evidence here, it worked. One wonders if these year-one teachers will eventually become anxious about the amount of science knowledge received by their pupils and if then they may (wish to) employ more direct teaching methods.

Having discussed the general findings of the study with respect to the teaching patterns of the year-one teachers attention now turns to certain specific findings about the classroom behaviours of teachers which either coincide or disagree with the findings of this study.

Other Research

Findings of this study regarding classroom interactions parallel the findings of similar studies in the following areas:

(i) "Classroom groups spend most (50 percent) of their time on relevant subject matter (Adams and Biddle, 1970)".*

In the case of this study however, about 90% or more of the lesson time was spent on relevant subject matter.

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* Findings in this chapter for Adams and Biddle (1970); Gump (1967); Lundgren (1972); and Perkins (1964), are all taken from a review of classroom interaction studies by Dunkin and Biddle (1974).

(ii) "<u>Longer incidents</u> (exchanges) are more likely to concern <u>relevant subject matter</u>; shorter incidents (exchanges) are more likely to concern <u>organization and sociation</u> . (Adams and Biddle, 1970)".

(iii) 'Less time is spent by classroom groups on <u>organization</u> than on <u>relevant subject matter</u> but more time is spent on <u>organization</u> than on <u>sociation</u>' (Adams and Biddle, 1970).

(iv) 'Little time is spent by classroom groups on <u>sociation</u>' (Adams and Biddle, 1970). This finding also parallels that of Perkins (1964) where reportedly, "little time" was spent by teachers, as "<u>socializing agents</u>". Power (1977) also observed that from the results of "pre-1973 studies" on classroom interactions:

> *Classrooms . . . appear as affective deserts, praise and criticism both . . . being quite rare . . . .*

(v) "Small groups are associated with <u>higher pupil involvement</u> than is the total classroom <u>group</u> (Gump, 1967)".

(vi)"Teachers address <u>individual pupils</u> more often than they address <u>pupil groups</u> (Gump, 1967)".

(vii) 'The teacher's role can be affected by the subject matter' (Adams and Biddle, 1970). In their study they found that teachers talked more during Mathematics lessons than during Social Studies lessons. In this study it was found that when science was not integrated with other subjects there was more <u>operation about relevant subject matter</u>, little <u>information dissemination about the subject matter</u>, and that teachers spent more time <u>as audience to small groups of pupils</u> (see for example the teaching profiles of teachers 1, 4, 5, 12, 14 and 17 - Appendix F). However, when science was integrated with Social Studies or Story (as was the case with teachers 8, 15, and 20 - Appendix F) there was, on an average, considerably <u>more information</u>

dissemination about relevant subject matter, less operation with the subject matter and less time spent by teachers as audience to small groups.

(viii) 'The role of the teacher can be affected by the ~~fore~~mat of the lesson' (Lundgren, 1972). In the present study it was found that lessons involving field trips (Teachers 10, 11, 12 and 17) followed an established pattern:

a) a preparatory lesson about the "objectives" of the field trip and the "code of pupil conduct";
b) the field trip itself; and
c) one or two "follow-up" sessions for discussion and consolidation of information acquired from the field trip.

Generally, field trips were high in operation about relevant subject matter and low in teacher talk. There were also more group discussions and more independent pupil investigations.

Lessons immediately before field trips tended to be high in information dissemination and teacher-talk. Those following field trips varied according to whether or not there was:

(i) a general discussion,
(ii) individual or group presentation of information generated from the field trip , or
(iii) further work (operation) with collected materials.

In certain cases the findings of this study have shown appreciable agreement with those of Adams and Biddle (1970). However, certain findings of this study appear to contradict some of the Adams and Biddle findings particularly in the areas of teacher role and pupil operations. In the Adams and Biddle study, teachers were found to emit for about 50% of the time and seldom occupied the role of "audience". Pupil groups, on the other hand, were found to spend little time performing operations. In this study the lessons of most teachers were predominated by pupil operations about the subject matter and by teachers occupying the role of "audience to small groups".

In science, however, there apears to be a trend towards more student involvement during classroom sessions. In his "Critical Review of Science Classroom Interaction Studies" Power (1977) observed that, particularly in 'Post 1973' studies where teachers used less "conventional" curricula, there was a notable shift from the usual teacher-centered approach to teaching to a more student-centered approach.

Attention now turns to the educational implications of the findings of this study.

Educational implications

Despite the small sample size (Lecturers: n = 5; teachers: n = 20) and the restriction of present study to the science department of a single Teachers College the research has generated an appreciable amount of information which could be of use to teacher-educators and educational planners alike.

Firstly, the findings of the study imply that both massed and spaced activity-centered training could be regarded as effective means of bringing about teacher acquisition and subsequent use of specific competencies. This assertion, though supported by the year-one teachers' own testimonies, is not solely based on them. If the subjects' evidence of their "pre-college" science education experience is correct, then given the vast difference between these earlier experiences and their own subsequent teaching performance, one must conclude that something intervened to bring it about. Reason would suggest that, given the similarity between College training and teaching performance, that the effective intervening variable was the College training. To put it quite simply, training does make a difference - and in this case apparently a substantial one. If this is the case, then relatively short periods of activity-centered training (refresher courses, summer workshops, inservice and preservice programmes) might be expected to effect teacher acquisition and use of specific skills and competencies. This point has also been supported by the research findings of Schmidt (1969) and Freyberg *et al*., (1974).

Secondly, role modelling, coupled with massed or spaced activity-centered training, appears to be an effective means of developing specific teaching behaviours in teachers. The reports of several studies (Bandura, 1969; Bandura and Walters, 1970 and Freyberg *et al*., 1974, attest to the fact that individuals may (consciously or unconsciously) acquire specific behavioural patterns after only relatively short periods of exposure to models.

Thirdly, the findings imply that College lecturers should try to "practise what they preach" because teachers may well tend to model the behaviours that they exhibit, perhaps even more than the behaviours the trainers verbalize. Although the teachers in this study showed clear evidence of having acquired the concept of the teaching patterns that were recommended by their lecturers, and although their teaching patterns did show some resemblances to their own recommendations, in the natural classroom situation they (largely unconsciously) followed the concrete examples of their lecturers' behaviours. This is consistent with the points made by Peck and Tucker (1973) and the research findings of Bryan and Walbek (1970). Students apparently tend to follow the actions of their instructors rather than their words.

Fourthly, the findings of this study would suggest that when teacher-training (massed or spaced) is closely aligned to the objectives of the schools in which the teacher-graduates will subsequently be placed this makes for positive transfer of training in the case of specific skills, competencies, and teaching behaviours - at least as far as the teachers themselves perceived it. This finding not only gives credence to the "identical elements" position with respect to positive transfer (advocated by Thorndike and Woodworth, 1901;+ Bronfenbrenner, 1979; and Gagné, 1962) but also supports the findings of Yum (1931); Ellis (1958), and Heath (1959).

Fifthly, it would appear that when the skills and competencies presented during training are the same as those which are required by teachers in the classroom the overall level of classroom success of teachers is enhanced. Not only did both groups reportedly use the competencies provided during preservice training, but both groups of teachers also reported that the use of these competencies <u>did</u> enhance their overall level of success as science teachers. Moreover, they also reported that preservice training enhanced their own <u>confidence</u>, <u>skills</u>, <u>motivation</u> and <u>ability</u> to teach science, as well as their <u>attitudes</u> towards the teaching of science. This could be due particularly to the fact that the objectives of the training programmes were <u>identical</u> to those of the schools' syllabus, and the skills and competencies provided during training were largely those that were subsequently required by the teachers in the context of the classroom.

Finally, the findings show that year-one teachers <u>do</u> request, and use the advice of peer and supervisory teachers. Therefore if, during the induction year, teachers are assigned supervisory teachers who are sympathetic to the objectives of the training situation,* this could not only serve as a means of reinforcing what was taught at Teachers College but could also provide a link in the classroom situation similar to that in the training situation and hence facilitate <u>positive transfer</u>.

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* A recommendation similar to that made in the 1980 "<u>Report of the National Inquiry into Teacher Education</u>", Australia. Australian Government Publishing Service, Canberra, 1980.

\+ Reported by Bugelski (1956)

Limitations of the Study

The generalizability of the results of this study is severely limited by the smallness of sample size - Lecturers : n = 5; group 1: n = 7; and group 2: n = 13. It is also governed somewhat by the fact that for certain transactions, the averaged scores were derived from individual lecturer or teacher-scores and the ranges were sometimes wide. Consequently, the findings of this study may complement similar findings of other studies. Where they contradict others the case must remain unproven.

Conclusions of the Study

Within the above mentioned limitations, the general conclusions that can be drawn from the study are: -

(i) The first-year treacher did
- a) perceive that they practised the competencies provided during preservice science curriculum training;
- b) attribute capability to practise these competencies to preservice training; and
- c) indicate that the practising of these competencies enhanced their overall level of success as science teachers.

(ii) Both the "massed trained" and "spaced trained" teachers did perceive that preservice science curriculum training enhanced their own attitudes, abilities, confidence motivation, and skills in the teaching of science.

(iii) The teachers did attribute their own teaching patterns to preservice training as well as to other factors including:
- a) the behaviours of College, "pre-college", and peer teachers,
- b) the policies and expectations of schools;
- c) University and work experience; and
- d) their own particular styles of teaching.

(iv) Preservice training in science teaching <u>did</u>, in this case, effect positive teacher attitudes towards the teaching of science.

(v) Preservice training in science teaching <u>did</u> appear to influence the teachers' own perceptions of how elementary science <u>should</u> be taught.

(vi) Although teacher-perceptions of the recommendations of their lecturers did appear to influence their own concepts of how science <u>should</u> be taught more than the actual behaviours of their lecturers, the <u>behaviours of their lecturers</u> did appear to have influenced their own teaching patterns <u>more</u> than their <u>own recommendations</u>.

(vii) Both massed and spaced enquiry-oriented, science curriculum training did appear to be effective means for ensuring teacher-use of competencies provided during preservice training.

(viii) Inquiry-oriented science curriculum training <u>did</u> appear to be an effective means of promoting teacher acquisition and use of <u>process skills</u>.

(ix) Role modelling did appear to be an effective means of promoting specific teaching behaviours in teachers.

(x) Positive transfer of training did appear to have resulted from programmes of training with the same objectives of the syllabus which the graduates of these programmes subsequently used.

(xi) The teachers' ability to <u>control</u> pupils during science classes did appear to have <u>the highest</u> level of influence on their overall level of success as science teachers.

(xii) The teachers' own <u>knowledge</u> and <u>understanding</u> of science did appear to be less influential on their science teaching success than was their own <u>ability</u> to teach whatever science they knew.

Whatever the force of the conclusions drawn from this study - and they have the capacity to lend support to some theoretical positions e.g. role modelling and transfer of training effects - the study can only be regarded as an elaborate pilot study. As such it has served to indicate some potential "explanations" of the relationship between teacher training and subsequent teacher performance. Should further research - no doubt more specific in orientation - corroborate the leads given, subsequent improvement in teacher training might well result.

The Appendices and Bibliography of the study follow in Volume 2.

ADDENDUM

A review of the study and its findings after completion suggests that several points are worth making in retrospect. They follow:

1. The Competencies Concept

In the study the word "competencies" was used as a label convenient to describe the set of understandings, skills and attitudes that the science teacher training scheme operating at that one Teachers College, was actually seeking to impart. Surprisingly, the selection of an appropriate, and relatively simple label proved rather difficult. 'Behaviours', 'skills', 'techniques' - all were insufficiently comprehensive while a combination such as the conventional 'understandings, skills and attitudes' seemed unwieldly. Given the nature of the derived set of 'competencies' (see page 73) which was, it must be admitted, a rather eclectic combination of types, the label 'competencies' seemed at the time as good as any. It still does. However, the word "competencies" runs some risk of inviting an association with the "Competency Teaching" concept which has of recent years enjoyed some vogue. The point should be made that any association is not, and was not deliberately intended. It follows then, that issues relating to the levels of 'competencies' reached, and how they were reached, while no doubt of interest, were not matters of direct concern to the thesis.

2. Teachers' understanding of competencies

Part of the empirical work of the thesis entailed drawing inferences about specific 'competencies', viz the extent to which teachers thought they had achieved competency and the extent to which they attributed their 'competencies' to prior experiences of various kinds.

It is not necessarily the case that all respondents saw each specific 'competency' in the same way. In other words, definitions of the reality of each 'competency' may well have varied. Leaving aside the phenomenological argument that has raged and continue to rage in philosophy and sociology over alternative interpretations of reality, several comments are worth making.

First, the subjects of this study were reporting on their own perceptions. To that extent the issue of variability is of less moment than if the competencies themselves were under examination.

Second, and more importantly, there are grounds for believing that there may well have been a certain amount of definitional consistency across the subjects. All teachers in the sample received the same training. This training was professed to be deliberately directed at the 47 'competencies' outlined in Chapter 4. Variations in teacher-understanding of the various 'competencies' might reasonably be expected to be considerably lower among the present sample than among teachers not subjected to this specific type of training.

3. Massed and spaced training

Education as a subject owes allegiance to a number of parent disciplines - psychology, philosophy, sociology to name a few. In each of them, specialised terminology has evolved, based often on the adaptation of everyday words. Once incorporated into the disciplines they are often regarded somewhat territorially.

The first of the retrospective comments above illustrated the point with respect to 'Competency Teaching'. In a similar vein, the terms 'massed' and 'spaced' training have been used in the present study in a nonspecialised way to designate the two systems of training in vogue at the specific Teachers College. They have no affinity with the earlier and established psychological usages of "massed" and "spaced" training.

Further, in labelling the two types of training in this way, clearly only one feature was highlighted - the duration of the two respective forms of training. Obviously duration was not the only dimension on which the two types of training differed.

At the College provisions were made for students to specialize in specific areas. The assumption was that indepth study in a particular area leads to competence and confidence that would stand the fledgling teacher in good stead. Students opt for specialist areas according to their interest. Within the College organization, a number of students who have an inclination towards science, select science as their specialist subject. (Others for example, select Social Studies, Art or Physical Education). For students who do select science it is apparent that the kind of experience provided is more intensive and extensive for the simple reason that it is spread over 2 years and entails much more time. However, students who are not specializing in science are obliged to take a concentrated course designed to give them a fundamental preparation for science teaching. This course (in the case of this study) was characteristically located shortly before the students graduated and went to their first teaching year. Accordingly there were certain differences between the two groups of teachers viz:

(i) 'Spaced' training was presented to volunteers while 'massed' training was provided to student 'conscripts'.

(ii) Conceivably, the science education backgrounds of the 'spaced'' trained teachers influenced whether or not they volunteered for the science specialist course and may also have influenced, their motivation to teach science their attitudes towards the teaching of science as well as their teaching behaviours.

(iii) The close proximity of training to the first teaching year of the non-specialists may have played some part in determining the extent to which they incorporated their training in their teaching practices.

The existence of such factors and the possibility of interaction among them imply that explaining performance differences between the two groups in terms of the 'massed' or 'spaced' nature of their training should be undertaken with caution.

4. Interpretation of Rating Scales

The numerical scale used to apply to the degree of perceived success, attribution, and influence (Chapter 4) diverges from conventional psychometric practice. A more conventional interpretation would have led to scores between the levels of: 2.5-3.4 being regarded as 'average'; scores of 3.5-4.5 as 'high'; and of 4.5-5.0 as 'extremely high'. When this interpretation is made, the general picture that emerges from the findings appears somewhat more conservative than that presented in the general body of the study. Viz:

(i) The averaged responses of the year-one teachers as a group indicated an "average" amount of perceived success in the 47 'competencies' (general competencies - 3.3; personal (teacher) attributes - 3.3). This was reported to be 'partly' attributable to training - mean ratings of 2.8 and 2.9 for general and personal 'competencies' respectively. Reportedly, perceived success levels in the 40 general competencies had an "average" level of influence (3.4) on the teachers' perceived overall level of success in science teaching. Perceived success levels in the 7 teacher-attributes were reported to have a "high" mean level of influence - an averaged rating of 3.8 (see Tables 4a and 4b, Chapter 4).

(ii) The mean scores for group 1 indicated an "average" amount of perceived success (3.4) for the 40 general 'competencies'. This was partly attributed to preservice training (3.0) and was reported as having had a 'high' level of influence (3.5) on overall reported success as science teachers. For the 7 teacher-attributes, the mean scores of group 1 indicated a 'high' amount of perceived competence (3.6) which was 'highly' attributable to training (3.5). It was also reported as having had a 'high' level of influence of their overall success in science teaching (4.0) see Table 5a and 5b.

(iii) The mean scores for group 2 indicated an average amount of perceived success for the 40 general 'competencies' (3.1). This was partly attributed to preservice training (2.7) and was reported as having had an 'average' level of influence on their reported success as science teachers (3.3) See Table 6a. For the 7 teacher-attributes the mean scores of group 2 indicated an 'average' level of competence (3.2) which was partly attributed to training (2.6). It was also reported as having had a 'high' level of influence on their overall success in science teaching (3.7) See Table (3b).

This alternative interpretation means that while in the second case the results are less positive, than in the former case nonetheless, the rating scale allows for greater discrimination between scores in the upper and lower levels of the scales.

5. Teaching Patterns

In a study like the present one where the potentially influential variables are many and may reasonably be expected to interact in complex ways, a number of possibly influential variables may perforce be neglected. It is fair to say that the influences of cognitive levels of, (i) teacher trainees as students in the classes of their lecturers and (ii) children as pupils in the classes of the (now) teachers were not taken into account.

It was assumed that given the nature of science, the universality of "discovery learning", and the philosophy of training embraced, the patterns of teaching behaviour in the two contexts would be (or even should be) similar.

The influence of cognitive differences then was not allowed for. Its subsequent investigation might prove valuable.

6. Effects of Variability Amongst Observations

Inevitably when a phenomenon as complex as teaching behaviour is under consideration, the question arises as to whether the behaviour sampled was truly representative of the teacher involved. It is probably true to say that no study has ever addressed fully this vexed question. Whatever behaviour is sampled is often taken to be representative. In the present study, the small number of observations per subject (three in the case of the lecturers and two in the case of the teachers) does not warrant generalization.

However, to compensate for the limited degree of behaviour sampling, an attempt was made to maximise between-observation differences for the lecturers. This was done by selecting the first, middle and final teaching sessions for each lecturer - a "seminar", a "workshop" and a "discussion" respectively. The effect was to yield a certain amount of artefactoral difference between the profiles generated. The subsequent "averaging" of the three types of observation would produce, it was thought, a picture closer to the norm. Nonetheless, a certain amount of caution is needed in concluding whether a specific lecturer's teaching style has been captured - a point salient to the teaching profiles of the year-one teachers as well. It should be recognised too that the effect of averaging the separate class behaviours of the lecturers tends to increase the likelihood that these profiles, in comparison with others would be similar rather than different - another artefact of the methodology.

7. Conclusion of the Study

While the findings of the study were qualified from time to time throughout the report, there may be some point in drawing attention to the following:

(i) The sample size was small - lecturers = 5; group 1 = 7; group 2 = 13.

(ii) Whether the "true" teaching patterns of either lecturers or teachers were captured by the analysis of 2 or 3 teaching sessions is problematical.

(iii) In certain cases the actual (average) teaching profiles of both lecturers and teachers were compared with profiles derived from the <u>perceptions</u> of the lecturers or teachers.

(v) The interpretations made of the rating scales of success, attribution and influence scores, in departing from conventional pyschometric practice, had the effect of making the results generally a little more positive.
In view of this, conclusions regarding the teachers' self-reported; (a) success levels in competencies' (b) attribution of success to training and (c) influence of success levels on overall teaching, need some qualification. While there is no need to change the interpretations that were based on the study's scaling system the impression given perhaps ought to be moderated

so that it would not be interpreted that the degree of effective training was more than it was. This point should be borne in mind particularly in the case of conclusions i, ii, vii, x, xi, and xii - pages 288 and 289.

The fact that the mean success, attribution, and influence scores of the 'spaced' trained teachers were, in a few cases, only slightly higher than those of the 'massed' trained teachers and that the spaced trained teachers were 'science-specialists' should also be borne in mind. However, irrespective of whatever may have influenced the 'massed' trained and 'spaced' trained groups, the findings still hold that the perceived success, attribution and influence mean scores of the 'spaced' trained teachers were higher than those of the 'massed' trained teachers for both general and personal 'competencies'.

On balance then, although the conclusions of this study stand in their own right, they should be weighed in light of the points outlined above. The caution should also be repeated that any generalization of results would be hazardous.