Title	Lecturing and structure: An experimental study
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Lecturing and Structure : An Experimental Study

Purpose of study

The lecture, in the context of higher education, "consists of an uninterrupted sequence of oral statements" (Gage, 1969, p. 1446) communicating a set of ideas for the purpose of instruction. The numerous research studies reported by McKeachie (1960, 1960, 1964, 1967a, 1967b), McLeish (1966, 1968), and Maddox (1970) reveal that the lecture, although a popular mode of instruction in colleges and universities, has serious limitations. Most of the recommendations put forth for the improvement of lecture presentation are based on common sense rather than on empirical data. Today, institutions of higher learning, especially those in developing countries, are facing a "crisis" resulting from a knowledge and student explosion. Because the lecture method can cater for large classes (Hudelson, 1928; Rohrer, 1957; DeCecco, 1964; McKeachie, 1967a) in the transmission of verbal content material for instruction purposes, it is therefore crucial that some adequate guidelines on lecture presentation techniques be found.

The term "structure" is a unifying construct. It is defined in Webster's dictionary as the "interrelation of parts as dominated by the general character of the whole." Any form of organized material has structure, and it simply consists of a set of elements linked together in some non-arbitrary manner to form a meaningful whole. A message in a lecture may therefore be conceived as a set of elements (ideas, concepts, principles, generalizations) linked together by a substantive structure. Structural representations showing the arrangements and relationships of constituent elements in a message are numerous and diverse in nature. Mathematical equations, logical propositions, logical pictures, informational listings and visual-iconic diagrams have greater applicability and simplicity than the other broad categories (Fleming, 1968, p. 1), they may therefore be considered as the typical modes for representing the structure of a message. Generally, informational listings are thematic in nature, while visual-iconic diagrams are schematic. Hence, it is more appropriate to refer to them respectively as thematic and schematic structural representations. Thematic structural representation is the sequential outlining of the substantive elements of the message according to topics and sub-topics. When visual-icon or diagramatic illustration is used to show how the substantive elements are related and organized, it is referred to as a schematic representation.

Many educators (Katona, 1940, Bartlett, 1954; Bruner, 1960; Bower, 1967) have recognized the fact that structure is a powerful and useful tool in aiding learning and memory. But, unfortunately, the various studies on the importance and effects of structures have not produced a significant impact on classroom teaching. The purpose of this study is therefore, to explore, under actual classroom conditions, some of the possible ways in which college lecturers can improve the effectiveness of their lectures with the use of structural support. The means by which the lecturer consciously exposes the structural pattern of his message to the students during lecture presentation are referred to as structural support.

The problem

This study is concerned with the problem of how organizing devices in the form of structural support may be effectively used in lecture presentation to facilitate learning in terms of immediate recognition and recall. The problem being investigated questions:

1. Is lecturing with the use of structural support a more effective way of conveying the kind of content material required at university level when compared to a straight lecture as commonly delivered?

2. Will there be a difference in performance between students who are exposed to structure at different points in time during lecture attendance?

3. What form of structural representation presented in which sequence of lecture augmentation is better suited to what type of students in terms of sex and academic background?

4. How do students react affectively towards the respective forms of lecture augmentation treatment to which they are being exposed?

The problem under investigation is considered significant in that it has useful implications for classroom teachers in the presentation of meaningful verbal material. The justification of the study is seen to be its pertinence in attempting to provide empirical evidence for alternative practices in lecture presentation.

In order to obtain answers to the various research questions concerning the problem in hand, the following hypotheses were formulated for testing:

1. That students would, for each lecture presentation, differ in their ability to recall either in terms of reporting skills or in terms of discrete themes. Reporting skills of students refer to their distinctive ability in mentioning, explaining, exemplifying and/or elaborating the main ideas perceived from the message transmitted during lecture attendance. Discrete themes, on the other hand, pertain .to the reporting of content material in terms of concepts and subconcepts that constitute the message.

2. That for each lecture and for each criterion measure, there is no significant difference in the performance in terms of immediate recognition and recall:

   (a) between students who are exposed to structure at the beginning, during, or towards the end of lecture attendance and those who are not so exposed to structure.

   (b) between students of different academic background (arts or science).

   (c) between students of different sex (male and female).

   (d) between students of different academic background (arts or science).

   (e) among students of different sex who are exposed to structure at different moments of lecture attendance and those who are not so exposed to structure.

   (f) among students of different academic background who are exposed to structure at different moments of lecture attendance and those who are not thus exposed to structure.

3. That there is no significant difference in the affective response in terms of opinions expressed between students in different treatment groups.

Previous research

Typically, research on the lecture method per se has compared lectures of one form with those of another form, or compared lectures which may differ along a single dimentions. Marr *et al.* (1960) and Holloway (1966) in their studies showed that attendance in lectures made a significant contribution to college students' education, but Milton (1962) found no significant difference in this study. Research conducted by Hudelson (1928), Rohrer (1957) and DeCecco (1964) concerning the optimum class size for lectures showed that it was possible for students to learn, remember and apply the knowledge they acquired during lecture attendance in very large or small classes. In the opinion of McKeachie (1967a), "in so far as information giving as a one-way process, size of group should be limited only by the audibility of the lecturer's voice" (p. 1132).

In terms of recall and retention, the studies by Jones (1923), McLeish (1966), Trenaman (1951), and Bartlett (1954) produced startling evidence to show that the conventional form of straight-forward lecture presentation was inefficient. A study on the concentration pattern of students during lecture attendance by Lloyd (1967) recommended that a variety of materials be used so as to diversify the one-hour lecture period. McClendon (1958), Eisner and Rohde (1959) and Freyberg (1965) found that the taking of notes during lecture attendance was not a crucial factor in enhancing comprehension. Most studies on lecturing styles (Mastin, 1963; Coats and Smidchens 1961) indicated that students generally learned more from lectures delivered enthusiatically and dynamically. On the question of principles versus details, the research findings of Eskine and O'Morchoe (1961), McKeachie (1967a) and Katz (1950) confirm the fact that students learn and retain better when their teacher omits details and teaches only basic principles. Katona (1940), Katz (1950), and Thistlewaite *et al,* (1955) in their separate studies, suggested that, perhaps, organisation might be the key factor that would help the lecturer to teach more effectively. Unfortunately, what good organization specifically is has yet to be made clear by research.

Investigation on the effects of stimulus organization (i.e. structure) on learning and

memory are not confined to recent educational reports. The works of Katona (1940), Wertheimer (1945). Brownell (1969), and Bartlett (1954) attested to the powerful influence of structural factors on learning and memory. Recent research on the formulation of information theory further confirm the importance of structure on immediate recall and retention. Aborn and Ruberstein (1952, 1954), Miller and Selfridge (1950), and Garner (1962) demonstrated in their experiments that when stimulus materials were well structured or organized, immediate recall could be improved. According to Alin (1964), structure is potentially meaningful. In his study, he reported that the gradual impairing of the structure of text material would affect its meaning and retention value. In various studies on the effects of organization and sequencing of verbal content material, Ausubel (1963), Gagne (1962), 1965), Anderson (1966), and Frase (1969) found that well structured communicated material substantially improved the acquisition of information. To enhance the effectiveness of the teacher, Ausubel (1963) recommended the use of advance organizers, while Gagne (1965) advocated the sequential arrangement (for careful programming) of the learning tasks from simple to complex in the hierarchy of organized knowledge structure. Anderson (1966), on the other hand, recommended that the teacher should order the content material to be presented ("stimulus kinetic structure") in such a way that the logical relationships among the substantive elements ("static structure") are made explicit. His "kinetograms" clearly illustrate the possibility of a diversity of organization. In the present study, various sequential combinations of structure and lecture presentation were being investigated with the aim of finding some readily applicable procedures that would make lecturing a more efficient and effectiveness means of instruction.

Procedures, subjects and tests

Four lectures, each about 30 minutes in length, were recorded on videotape. The lectures dealt with the following topics:

Lecture I – Interpreter model of communication (Schematic structure)

Lecture II – Formulation of instructional objectives (Thematic structure)

Lecture III – Concept of a system in classroom instruction (Schematic structure)

Lecture IV – Aims and objectives of evaluation in the educational process (Thematic structure)

The underlying structures of these lectures were separately prepared on overhead transparencies (Figure 1, Figure 2, Figure 3, and Figure 4). Physically, the mode of lecture presentation differed from the usual lectures in that the television medium was used as a means of delivering the lectures instead of live lecturers. In so far as the manner of presentation was concerned, the different lecturers delivered their lectures in the usual manner except for the presence of the television camera. The subjects who participated in the experiment consisted of 220 student teachers. They were selected from about 450 graduate students who had enrolled in the Faculty of Education, University of Malaya, for a course in teacher training leading to the Diploma in Education. It was presumed that differences in entry behaviours with respect to knowledge of the principles of educational practice, critical thinking and aural comprehension were likely to affect the results of the final comparisons. The students were therefore tested in these areas. The scores obtained were used for covariance adjustments.

The subjects were divided into five groups according to sex and academic background. Academic background was taken to mean whether the students graduated in an arts discipline (e.g. Languages, Geography, Economics, Islamic Studies) or a science discipline (e.g. Physics, Chemistry, Biology, Agriculture, Mathematics, Engineering technology). The subjects in the three experimental groups (i.e. E1, E2, and E3) and one of the two control groups (i.e. C1) were given a lecture with the specific purpose of sensitizing them to the importance and functions of message structure in lecture presentation. The second control group (i.e. C2) was not exposed to such a lecture. Each of the four lectures recorded on videotape was presented to the five groups in different rooms according to a schedule worked out in such a way that there was minimum opportunity for the subjects in one group to discuss with those in the other groups. Hence the subjects in all the five groups heard and saw exactly the same lecture. The manner in which they perceived the structural support remained the only variable that differed between groups. The procedures for presenting the respective structural support in each of the four lectures were as follows:

Group E1 – For each lecture, the subjects were exposed to the underlying structure at the beginning of lecture attendance.

Group E2 – For each lecture, the subjects were exposed to the underlying structure towards the end of lecture attendance.

THE INTERPRETER MODEL OF COMMUNICATION*

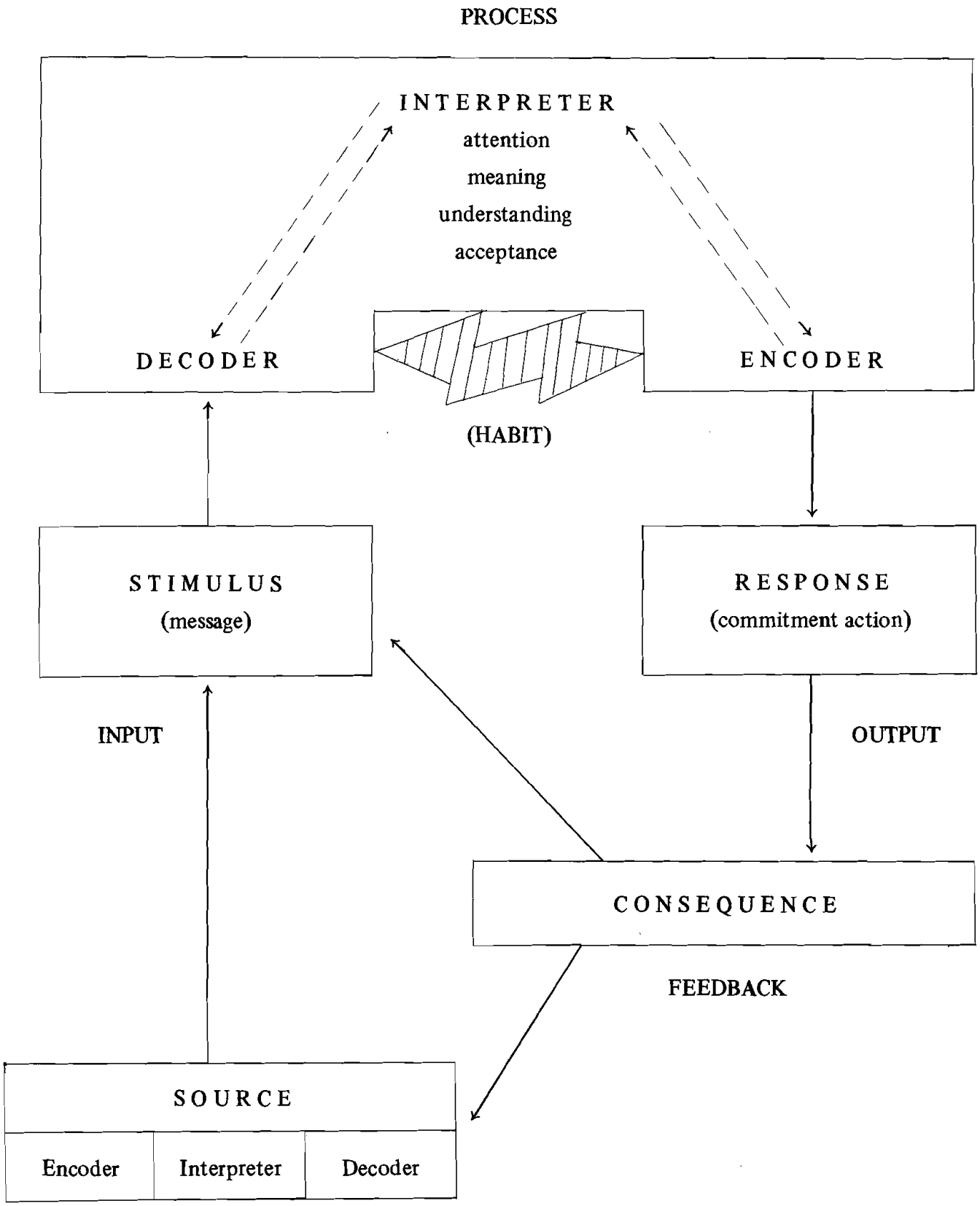


Figure 1 Structural Support for Lecture I (Schematic)

*Source: Bettinghause, E.P. The interpreter model. *Research Principles and Practices in Visual Communication*, DAVI, NEA, 1960, p. 33–37.

FORMULATION OF INSTRUCTIONAL OBJECTIVES

1.0 **Basic Questions**

- 1.1 What are instructional objectives?
- 1.2 What is wrong with conventional objectives?
- 1.3 Why must objectives be specific?
- 1.4 What is a behavioural objective?
- 1.5 How are behavioural objectives formulated?

2.0 **Introduction**

- 2.1 Instructional objectives – teachers' intentions pertaining to learning and teaching.
- 2.2 Non-instructional objectives – e.g. to teach "topic X".

3.0 **Conventional Objectives**

- 3.1 Vague and global.
- 3.2 Teacher-oriented.
- 3.3 Useless as basis for lesson planning.
- 3.4 Difficult to decide if and when attained.

4.0 **Specificity**

- 4.1 Teacher knows exactly
  - i) what to teach
  - ii) how to teach
  - iii) how to evaluate
- 4.2 Pupils know exactly what to learn.

5.0 **Behavioural Objectives**

- 5.1 A statement describing the performance (or observable behaviour) the teacher wants his pupils to demonstrate.
- 5.2 It consists of
  - i) Task – terminal behaviour
  - ii) Conditions – "givens" and restrictions.
  - iii) Criterion – standard or minimum level.

6.0 **Formulation**

- 6.1 Ask first question first – e.g. what will pupils be able to do?
- 6.2 Use verbs that identify task.
  - 6.21 Avoid ambiguous words – e.g. to know, to understand, etc.
  - 6.22 Use words that describe specific ability – e.g. to write, to solve, to apply, etc.
- 6.3 Identify objective components.
  - 6.31 State terminal behaviour.
  - 6.32 State conditions imposed.
  - 6.33 Specific criterion or minimum level of acceptance.

Figure 2 *Structural support for Lecture II (Thematic)*

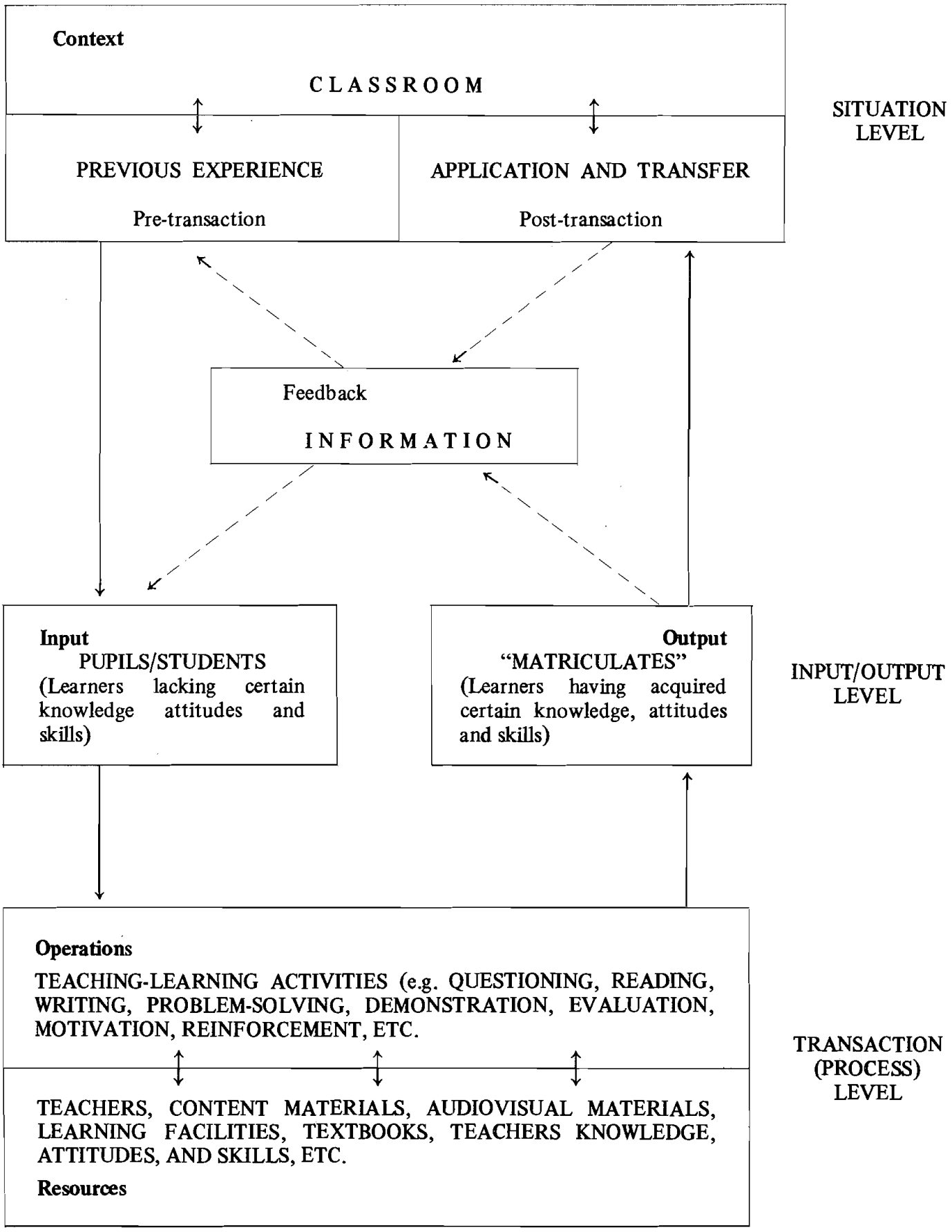


Figure 3 Structural support for Lecture III (Schematic)

AIMS AND OBJECTIVES OF EVALUATION IN THE EDUCATIONAL PROCESS

1.0 **Basic Questions**

- 1.1 How, when and why?
- 1.2 Who should evaluate?
- 1.3 What is to be evaluated?
- 1.4 Who is to make what kinds of decisions?
- 1.5 Which criteria are to be used and for whose benefit?

2.0 **Introduction**

- 2.1 Definition of evaluation – systematic data gathering for decision-making.
- 2.2 Evaluation models.
  - 2.21 Engineering model – product evaluation.
  - 2.22 Medical Model – comparing treatments and checking progress, make prescriptions, etc.

3.0 **HOW, WHEN and WHY?**

- 3.1 Methods – different methods for different purposes.
- 3.2 Frequency – depends on what aspects of the education process being assessed.
- 3.3 Aims – mainly to provide diagnostic and prognostic information

4.0 **WHO should evaluate WHAT?**

- 4.1 Who?
  - 4.11 Pupils – to check own progress.
  - 4.12 Teachers – to guide instruction.
  - 4.13 Parents – to understand their role better.
  - 4.14 Administrators – to aid policy making.
- 4.2 What?
  - 4.21 Changes in behaviour with respect to:
    - i) Cognitive development.
    - ii) Affective behaviour.
    - iii) Psychomotor performance.

5.0 **WHO is to make WHAT KINDS OF Decisions?**

- 5.1 Everyone involved – to "change" or not to "change".
  - 5.11 Students and teachers – instructional decision-making concerning class or content.
  - 5.12 Teachers and administrators – institutional decision-making concerning the school.
  - 5.13 Administrators and politicians – societal educational decision-making concerning the system.
- 5.2 International evaluation – overall progress between nations.

6.0 **WHICH Criteria for WHOSE Benefit?**

- 6.1 Criteria
  - 6.11 Quantitative (economic) criteria in education.
  - 6.12 Qualitative criteria in education.
- 6.2 Findings must be couched in terms meaningful to decision-makers.

Figure 4 *Structural support for Lecture IV (Thematic)*

Group E3 – For each lecture, the subjects were exposed to the underlying structure gradually as each of the substantive content elements was being presented during lecture attendance.

Group C1 and C2 – For each lecture, the subjects were not exposed to any form of structural support during lecture attendance.

Exposure of structural support was done with the use of the overhead projector. For groups E1 and E2, exposure of structural support was accompanied by a few oral statements as a form of synopsis or summary.

At the end of each lecture, the subjects were allowed 10 minutes to read over whatever lecture notes they had made before being tested for recognition and recall. The recognition test consisted of a 10-item objective test while the recall test was an essay test. They were essentially tests of knowledge. Upon completion of the tests at the end of the fourth lecture, an opinionnaire was also administered to each of the five groups. The responses to the various tests administered were scored according to prespecified marking schemes. The objective test scores for each lecture were subjected to analysis of covariance. As there were too many variables to be considered in each series of essay test scores, factor analysis was used to collapse them into a few manageable and meaningful factor scores. The factor scores for each lecture were also subjected to covariance analyses. Chi-square tests were applied in the analysis of the responses to the opinionnaire.

Results

The results obtained from covariance analyses of objective test scores for all the four lectures showed that the between group differences were larger than could be expected (Table 1). The exposure of students to structure therefore facilitated their matching of appropriate knowledge which had been stored in memory to meaningful verbal units of information presented in the objective tests. The experimental groups were distinctly superior to the control groups at the .001 level of significance only in lectures with schematic structures. For lectures with thematic structures, the superiority of the experimental groups, though significant at the .05 level, was less distinctive. Results showing variances between sex and between academic background were not significant. There were no significant interactions either.

Most of the factors obtained from factor analyses of essay test scores could be meaningfully interpreted and identified as discrete themes pertaining to the concepts and subconcepts of the lectures and not as reporting skills in terms of mentioning, explaining, exemplifying and elaborating. Of the 14 factors generated from factor analyses, covariance analyses of the factor scores produced significant differences in seven of them (Table 2 and Table 3). The factor scores with significant differences indicated that in general, the experimental groups tended to be superior to the control groups, but there were a few cases in which not all the control groups were significantly inferior to all the experimental groups (e.g. Lecture I, Factor 5: *E1 E3 C1 C2* E2 **).

The results of covariance analyses also indicated that each of the experimental groups tended to be superior along different dimensions. Experimental group E1 tended to excel in the following dimensions:

Table 1 ANCOVA RESULTS SHOWING MAIN EFFECTS BETWEEN GROUPS IN OBJECTIVE TEST PERFORMANCE

STRUCTURE		LECTURE	GROUP DIFFERENCES				
Schematic	I	Interpreter model of communication	E3 4.36	E2 3.71	E1 3.61	C1 2.99	C1 *** 2.90
Schematic	III	Concepts of a system in classroom instruction	E3 5.21	E1 4.66	E2 4.57	C1 3.75	C2 *** 3.60
Thematic	II	Formulation of instructional objectives	E1 5.56	E2 5.53	E3 5.30	C2 5.00	C1 * 4.62
Thematic	IV	Aims and objectives of evaluation in the educational process	E3 4.26	E2 4.11	E1 3.78	C1 3.60	C2 ** 3.33

* .05 level of significance ** .01 level of significance *** .001 level of significance

Table 2: **ANCOVA RESULTS SHOWING MAIN EFFECTS BETWEEN GROUPS IN ESSAY TEST PERFORMANCE FOR LECTURE I AND LECTURE III**

LECTURE I (SCHEMATIC STRUCTURE)								
Factor 1	:	Stimulus reception and feedback	E1 .19	C1 .08	C2 –.07	E3 –.08	E2 –.12	
Factor 2	:	Emphasis on response in learning and communication	E2 .13	C1 .07	C2 –.02	E3 –.02	E1 –.15	
Factor 3	:	Response elements within the interpreter model context	E3 .43	E2 .32	E1 .00	C2 –.26	C1 –.49	***
Factor 4	:	Source-receiver relationships versus the formation and breaking of habit	E1 .29	E2 .28	E3 –.00	C1 –.26	C2 –.30	**
Factor 5	:	Source-receiver relationships in the formation and breaking of habit	E1 .27	E3 .12	C1 .10	C2 .02	E2 –.47	**
LECTURE III (SCHEMATIC STRUCTURE)								
Factor 1	:	Relationships among levels in instructional system	E1 .62	C1 –.05	C2 –.14	E3 –.16	E2 –.27	***
Factor 2	:	Properties and elements of a system	E1 .12	E3 .10	C2 –.07	C1 –.10	E2 –.14	
Factor 3	:	(unidentified)	E3 .34	C1 .03	C2 –.03	E2 –.16	E1 –.17	

** .01 level of significance
** .001 level of significance

Table 3 : ANCOVA RESULTS SHOWING MAIN EFFECTS BETWEEN GROUPS IN ESSAY TEST PERFORMANCE FOR LECTURE II AND LECTURE IV

LECTURE II (THEMATIC STRUCTURE)							
Factor 1	:	Specifying conditions and criterion for criterion testing versus questions stressing need for specificity	C1 .19	E3 .05	C2 –.02	E2 –.10	E1 –.11
Factor 2	:	Formulating objectives in general versus formulating behavioural objectives	E2 .29	E1 .04	E3 –.03	C2 –.13	C1 –.16
LECTURE IV (THEMATIC STRUCTURE)							
Factor 1	:	Relevance of evaluation process	E3 .28	E2 .17	E1 –.03	C2 –.05	C1 * –.36
Factor 2	:	Exemplifying evaluation process	E2 .60	E1 .20	E3 .18	C1 –.39	C2 *** –.59
Factor 3	:	Decision-making process of evaluation	E3 .30	E2 .18	E1 .04	C2 –.07	C1 ** –.45
Factor 4	:	Exemplifying purposes of evaluation	E1 .90	E2 .02	C1 –.01	E3 0.04	C2 –.04

* .05 level of significance
** .01 level of significance
*** .001 level of significance

1. Objective test for Lecture II: (Formulation of instructional objectives (*E1 E2 E3 C2* C1 *)

2. Essay test for Lecture I, Factory 4: (Source-receiver relationship versus formation and breaking of habit (*E1 E2 E3* C1 C2 **)

3. Essay test for Lecture I, Factor 5: Source-receiver relationships in the formation and breaking of habit (*E1 E2 E3* C1 C2 **)

4. Essay test for Lecture III, Factor 1: Relationships among levels in instructional system (E1 *C1 C2 E3 E2* ***)

A critical comparison between Lecture II and Lecture IV revealed that the content matter of Lecture II was less complex. Since the objective test involved mainly recognition tasks, it may therefore be inferred from the first set of group differences that for a lecture involving an underlying thematic structure with less complicated content material, presentation of the structure before the lecture helps in recognition tasks involved in the objective test. The other three dimensions involved the recall of relationships between relevant substantive elements for the factors concerned. The superiority of experimental group E1 in the essay test performance for these three dimensions supports the inference that for a lecture involving an underlying schematic structure, presentation of the structure before the lecture helps in perception of relationships. The implication is that exposure to structure before the lecture is on the whole an effective means in facilitating recall for lectures with underlying schematic structures.

Experimental group E2 obtained relatively high scores in the following dimensions:

1. Objective test for Lecture II: Formulation of instructional objectives (*E1 E2 E3 C2* C1 *)

2. Objective test for Lecture IV: Aims and Objectives of evaluation in the educational process (*E3 E2 E1* C1 C2 **)

3. Essay test for Lecture IV, Factor 2: Exemplifying evaluation process (*E2 E1 E3 C1 C2* ***)

4. Essay test for Lecture IV, Factor 1: Relevance of evaluation process (*E3 E2 E1 C2 C1* *)

5. Essay test for Lecture IV, Factor 3: Decision-making purposes of evaluation (*E3 E2 E1 C2 C1* **)

In combining the significant objective test result of Lecture II and Lecture IV, it may be inferred that for a lecture involving an underlying thematic structure, presentation of the structure (whether simple or complex) at the end of the lecture helps in recognition tasks involved in objective test. Even though the differences between group E1 and group E2 for the two lectures were not significant, the results seem to indicate that presentation of the structure before the lecture is only effective with relatively simple lectures whereas presentation of structure after the lecture appears to be relatively effective in facilitating recognition tasks for both simple and complex lectures.

In the set of results showing essay test performance, the three factors, for which experimental group E2 scored relatively high involved the recall of concepts and principles pertaining to the evaluation process discussed in Lecture IV. The possible implication arising from these results is that for a lecture involving an underlying thematic structure with more complicated content material, presentation of the structure at the end of the lecture helps in the recall of concepts and principles. On the whole, experimental group E2 tended to perform relatively well for lectures with thematic structures.

Experimental group E2 obtained relatively low scores in the essay test performance for Lecture I (interpreter model of communication) and Lecture III (concept of a system in classroom instruction) in general. The only exception is seen in the bi-polar factor of Lecture I, Factor 4: Source-receiver relationships versus the formation and breaking of habit (*E1 E2 E3* C1 C2 **) where group E2 scored significantly higher than the control groups. The performance of group E2 was significantly inferior in the following dimensions:

1. Essay test for Lecture I, Factor 5: Source-receiver relationships in the formation and breaking of habit (*E1 E3 C1 C2 E2* **)

2. Essay test for Lecture III, Factor 1: Relationship among levels in instructional system (*E1 C1 C2 E3 E2* ***)

From the results of the above two factors, it is clear that for a lecture involving an underlying schematic structure, presentation of the structure at the end of the lecture is not very helpful in the perception of relationships. In general, the evidence obtained seems to show that exposure of the structural support after the lecture tends to inhibit recall for lectures involving an underlying schematic structure.

In analyzing the objective test performance of experimental group E3, it was found that the group as a whole obtained relatively high scores in practically all the four lectures. The following results show the superiority of experimental group E3:

1. Objective test for Lecture I: Interpreter model of communication (E3 E2 E1 C2 C1 ***).

2. Objective test for Lecture III: Concept of a system in classroom instruction (*E3 E1 E2 C1 C2* ***)

3. Objective test for Lecture IV: Aims and objectives of evaluation in the educational process (*E3 E2 E1* C1 C2 **)

Although group E1 scored the highest in the objective test for Lecture II – Formulation of instructional objectives (*E1 E2 E3 C2* C1 *) – the lower score obtained by group E3 was statistically not significant when compared to E1 and E2. Thus, the above results provide very strong evidence to support the inference that for a lecture involving either a schematic or a thematic structure, presentation of the structure during the lecture helps in recognition tasks involved in objective tests. While it was seen from the earlier results for E1 and E2 that presenting the structural support before or after the lecture is effective in facilitating recognition tasks for lectures with thematic structures only, presenting the structure (progressively in stages) during the lecture (as in the case of E3) is a superior mode of structural support for lectures with either form of structure. Thus, for recognition tasks, the treatment received by E1 and E2.

Covariance analyses of the factor scores showed that the performance of experimental group E3 was high along the following dimensions:

1. Essay test for Lecture I, factor 3: Response model within the interpreter context (*E3 E2 E1* C2 C1 ***)

2. Essay test for Lecture IV, Factor 1: Relevance of evaluation process (*E3 E2 E1* C2 C1 *)

3. Essay test for Lecture IV, Factor 3: Decision-making purposes of evaluation (*E3 E2 E1 C2* C1 **)

Group E3 scored lower than group E1 in the following dimension:

1. Essay test for Lecture 1, Factor 4: Source-receiver relationships versus the formation and breaking of habit (*E1 E2 E3* C1 C2 **)

2. Essay test for Lecture I, Factor 5: Source-receiver relationships in the formation and breaking of habit (*E1 E3 C1 C2* E2 **)

However, multiple comparison of means showed that the differences between groups E1 and E3 were not significant. Thus, E2 can still be considered as having a relatively higher score in these two dimensions. In combining the results of the essay test performance in which E3 is superior, the evidence seems to suggest that the dimensions involved were concerned with the recall of meaningful conceptual wholes in terms of "context", "relevance" and "decision-making" rather than discrete and diverse facts. Hence a possible interpretation for this set of results is that irrespective of the underlying structure of a lecture, presentation of the structure during the lecture helps in the recall of conceptual gestalts. In other words, by exposing the relevant parts of the structure (progressively in stages) as the substantive content of the lecture is being presented, students are better able to perceive the broad and more inclusive concepts in terms of meaningful wholes and to differentiate them from the sum of the parts which comprises the substantive elements of the lecture.

The two control groups C1 and C2 were, in general, inferior to the three experimental groups in both objective and essay test performance. It was only in one dimension in which both C1 and C2 obtained significantly higher scores than Experimental Group E2 but not for E1 and E3 (Essay test for Lecture I, Factor 5: Source-receiver relationships in the formation and breaking of habit – (*E1 E3 C1 C2* E2**). Both control groups C1 and C2 were not exposed to any form of structural support during lecture attendance but C1 differs from C2 in that the former was, before the commencement of the experiment, sensitized to the existence and importance of structure in lecture presentation.

Since the results showed no significant differences between the performance of C1 and C2 for all the dimensions considered in both the objective and essay tests, it is therefore evident that a knowledge of the existence and importance of structure does not seem to help in recognition and recall tasks. As the performance of control groups C1 and C2 was by and large inferior to that for the other groups that were directly exposed to structure, the plausible conclusion is that whether or not students are sensitized to the existence of underlying structure, their performance in recognition and recall will tend to be retarded when lecture presentation is not augumented with structural support.

With the exception of a few isolated odd cases, there were no significant differences in immediate recall performance between male and female students, and also between students with arts and science background. Similarly, other than two isolated cases, there were no significant interactions between treatment and sex and between treatment and academic background. As these few cases of significant results produced no consistent pattern, they are therefore not susceptible to ready interpretation. The bulk of the non-significant results seems to suggest that sex, academic background and their interactions with the different modes of structural support have very little influence on students' performance in recognition and recall tasks.

Chi-square analyses of the opinionnaire responses revealed that the students had incorrect knowledge concerning what the experiment was attempting to accomplish and how the five treatment groups were different. However, as regards their views concerning the respective modes of lecture treatment, chi-square tests showed that a significant majority of the students gave unfavourable views; and particularly, those in control groups C1 and C2 and experimental group E2 expressed significantly more unfavourable opinions (Figure 5). Although the majority of the students reacted negatively towards the respective lecture treatments to which they were exposed, the likelihood was that more students tended to respond favourably when structures were presented early or during the lecture.

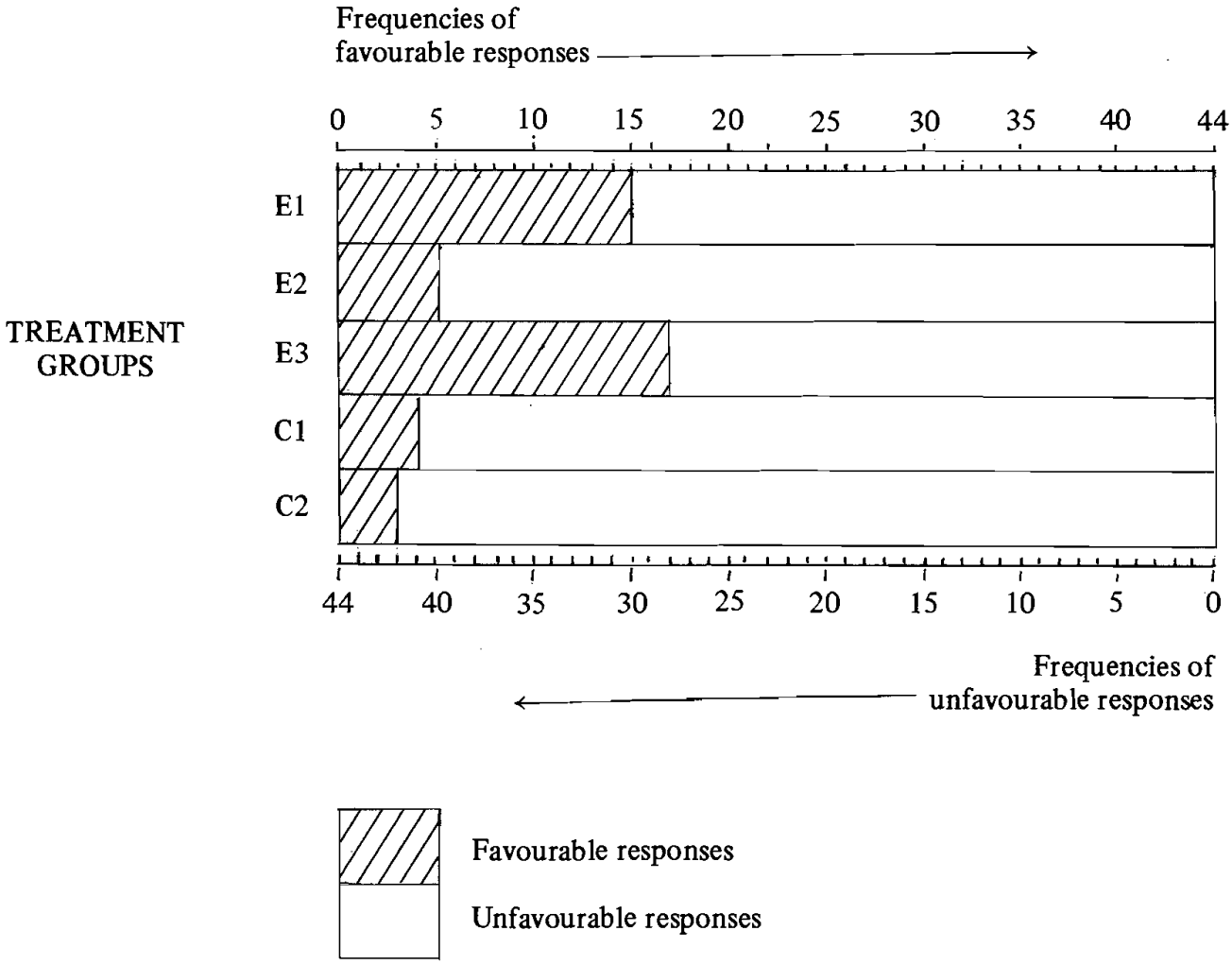
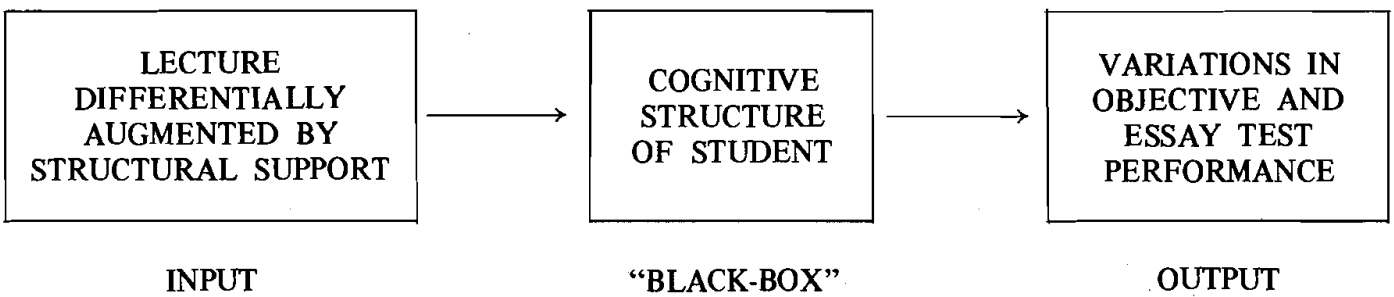


Figure 5 Bar-graph showing frequency of favourable and unfavourable opinion on mode of lecture treatment

Implications and recommendations

To answer the question on specifically how meaningful verbal learning in terms of immediate recognition and recall can be facilitated through the use of structural support, it seems justifiable to deduce certain implications concerning what actually went on in the "blackbox" (or mind) of students during lecture attendance. In this study, the inputs into the "black-box" consisted of the substantive content elements that made up the four lectures. Each lecture was differentially augmented by structural support. Each mode of structural support was presented to a different group of students at different moments in the lecture period. The outputs from the "black-box" were measured in terms of objective and essay test performance immediately after each lecture. The components involved can be simplified and diagrammatically represented as follows:



Since the subjects in the five groups received exactly the same lecture presented in exactly the same manner via the television monitor, the variations in outcomes measured between groups may therefore be assumed to be the effects of the different modes of structural support. The assumption is that each mode of structural support somehow modified the students' cognitive structure in such a way as to induce better learning along different dimensions as indicated by students' performance in immediate recognition and recall.

It is difficult to put forward a theory to explain exactly how each mode of structural exposure modified the cognitive structure of students such as to effect better recognition and greater recall along the various dimensions identified in the study; but nevertheless, it is possible to speculate that structural support in lecture presentation does evoke the kinds of mediating processes discussed by Anderson (1970) as being essential if an instructional communication is to result in efficient and effective learning.

According to Anderson (1970), it is a fallacy "that students learn more when they are required to make frequent, overt responses (p. 355). To account for the apparent lack of overt responses in learning during classroom instruction, he conceived the following three mediating processes as a basic minimum prerequisite:

1. Noticing the stimulus.
2. Encoding the stimulus in a meaningful manner.
3. Conceiving linkages or relationships between aspects of the stimulus perceived.

Noticing the stimulus involves the process of attention. Because of the transient nature of speech, students attending lectures are generally under the pressure of having to take down notes quickly if they are not bored and tired. Notetaking during lecture attendance can be considered as responding actively and overtly to the stimulus material. But in doing so, the students may not be paying attention to the critical substantive content, or they may be paying attention to the unimportant material. As such, learning suffers; and this is evident in the case of groups C1 and C2. Control of attention is, therefore, likely to be the most important factor if students are to perceive meaningfully the substantive content presented in a lecture. The use of structural support in lecture presentation may maintain some control over attention.

A structural outline of a lecture consists of only the critical substantive content material; and when presented to students before the lecture (as in group E1), it orientates the sensory receptors of students towards the key elements. In other words, it induces set by getting the students ready for more detailed information. When presented concurrently, with the lecture as in the case of group E3, the structural support focuses on each substantive element at the relevant portion of the lecture. Thus students' attention on the various key concepts in the lecture which they should specially perceive is to a certain extent under control. The lecture is a compound stimulus material. By exposing the structure (progressively in stages) as each of the substantive content elements is being delivered, students' attention is under control to the extent that meaningful perception of these elements is carefully regulated and strengthened. In other words, gradual exposure of structure directs and reinforces the attention of students to the key elements that constitute the critical material in the lecture. Presenting the structure at the end of the lecture (as in group E2) may not be as effective in controlling attention when compared to the "before" and "during" situations. This is because structure is being exposed at a time when the students are seemingly tired and bored, if not confused. When structure is presented after the lecture, it tends to consolidate rather than emphasize the key elements. Hence, it does not have the "force" that will bring about improvement in students' attention. Without the use of structural support, for example in groups C1 and C2, students may often fail to perceive what the lecture is intended to teach. Since structure emphasizes the critical substantive elements, increase in attention could be attributed to exposure. It is a necessary but not a sufficient condition for the learning of meaningful verbal material presented from lectures.

Attention without meaningful encoding of the stimulus presented will not give rise to efficient and effective learning of verbal material. Meaning arises because of the ordering or arranging of the substantive elements involved in some content matter. Since structure involves the order or manner in which the critical substantive elements are organized, it is, therefore, by itself potentially meaningful. If the position of the substantive elements is changed, the meaning of the structure will alter accordingly. Meaningful encoding in the context of lecture attendance does not imply only the giving of meanings to the individual substantive elements perceived, but it includes also the overall "sensory" representation (i.e. the mental "image") of what the entire lecture is about.

When structure is presented before the lecture is delivered, it induces a meaningful learning set in students. It provides a meaningful frame of reference for students to organize and understand the substantive content material presented. New meanings are acquired and old ones are reinforced when the subsequent facts, concepts and propositions perceived from the lecture are related and incorporated, on a non-arbitrary basis,

within the structure initially perceived. Hence, structure helps semantic encoding of the content material presented. It therefore becomes easier to learn from a lecture that is perceived as meaningful. When structure is presented concurrently with the lecture, it provides a "visual symbolic representation" for each of the critical substantive content elements in the lecture. This visual "image facilitates and reinforces the meaningful encoding of relevant key ideas or concepts perceived. Because each aspect of the compound stimulus in this case is quite "accurately" encoded, the sum total would, therefore, produce a meaningful representation of what the entire stimulus is about. Such a gradual building up of the overall "image" for the whole lecture can be described as "meaningful processing". Hence, presenting the structural support in progressive stages as the lecture is being delivered allows for meaningful processing; and it facilitates learning because it helps the students to "understand" better. Presenting the structure after the lecture has been delivered helps the students to "discern the forest from the trees." Masses of factual details are initially presented, but the exposure of structure at the end constitutes a consolidation of the various critical aspects of the compound stimulus. In summarizing the key ideas and concepts, the structure assists students to perceive the seemingly diverse facts and concepts as a meaningful entity. It therefore clarifies learning. When a lecture is not augmented with structural support, it becomes relatively more difficult for students to discern the manner in which the lecturer has organized the substantive content material. Hence, straight lecture presentation may not be as effective in evoking semantic encoding and learning without proper understanding can be the obvious result.

When students have to deal with a large quantity of verbal material, such as when listening to a lecture, meaningful processing deteriorates. There are too many details involved, and the relationships among the various critical elements may not be apparent to students during the lecture. In order for students to recognize and recall meaningfully the content material perceived, they need to establish certain "linkages" between the various aspects of the compound stimulus. These linkages will serve as cues for eliciting relevant responses during recognition and recall. Structure consists of the manner in which the substantive elements are related and organized. When these critical elements and their relationships are meaningfully perceived, they would serve as cues for prompting or providing units to help students recognize and reproduce the details presented in the lecture.

When the structure is presented before the lecture, it may have a similar function as Ausubel's (1963) advance organizer in that it may serve as an "anchoring post" for subsequent learning of the facts and concepts presented. This anchorage constitutes the linkage between critical substantive elements and their relevant details. Thus when structure is presented early, it provides a scheme or setting for the conception of relevant linkages. It therefore sets the stage for remembering and tying together the mass of detailed information presented in the lecture. When structure is present during the lecture, the students need not have to search for the essential cues. These cues are already selected for the students and they appear as critical elements side by side with the relevant detailed information. Hence, the students can readily associate these cues as prompting procedues for the verbal material which they have to reproduce during recall. Presenting the structure at the end implies that the students will have to organize the content material perceived into specific settings provided by the framework of the structure so that each element of the critical material will be linked to the detail perceived. This sorting procedure seems to be a more complex process, and may not therefore be as efficient in helping students conceive the essential linkages between the various aspects of the stimulus. Without the use of structural support, it may even be more difficult for students to form adequate linkages for the various discriminable aspects of a compound stimulus. From the results obtained, it seems reasonable to suggest the following as general principles for augmenting lecture presentation with structural support. (Figure 6)

1. When the substantive elements in a lecture are organized either schematically or thematically their relationships are made apparent.

2. There is no one superior form of structural pattern. The decision on whether to adopt a schematic or thematic form is dependent on the nature of the content matter.

3. Presenting a thematic structure before a lecture is delivered helps in the recognition of substantive elements only for lectures involving less complicated content material.

4. Presenting a schematic structure before a lecture is delivered helps in the recall of substantive elements for both simple and complex lectures.

5. Presenting a thematic structure after a lecture is delivered helps in the recognition of substantive elements for both simple and complex lectures.

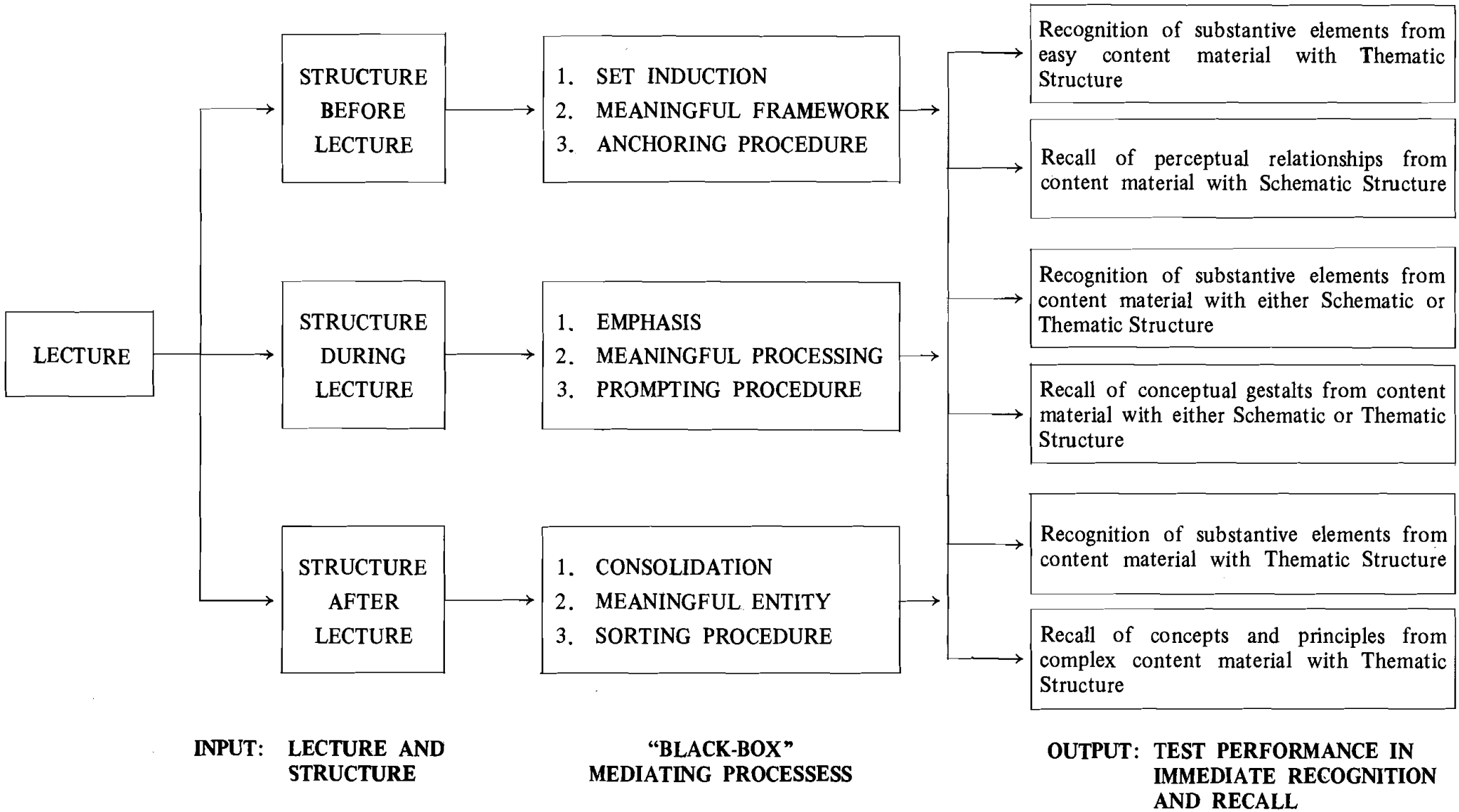


Figure 6 A Model for augumenting lecture presentation with structural support

6. Presenting a thematic structure after a lecture also helps in the recall of concepts and principles from lectures involving relatively complex content material.

7. Presenting either a schematic or thematic structure progressively in stages as the lecture is being delivered helps in the recognition of substantive elements irrespective of the complexity of content material.

8. Presenting a schematic or thematic structure progressively in stages as the lecture is being delivered also helps in the recall of substantive elements involving conceptual gestalts or overall patterns.

9. Of the three sequential modes of structural support, presentation of structure during the lecture appears to be the most versatile.

10. Using structural support to augment lecture presentation may help to evoke and reinforce the essential mediating processes that facilitate learning in students.

The findings offered are tentative and inconclusive except where they are consonant with the results of other studies. The conditions under which the study was conducted imposed certain limitations on the results obtained and hence, caution must be exercised in their interpretations. The present study was conducted in the context of teaching in higher education, and it specifically dealt with the lecture as a mode of instruction. Further studies are therefore required to determine the effects of the various possible combinations of the three sequential modes of structural support. As this study was only concerned with influence on immediate learning in terms of recognition and recall, future research may consider the effects of structure on retention and transfer of learning. Very little is known about exactly how each mode of structural support will affect retention and transfer of verbal material learnt. A particular mode of structural support that is effective in enhancing learning for students with a certain aptitude level may not necessarily be as effective for students with another aptitude level. Hence, studies involving aptitude-treatment interaction will open up new directions for future research in the area of structure in teaching. As the findings in this study may not be necessarily generalizable beyond lecture situations in higher education, it would therefore be most useful if the study is replicated in schools as well as in colleges and university settings with other teaching procedures besides the lecture method.

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