AN EXPERIMENTAL STUDY OF THE EFFECTIVENESS
OF THREE METHODS OF INSTRUCTION
FOR TEACHER-TRAINEES

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by
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CHAPTER I

THE PROBLEM

General

Teachers' Colleges in New Zealand are undergoing a period of rapid transformation. Not only are increasing numbers of students entering our colleges, but the amount of time spent on training them is being extended. Two colleges, Dunedin and Hamilton, have already begun three-year courses for primary-school teacher-trainees to replace the previous two-year courses, and Christchurch Teachers' College begins its three-year course for these students in 1967. Planning to meet the needs of this extended course is well in hand.

Faced with the prospect of these changes, and stimulated by the resulting upsurge of interest in this area of education, all those connected with teacher-training have become increasingly aware of the need to view critically the teaching methods used in our colleges. There is growing concern that the traditional lecture methods of instruction may not be adequate, and that other, more effective methods should be examined.

This attitude of enquiry was reflected in the Wallis House course of August, 19651, and in the many articles which

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have since appeared in the journal of the New Zealand Teachers' Colleges Association. A recent issue contained no less than three articles on this topic.²

Most experimental studies on the relative effectiveness of different methods of teaching have been conducted in the United States of America. At the Teachers' College level, there has been no major research completed in New Zealand. One study currently being undertaken at the University of Canterbury is attempting to evaluate the relative effectiveness of lectures and programmed text presentation of the Stage II Education course in statistics. No results have yet been published.³ A similar study at the University of Auckland has, to date, gathered information about students' reactions to the methods in use, but has not yet shown results of relative effectiveness.⁴ The time seems most appropriate for an experimental study which will investigate the amount of learning that occurs under different methods of presenting course material at the Teachers' College level.


³ See p. 75 for further reference to this study.

in New Zealand.

**Aims of the Study**

The general conditions outlined led to the framing of several important questions regarding the effectiveness of instructional methods used in Teachers' Colleges.

1. How effective are the traditional lecture methods?
2. What other methods could be used in presenting the factual content of courses?
3. To what extent are other methods comparable to lectures in effectiveness?
4. Are different methods equally effective for students of varying abilities and personalities?
5. Are different methods equally effective for short-term and long-term retention?

Consideration of these questions led to the formulation of four working hypotheses for the study.

1. **That retention of the factual content of the course will vary according to the method used in presenting the material.**

2. **That retention of the factual content of the course will vary according to the level of reading comprehension of the students.**

3. **That retention of the factual content of the course will vary according to the level of independence of the students.**
4. That retention of the factual content of the course over a long term will differ from retention of the factual content over a short term.

Some basic assumptions regarding the selection of reading ability and independence as variables underlie these hypotheses. These assumptions are elaborated in the appropriate sections of Chapters III and IV.

The study was designed to compare three selected methods of instruction in terms of their relative effectiveness in transmitting the factual content of a section of the second-year course in Educational Psychology for Division A students at the Christchurch Teachers' College. The three methods selected were:

1. Lectures
2. Programmed Instruction
3. Directed Reading and Discussion.

Reasons for the selection of these particular methods are considered in Chapter III.

The content presented was the same for each of the three methods -- a summary of the views of Jean Piaget on intellectual development. The success of each method was judged in terms of the amount of retention of the content as measured by a post-test one week after the conclusion of the four teaching periods devoted to the experiment. The post-test was repeated approximately three months later as a
measure of longer-term retention of the course material. Reasons for limiting the measurement of learning outcomes to retention of factual content are considered in Chapter III.

Selection of this particular section of the Educational Psychology course as the content for the experiment was based on two main considerations. Firstly, at the level at which the students involved deal with such topics, the material could be treated as a somewhat self-contained unit and presented within a relatively short period of time. Although later sections of the course build upon an understanding of Piaget's views, these sections could be delayed in their presentation until after the second post-test. Secondly, the selected section was seen as a specific, specialized viewpoint which was not covered as a topic in the course textbooks. As such, it represented an area of learning less exposed to contamination through prior knowledge than other aspects of the course. Safeguards against errors in this assumption are considered in discussion of the sample in Chapter III.

The remaining chapters of the thesis will deal with a brief review of the literature on the three selected methods of teaching at the tertiary level, followed by statements on the research design, including the instruments used, the treatment methods, the construction of the programme, the sample, statistical techniques, and the experimental procedure.
Subsequent sections will contain a concise statement of the results of the analyses, conclusions to be drawn from the results, and a discussion of their implications with particular reference to further research in this area.
CHAPTER II

REVIEW OF THE LITERATURE

The research literature evaluating various methods of classroom teaching at the college level reveals a diversity of conflicting and ambiguous results. The general model followed by researchers has been one in which the results of teaching by lectures have been compared with results obtained by some other method, usually discussion or reading.

Lectures and Reading

The assumption underlying nearly all of the research in this area is that something is being taught in the lecture that the student is not able to get for himself by reading the textbook for the course. Corey used simple experimental designs to compare the effectiveness of one or two lectures with a similar number of reading periods, but did not generalize the results to the effect of lectures for a whole course of instruction. More recently, a sophisticated study by Marr assessed the value of the lecture by comparing it to

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a condition in which the students received no lectures. The subjects were rated in three categories according to past achievement, and analysis of variance was used to show that significant differences in knowledge, as measured by test performance, resulted from the methods employed (those who received lectures did better than those who did not receive lectures), from levels of achievement (students higher on past achievement did better than less able students when similar instruction was received), from the instructors used in the study (four teachers took part), and from the interaction of instructors and levels of past achievement (suggesting that some teachers are more suited to teaching less able students, others more suited to teaching able students).

Caro, using end-of-course achievement tests as the criterion, found that students performed as well through independent study as in the conventional class situation.

**Lectures and Discussion**

Research comparing the lecture method with the discussion method is extensive. Wallen and Travers summarize this

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research with respect to the immediate mastery of factual information. They cite Asch (1951), Bane (1931), Bills (1952), Carlson (1953), Casey and Weaver (1956), Deignen (1956), Eglash (1954), Gerberich and Warner (1936), Haigh and Schmidt (1956), Husband (1951), Johnson and Smith (1953), Lifson, Rempel, and Johnson (1956), Maloney (1956), Slomowitz (1955), Wispe (1951), Zeleney (1940), as all having found no significant differences between lectures and discussion methods. They also cite Burke (1956), Guetzkow, Kelly, and McKeachie (1954), Remmers (1933), Ruje (1954), and Spence (1928) as typical of the few studies which have reported differences in favour of the lecture, and only Faw (1949) as having found differences in favour of the discussion method.

Comparatively little research has been done on the more important question of the longer-term retention of information. Again, Wallen and Travers provide a useful summary of the literature. Bane (1931) and Rickard (1946) found retention of material to be superior over a long term in groups taught by the discussion method, while Eglash (1954) found no differences. Ward (1956) found better retention of 'understanding-type' learning among academically able students under discussion methods, but better retention of such material under lecture methods with less able students. Further, less able

students showed greater immediate recall of information under the lecture method, whereas with more able students, immediate recall was little affected by method.

Advocates of discussion characteristically claim advantages for this method in learning outcomes other than the acquisition of factual knowledge, and see it as leading to greater ability in problem-solving, application of knowledge, and acceptance of responsibility. Patton (1955) found some evidence of greater acceptance of responsibility for learning by students in discussion classes, and Bovard (1951), McKeachie (1954), and Perkins (1950) found some indication of greater use of psychological knowledge. Eglash (1954) found no difference between discussion and lecture class scores on a measure of tolerance.

Programmes

In general, as Cohen points out, the main areas of research on programmed instruction to date have been to

6 Ibid., p. 482.

7 Cited in McKeachie, W. J. "Research on Teaching at the College and University Level." in N. L. Gage, editor, Ibid., p. 1126.

determine its effectiveness relative to traditional teaching methods, to identify areas in which it is applicable, and to determine optimal conditions for presentation. Most studies demonstrate some advantages for programming. Ferster and Sapon\(^9\) found comparable results between small classes learning German by programmed methods and by traditional methods; Roe\(^{10}\) found that the programme was effective in significantly changing the performance level of the students in a freshman engineering course; and Hough\(^{11}\) reports no significant differences in learning by college educational history students, but significant savings in time by the programmed-instruction groups.

On the question of retention, Gagne and Bassler\(^{12}\) showed high amounts of retention of programmed material over

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periods of weeks and even months, and a high correlation between achievement measured immediately following learning and after a longer retention interval. These findings support those of studies by Alter (1962), Gagne and Dick (1962), and Glaser and Reynolds (1962), cited by Gagne.13

Holland14 sums up the limitations of comparing programmed instruction with conventional methods.

"Despite their prevalence," he writes, "such studies lack validity in the sense that they do not permit generalization of the results beyond the particular instances used in the study. No teaching-machine program and no 'conventional' method represent their whole class; nor do the two differ in only a single dimension; they differ, instead, in an indefinite number of ways."

The following researches should be read with this limitation in mind.

Programmes and Lectures

Many studies which compare programmed instruction with conventional methods of teaching have been undertaken at the

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primary- and secondary-school levels. In many cases, the 'conventional methods' used with the control groups have been poorly defined, and, in fact, frequently consist of a composite of various teaching techniques rather than one clear-cut method. At the tertiary level, the study by Roe\textsuperscript{15} made use of a lecture method for the control groups whose achievements were significantly lower than those of the programmed-instruction groups.

Hough\textsuperscript{16} based his control groups on a lecture-discussion method. In neither of these studies was the 'conventional method' adequately defined. In addition, Hough acknowledged that the small size of his sample was a major limitation in drawing firm conclusions from his study.

More clearly defined was the lecture method used by Wendt and Rust.\textsuperscript{17} Their lectures were based on the programme used by the experimental groups. They found non-significant differences between programme-taught and lecture-taught college freshman in learning to use the library. However, they report that large time savings were made by the groups using the

\textsuperscript{15} Roe, A. \textit{Loc. cit.}

\textsuperscript{16} Hough, J. B. \textit{Loc. cit.}

programme method, and they view this as a major advantage over the lecture approach.

Programmes and Textbooks

There have been very few good studies which compare programmes and texts. One recent research by Feldman is a notable exception. She divided 144 college students into high and low ability groups and assigned them to one of three difficulty levels of a programme and a text created from identical words. Her results indicate that low ability subjects using the text did better than those using the programme. There were no differences in difficulty levels. Two measures of learning outcome were used, one consisting of items similar to the learning material, and the other, to assess transfer, consisting of items not similar. High ability students achieved significantly better than low ability students on the transfer test but not on the test of similar items.

Personality and Methods

Holland investigated the effectiveness of Cattell's


16 P. F. Questionnaire in predicting college grades and found no fewer than ten personality factors out of the sixteen to be significant at the .05 level or better. Grooms and Endler found that high anxiety subjects did not differ significantly from low anxiety subjects on the aptitude and achievement measures used, and they conclude that there is no direct, significant relationship between anxiety and academic achievement at the college level. Feldhusen found significant negative correlations between anxiety and convergent thinking in seventh- and eighth-grade pupils, but no differences between anxiety and divergent thinking.

Although studies of this kind may be of general value in the prediction of achievement, they fail to associate different personality variables with specific methods of teaching. Leith suggests the possibility that personality type may interact with method. After reviewing research in


this area, McKeechie\textsuperscript{23} concludes that most studies show some consistency in finding that a certain type of student, characterised as independent, flexible, or in high need of achievement, likes and does well in classroom situations which give students opportunity for self-direction. Amidon and Flanders\textsuperscript{24} offer some evidence to suggest that for dependent-prone students, learning may be less effective in teaching situations which do not give opportunity to ask questions and to gain assurance.

Cattell\textsuperscript{25} indicates those factors from the 16 P. F. Questionnaire which appear to have general validity for predicting school achievement: general intelligence; persistence and conscientiousness; will control; and sober temperament. These would appear to operate regardless of the methods employed in the teaching.


On the whole, the research indicates that the personality factor most closely linked with method variation in instruction is that of independence. This factor was selected as a major variable in the present experiment.
CHAPTER III

THE RESEARCH DESIGN:
INSTRUMENTS AND METHODS

This chapter is concerned with specifying the instruments used, and with describing the teaching methods used in the experiment. The bases of selection of the personality factors are considered, and the construction of the programme is discussed in some detail.

A. The Instruments Used

The following instruments were used in the study:

1. A.C.E.R. Co-operative Reading Comprehension Test, Form Y, Section 3, Level of Comprehension.

2. I.P.A.T. 16 P.F. Questionnaire, Form B, Factors E, I, and Q2. For a discussion of the selection of these factors, see Section C of this chapter.

3. Programmed Text. This was an original programme especially devised for the experiment. For a description of the construction of the programme, see Section D of this chapter. A complete copy of the programme is included in Appendix A.

4. Post-Test. Considerations underlying the construction of the post-test are discussed in Section E of this chapter, and a complete copy is included in Appendix C.
5. Reading List. This is discussed in Section B of this chapter, and a complete copy is included in Appendix B.

6. Lectures. These are considered in Section B of this chapter.

B. Description of the Treatment Methods

The three methods of presenting the course content were selected in terms of the degree of structuring of the material by the teacher.

PROGRAMMED INSTRUCTION METHOD: This represents the greatest degree of structuring of the content and of the actual presentation of the material. The teacher controls each segment of the material, both in what is to be presented, and in the manner and sequence of its presentation. In addition, the student has an awareness of his learning progress because of the immediate feedback in knowledge of results after each step of the learning process.

Consideration of the factors underlying programme construction involves lengthy discussion. For this reason, a separate section of this chapter has been devoted to this topic.

LECTURE METHOD: This method allows the content to be structured by the teacher both in what is to be presented and in the sequence of presentation. Because of differing student response, however, the structuring is far less rigorously
controlled than in the Programmed Instruction method.

The lectures were based on the content, wording, and sequence of the programme. As is normal practice with the typical small (35 - 40) lecture groups at Christchurch Teachers' College, students are permitted (and, indeed, encouraged) to ask questions and raise problems relevant to the topic. Thus, a certain amount of feedback may occur, examples may be extended and repeated, and emphasis placed in accordance with the lecturer's reaction to the students' responses.

Although the broad plan of the programme was followed reasonably well in the lectures, the method of lecturing was not sacrificed for the sake of an exact paralleling of the programme. However, all the main points in the content were covered in all three methods used in the study.

DIRECTED READING AND DISCUSSION METHOD: Here, the degree of structuring is minimal and extends only to the choice of texts and topics, and to the indications given by the teacher of the relative importance of any given section of the assigned reading. The student is expected to read the material for himself, to structure the content according to his own views of the topic, and to organize his own learning of the material. Except through any self-imposed testing he may choose to undergo, he has no knowledge of his success or failure in mastering the material during the learning process.

Although he has an advantage in being able to discuss
the material with a group and may have opportunity to read more widely, the onus of structuring the content rests with him; the opinions of others and a broader coverage of the topic may serve only to confuse rather than to clarify the issues. The ability to read well would appear to be of great importance to this method of independent study. It was therefore postulated that students with high levels of reading comprehension would be more likely to perform well using this method than would students of low reading ability.

Various types of discussion methods have been studied in past researches. One of the major problems in evaluating results has been that there is no consistent definition of discussion as a method. As Wallen and Travers¹ point out, the salient characteristic is a greater degree of participation (talking) on the part of the students in comparison with the lecture method, but actual practices may vary from a largely unstructured situation in which the teacher plays a non-committal, mediating role, to one in which the teacher asks and answers questions. Varying degrees of student control of class activities are also found. "Thus," they conclude, "we note that one man's 'lecture' may be another man's 'discussion'."²


² Ibid., p. 481.
For the purpose of this study, the discussion part of the Directed Reading and Discussion Method may be defined as "Free Group Discussion" as this term is used by Powell.\(^3\) Here, the tutor hands over many of his traditional roles to other members of the group. "Instead of initiating, questioning, criticizing and directing the discussion, his main function becomes that of a sympathetic listener."\(^4\) The lecturer acts merely as a chairman to ensure that the time allocated is actually spent on the topic to be studied.\(^5\)

A detailed reading list was prepared and copies issued to each student in the Directed Reading and Discussion treatment groups. Sources from which the texts could be obtained were made known, and to ensure equal access to the references, one copy of each was placed on reserve in the College library. The only text not held by the College was obtained on inter-loan and placed on reserve with the others.

The most important reference, a series of journal


\(^4\) Ibid., p. 184.

articles by Lawrence,⁶ was cyclostyled and individual copies were issued to each student in the Directed Reading and Discussion treatment groups.

For full details of the actual reading assigned, see the copy of the issued reading list in Appendix B.

C. Selection of the Personality Factors

As the methods to be used were selected in terms of the degrees of structuring of the material and the learning by the teacher, it was felt that the aspects of personality most likely to affect learning would be those which would make the student more prone to depend on the teacher for confidence and guidance in the learning situation.⁷ It was postulated that the more dependent, less confident student would achieve better in methods carefully structured and controlled by the teacher, while the more independent, self-confident student would achieve better in a method which allowed him scope to structure his own learning.

As the 16 P.F. Questionnaire purported to measure all

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⁷ See also "Personality and Methods," pp. 14 - 17 of this study, for further comments.
important aspects of the total personality, this test was selected as the most suitable measuring instrument and was carefully examined for factors which appeared to be related to the form of independence described. The following were found to be most saturated with the personality factors seen as important to the study:

**Factor E:** The Manual describes the positive subject as assertive, self-assured, and independent-minded. An analysis of the items indicates that the positive subject has confidence in his own judgment, and a desire to implement and express his own ideas. The negative subject is described as being submissive, kindly, and easily upset. Groups averaging high on this factor show more effective role interaction and democratic procedure.

**Factor I:** The Manual describes the positive subject as dependent, seeking help, and, in children, reliant

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9 Ibid., p. 12.

10 Ibid., p. 15.
on the teacher. The negative subject is described as self-reliant and able to carry responsibility. Note that the negative pole of this factor indicates the independent person.

Factor Q₂: The Manual\textsuperscript{11} describes the positive subject as self-sufficient, resourceful, resolute, and accustomed to making decisions for himself. The negative subject is described as socially group dependent. An analysis of the items which make up this factor in the questionnaire indicates that the positive subject prefers to plan for himself, to accept responsibility for his own decisions, and to work alone in studying problems, while the negative subject is more withdrawn and prefers to seek help with problems. He is more concerned with group standards than is the positive subject.

Cattell\textsuperscript{12} emphasizes that the factors in the 16 P.F. Questionnaire are independent of each other in that they do not overlap in meaning or waste scores by partially repeating the same measure under a new name. He points out that

\begin{itemize}
\item \textsuperscript{11} Ibid., p. 18.
\item \textsuperscript{12} Ibid., p. 2.
\end{itemize}
it is therefore possible to combine any score whatever on one
factor with any score on others. As the three factors listed
appear to combine to make up the independence factor seen as
important to the study, all students in the sample were scored
on these three factors, their raw scores were converted to
stens, and the three added without weighting to give a
composite Independence Score. It should be noted that the
negative pole of Factor I was added as positive. No correct-
ton of raw score for age was made in Factor I. In convert-
ing raw scores to stens, Table 3B was used.

Subjects were assigned to one of three categories on
the basis of their composite Independence Score. The class-
ifications used were High Independence, Average Independence,
and Low Independence. Students whose Independence Score came
within the range of 12 to 14 inclusive constituted the Average
group, with the High and Low groups falling above and below
this range respectively.

D. The Construction of the Programme

From the selected content, a list was made of all the
major facts and understandings seen as essential to an adequate

13 Cattell, R. B. THE 16 P.F. QUESTIONNAIRE HANDBOOK,

14 Ibid., p. 5.
concept of the topic. Material by means of which these facts and understandings should be conveyed was also listed. Test items were then constructed around these ideas. The facts and generalizations were arranged in what appeared to be an appropriate sequence. Detailed lecture notes for the course were also prepared from the list of basic understandings, following the same sequence.

The content of the course was then divided up into instruction frames for a programme, and response frames were compiled to correspond with these instruction frames. This became the draft programme which was re-examined thoroughly, frame by frame, and smaller steps created when it was felt that too much information was being presented in any one item. The draft programme was then submitted to colleagues for comments on suitability, comprehension level, precision of wording, accuracy of content facts, and sequence of presentation.

After minor modifications, the programme was then tried out with six young teachers who had not taken Education as a subject at university, and whose knowledge of Piaget's views of intellectual development was very limited. The ages of these subjects ranged from 22 to 30 years, and their teaching experience ranged from two to eight years. The fact that the programme seemed to be quite satisfactory for these subjects does not necessarily indicate that it is suitable for second-year Teachers' College students. The trials did,
however, give some indication of the usefulness of the programme in action. The choice of these subjects for the pilot trials was made on the grounds that all available second-year students were to be included in the research sample, and that many first-year students had siblings or friends among the second-year groups, a fact that could lead to the possibility of prior knowledge of the course content reaching some of the sample group.

The trials were conducted to determine the suitability of the format and the vocabulary used, the adequacy of the time limits imposed by College organization and by the research design, the presence of ambiguities, and the error rates for the frames. Subjects were encouraged to comment aloud as they worked through the programme, and their remarks led to subsequent minor modifications in the final programme.

In assessing the seriousness of the error rates, it should be noted that the number of responses required in a single frame varies from one to nine, and that, although the programme contains only seventy-two frames, the total number of responses demanded is 311. In no single frame was an error made by more than one subject, and in no case was more than one error made in frames requiring multiple responses. The average number of errors was five for the whole programme, and this figure was considerably influenced by the performance of one subject who, because of pressure of time, worked
through the whole programme in one evening with a minimum of rest. His comments indicated that several of his errors were due to fatigue. After the first trial, two frames were amended to remove ambiguities which could have caused the errors noted, and subsequent trials produced no mistakes in these frames.

On the trials, the mean error rate per frame was less than 7 per cent, while the error rate in terms of the number of wrong responses in proportion to the total number of responses was less than 2 per cent. This was considered to be quite adequate for the purpose of the study.

Time taken for the completion of the programme ranged from 2 hours 47 minutes to 3 hours 55 minutes, with an average time of 3 hours 10 minutes for the six subjects. It is interesting to note that spontaneous requests for rest periods occurred at an average interval of 54 minutes, the mean number of frames completed in this time being twenty. As the research groups had available four 50-minute periods in which to complete the programme, the time factor was considered to be adequate. The need to conduct the study in 50-minute periods was imposed by College organization. Although this would appear to be rather too long for working on a programme, the trial subjects did not seem to find this span of concentration too much of a disadvantage. In the actual research groups, however, it was noted that many subjects began to
slow down their speed of working after 30 to 35 minutes, and that less than half of the subjects appeared able to maintain their concentration throughout the whole period of 50 minutes devoted to the experiment each day.

The final form of the programme was decided upon with the following main facts in mind. Firstly, the age and maturity of the students were considered. The sample consisted of second-year Teachers' College students who were considered capable of absorbing information in something larger than the very small steps usually used in programmes for children. Apart from the fact that these students would probably become bored by a minutely detailed approach, research has shown that small steps may produce superior learning only at the cost of greatly increased training time. Pressey has also concluded that the abandonment of the 'many easy questions' concept will both greatly decrease bulk and increase incisiveness. Markle considers that the principle of small steps


is not basic at all, and she points to the increasing reaction against it. Goldbeck and Campbell\textsuperscript{19} support the idea of larger steps on the grounds that students may become bored by overcuing. Taber\textsuperscript{20} also supports this view in asserting that principles of learning may be applied to gross units if these are the most effective way to attain the desired terminal behaviour. Leith\textsuperscript{21} goes even further in suggesting that we could well ask "whether some learning is not more profitable if the pupil has to grapple with ideas which resist easy understanding."

The second consideration was that of time. With only four 50-minute periods in which to present the content of the programme, a decision had to be made as to whether it was better to present in the programme the same amount of content as in the other two treatment methods, using large steps to accomplish this, or to present in smaller steps, and with greater detail, a segment only of the course content. The need to control as closely as possible the variables of time


and similarity of content dictated that a decision be made in favour of the former alternative.

Thirdly, consideration was given to the most suitable response mode. In keeping with Taber's\textsuperscript{22} view that it is more reasonable to employ a variety of modes so as to increase general interest, and bearing in mind the general principle of active and frequent responses by the subjects, the programme employed constructed answers, multi-choice, and true-false responses at frequent intervals. In addition, reinforcement was strengthened through repetition. The use of multi-choice answers is criticized by some psychologists on the grounds that incorrect stimuli may be learned incidentally, but, as Taber points out, research indicates no differences between students who construct responses and those who select multiple-choice answers.\textsuperscript{23}

The principle of diminishing prompts was incorporated to some degree, especially in the Review Frames, but it was noted on the trials that problems arose when prompts were withdrawn too soon. Ambiguities corrected during the trials arose from this attempt to include vanishing cues, and some which had been withdrawn had to be replaced.


\textsuperscript{23} \textit{Ibid.}, pp. 135 - 136.
Another major concern was the future use of this kind of programmed instruction approach as a teaching method at Teachers' College. The type of programme finally designed was seen as more likely to be constructed by lecturers for the presentation of their course material than would be a minutely detailed, small-step programme which is not only more time consuming to devise, but which would require more knowledge of the techniques of programme construction than most lecturers at this college possess.

During the construction of the programme, the three major factors pointed out by Lumsdaine were kept in mind. He emphasized the need for: (a) frequent response by the student; (b) immediate correction or confirmation; and (c) progression at an individual rate. Markle reinforces the importance of these in her three principles of linear programming -- active responding, minimal errors, and knowledge of results. It was felt that the programme in its final form filled these basic requirements of self-instruction.

For a complete copy of the programme used, see Appendix A.


E. The Post-Test

Powell states: "The prime consideration, when deciding which teaching procedure to use, must always be the extent to which it will succeed in attaining our educational objectives." 26

Undoubtedly, one of the reasons for the often conflicting and ambiguous results from studies of different methods of teaching is the failure to define adequately the learning outcomes to be measured, or to devise suitable instruments for the accurate measurement of the defined objectives. As Hurst 27 indicates, the majority of studies use only one measure of outcome, usually an index of the amount of factual material required.

"It has been recognized for many years that the mastery of factual material is not the only goal to be sought in teaching educational psychology to prospective teachers. Three major goals are usually cited for this type of professional preparatory course: (a) the development of specific attitudes, (b) the application of knowledge to the professional setting, and (c) the mastery of a body of factual information. Several studies have clearly indicated that these goals are quite independent. Thus, a student's status on each of them cannot be represented collectively by a single numerical index." 28

Hurst used factor analysis and multiple regression analysis in his study of three teaching methods with four


28 Ibid., p. 147.
indices of the course's objectives. He concludes that "the superiority of a method was related to specific indices rather than being general to all of the indices of outcome."^29

The present study is concerned with the measurement of retention of content material. Although the importance of other goals in the professional training of teachers is clearly recognized, no attempt has been made to measure attitudinal changes or the application of acquired learning in the professional setting. The post-test was designed to measure students' mastery of specific facts and generalizations from the course content, firstly as short-term retention, and secondly as long-term retention. The short-term retention was measured one week after the conclusion of the treatments; the long-term retention was measured by a repeat of the same post-test approximately three months after the conclusion of the treatments.

In terms of Bloom's^30 taxonomy, the post-test sought to measure knowledge of terminology, knowledge of specific facts, knowledge of classifications and categories, and extrapolation. These categories of Bloom's taxonomy call for recall rather than recognition, but it was considered

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^29 Ibid., p. 150.

desirable to include both of these aspects in the post-test. To reduce subjectivity in the scoring, essay-type items were avoided.

The post-test as finally devised consisted of two sections: Section A, Recall, containing open-ended questions demanding constructed responses; and Section B, Recognition, containing multiple-choice questions. Because of the degree of overlap in the facts tested in the two sections, Section A was administered first and the scripts collected before Section B was distributed to the subjects.

For full details of the post-test used, see Appendix C.
CHAPTER IV

THE RESEARCH DESIGN:

SAMPLE, PROCEDURE, AND STATISTICAL TECHNIQUES

A. The Sample

The sample was drawn from all second-year Division A students at the Christchurch Teachers' College, at the time of the experiment, a total of 298 students of whom 57 were males and 241 were females. Division A consists of two-year trainees for primary teaching.

Students who have passed Stage 1 Education at university are normally excused some sections of the Educational Psychology course at Teachers' College. These students were omitted from the sample. Students who have attempted Education 1 at university and have failed are not normally excused sections of their College course, but because they had been exposed to the ideas contained in the content to be presented in the research, their results were not included in the final data. Previous exposure to the content disqualified 53 students. A further 11 students were omitted from the final sample because of absences during the experiment. Thus, the sample was reduced to 234, of whom 49 were males and 185 were females.

Second-year students in Division A at this college are organized into eight groups of approximately equal size.
These groups are lettered from A to H. Groups A to D consist of students who are not doing university work. Groups E to H consist mainly of students who are doing some university work in conjunction with their College courses. On the whole, past performances at College of students in groups E to H have been somewhat better than the performances of students in groups A to D.

Students are allocated to College groups according to the subject(s) they are studying at university. Thus, Group F contained only one student who had not attempted Education 1, and Group G contained only twenty-four students who fell into this category. Only these students were included in the sample.

Of the 234 students in the sample, 95 were from university groups and 139 were from non-university groups. Because of the small number of males in the sample, it was not considered justifiable to dichotomise on a sex basis in the analysis of the data. Scores for males and females were, however, kept separate for future reference.

For the final analysis, this sample was further reduced by random selection for reasons explained in the next section of this chapter.

Age and pre-requisite qualifications for entry to a course for primary-school teaching are common to all Teachers' Colleges in New Zealand, although there may be local variations
in the numbers of applicants with higher qualifications available in any one year. It is therefore probable that results from the sample selected for this study could be generalized to second-year students in equivalent courses in other New Zealand Teachers' Colleges. It should be remembered, however, that the nature and length of Division A courses are undergoing a process of change which could well mean that a different type of student will enter the colleges in future years. The higher level of professional training offered, and the introduction of more university studentships for Division A students, certainly increase the probability that future primary-teacher trainees will include larger numbers of students doing part-time or even full-time university work. It is even possible that some senior students will have completed university degrees. In view of these developments, generalization from the sample of the present study to students in future courses at this college would appear to be unjustifiable. The results of this research should be viewed with these limitations in mind.

B. Procedure

College organization imposed certain limitations upon the ways in which the groups could be merged for the purposes of the experiment, and the exemption of students who had been exposed previously to the content created problems of balancing
numbers to achieve approximately equal treatment groups. It was also felt necessary to ensure that each treatment group contained sufficient numbers of high, average, and low ability readers to permit an adequate analysis to be carried out.

The A.C.E.R. Co-operative Reading Comprehension Test, Form Y, was administered and scored. On the basis of the scale scores on the Level of Comprehension section of this test, students were classified as high, average, or low in reading ability. The mean score was 55.4 and the s.d. was seven when rounded off to the nearest whole number. The average group was defined as those students whose scores fell in the range 58 to 53 inclusive, these scores representing a range of somewhat less than \( \frac{1}{2} \) s.d. each side of the mean. It is interesting to note that the distribution of the research sample was similar to that reported in the test manual for Sydney Teachers' College Non-university Students, 1962.¹

When the numbers falling into each of the three Reading Comprehension categories had been calculated, and the College organization considered, the groups were merged into Treatment Groups. The desirability of including some university and some non-university students in each of the merged Treatment

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¹ MANUAL FOR CO-OPERATIVE READING COMPREHENSION TEST FORM Y. A.C.E.R. p. 21.
Groups was also taken into consideration. The combination of groups was finally determined by the need for each sub-cell of the three Treatment Groups to contain a sufficient number of subjects to allow an adequate analysis to be made. The final allocation was:

- **Treatment 1**: Groups A, C, and G.
- **Treatment 2**: Groups D, E, and F.
- **Treatment 3**: Groups B and H.

The numbers involved in each Treatment Group for each level of Reading Comprehension are shown in Table I.

Methods were then randomly allocated to Treatment Groups by drawing lots. The results were:

- **Treatment 1**: Programmed Instruction
- **Treatment 2**: Directed Reading and Discussion
- **Treatment 3**: Lectures

When the allocation of students to Treatment Groups and to Reading Comprehension levels had been completed, the 16 P.F. Questionnaire was administered and the three selected factors were scored. The scores for these factors were added, without weighting, to yield an Independence Score. Students were then rated as High, Average, or Low in independence according to whether they fell above, within, or below the range of 1 s.d. about the mean for the sample. (Sample mean was 13; s.d. was 2; N = 234).
TABLE I

THE SAMPLE AS ALLOCATED TO TREATMENT GROUPS AND READING LEVELS

<table>
<thead>
<tr>
<th></th>
<th>Treatment 1</th>
<th>Treatment 2</th>
<th>Treatment 3</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading 1 Above Average</td>
<td>27</td>
<td>27</td>
<td>27</td>
<td>81</td>
</tr>
<tr>
<td>Reading 2 Average</td>
<td>36</td>
<td>26</td>
<td>19</td>
<td>81</td>
</tr>
<tr>
<td>Reading 3 Below Average</td>
<td>28</td>
<td>22</td>
<td>22</td>
<td>72</td>
</tr>
<tr>
<td>Total</td>
<td>91</td>
<td>75</td>
<td>68</td>
<td>234</td>
</tr>
</tbody>
</table>

Total second-year Division A population 298

Omitted because of prior exposure to content to be presented through previous courses at university 53

Omitted because of absences during the experimental presentation of content 11

Number of students remaining as participants in the experiment 234
When the Independence categories were tabulated in conjunction with the Treatment Groups and the Reading Comprehension levels, the analysis matrix emerged as shown in Table II. It will be noted that there is a wide range of variation in the sub-cell sizes, some sub-cells containing as few as five students and one containing as many as twenty-three. In order to reduce the complexity of the statistical procedure, all over-size sub-cells in the matrix were reduced to five by random selection. Thus, the final matrix for analysis contained a total of 135 students. Of these, 33 were males and 102 were females, 60 were from university groups and 75 were from non-university groups.

After the administration of the A.C.E.R. Co-operative Reading Comprehension Test and the 16 P.F. Questionnaire had been completed, six lecture periods of 50 minutes each were devoted to the experimental section of the study. These periods were one section of the time allocated to the topic of Education in the normal College course. Each Treatment Group had two lecture periods per week, one on each of two successive days, but the days of the week and the time of day both varied from group to group. This was dictated by College organization.

The first period for each Treatment Group was devoted to an introductory lecture which served two major purposes. Firstly, all students were informed that they were taking
## TABLE II

**THE SAMPLE AS ALLOCATED TO TREATMENT GROUPS, READING AND INDEPENDENCE LEVELS**

<table>
<thead>
<tr>
<th>Independence 1 Above Average</th>
<th>Treatment 1 Programme</th>
<th>Treatment 2 Reading</th>
<th>Treatment 3 Lectures</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>R₁</td>
<td>8</td>
<td>8</td>
<td>7</td>
<td>23</td>
</tr>
<tr>
<td>R₂</td>
<td>5</td>
<td>5</td>
<td>6</td>
<td>16</td>
</tr>
<tr>
<td>R₃</td>
<td>9</td>
<td>8</td>
<td>5</td>
<td>22</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Independence 2 Average</th>
<th>Treatment 1 Programme</th>
<th>Treatment 2 Reading</th>
<th>Treatment 3 Lectures</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>R₁</td>
<td>7</td>
<td>7</td>
<td>11</td>
<td>25</td>
</tr>
<tr>
<td>R₂</td>
<td>8</td>
<td>10</td>
<td>5</td>
<td>23</td>
</tr>
<tr>
<td>R₃</td>
<td>9</td>
<td>7</td>
<td>5</td>
<td>21</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Independence 3 Below Average</th>
<th>Treatment 1 Programme</th>
<th>Treatment 2 Reading</th>
<th>Treatment 3 Lectures</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>R₁</td>
<td>12</td>
<td>12</td>
<td>9</td>
<td>33</td>
</tr>
<tr>
<td>R₂</td>
<td>23</td>
<td>11</td>
<td>8</td>
<td>42</td>
</tr>
<tr>
<td>R₃</td>
<td>10</td>
<td>7</td>
<td>12</td>
<td>29</td>
</tr>
</tbody>
</table>

| **Total**                    | **91**                | **75**              | **68**               | **234** |

Total second-year Division A student population 298

Omitted because of prior exposure to content to be presented through previous courses at university 53

Omitted because of absences during the experimental presentation of content 11

Number of students remaining as participants in the experiment 234
part in a research which would be explained fully at a later date. (This was duly done at the conclusion of the experiment.) It was hoped that, by making all students equally aware that they were participants in an experiment, the possibility of the intrusion of a Hawthorne effect would be greatly reduced, or, if Hawthorne effect did intrude, it would be more likely to be distributed randomly among the members of all Treatment Groups.

Secondly, it was felt desirable that all students should start the experiment with a common level of background knowledge. It was assumed that none of the students in the sample would have any precise knowledge of the content which consisted of a narrowly specific area of educational psychology. This assumption was confirmed by oral questioning in casual conversations with thirty-five randomly selected sample subjects. Of these, nineteen had not previously heard of Jean Piaget, fourteen had heard of him but could not recall in what subject area, and only two students stated that they knew of him as being connected with child development or educational psychology. They disclaimed, however, any knowledge of his theories, and could not state a single contribution to the subject field made by Piaget. The possibility that knowledge of the highly specialized content had been acquired by many of the sample subjects through personal reading or experience was therefore considered to
be remote. However, certain basic psychological knowledge was seen as essential to an adequate understanding of the content, and because some students may not have acquired this basic knowledge from previous studies in their College courses, the following terms and concepts were briefly explained in the introductory lecture: I.Q.; Mental Age; Perceptions; Concepts; Symbols; Symbolic Thought; Environment; Self; Manipulation; Nervous System; Adolescence; Hypothesis; Stimuli; Variables.

The second, third, fourth and fifth periods were devoted to the three Treatment Methods already defined. Great care was taken to prevent any departure from the methods as defined. For example, with the Programmed Instruction Groups, only questions relating to the working of the programme and to general procedure were answered, care being taken that no discussion should arise over the actual content and the understanding or interpretation of it. Similarly, while discussion was encouraged with the Directed Reading and Discussion Groups, care was taken to ensure that the lecturer maintained a neutral position, chairing but not leading the discussions.

The sixth period was devoted to the post-test to measure retention over a comparatively short term.

Approximately three months later, a seventh period, coinciding with the normal mid-year College examinations, was devoted to a repeat of the post-test to measure long-term retention.
C. The Statistical Techniques

As mentioned in Chapter I (p. 4), some basic assumptions regarding the selection of reading ability and independence as variables underlie the Experimental Hypotheses. It was considered likely that students with a high level of reading comprehension would tend to score well regardless of the teaching method employed. In addition, it was thought possible that reading ability might interact with method. Similarly, independence was seen not only as a possible main effect, but also as an interacting variable. This was discussed in Chapter III. The possibilities of interaction effects led to the formulation of one further Experimental Hypothesis:

5. That retention of the factual content of the course will vary as a function of interaction effect between the variables of Reading, Independence, and Method.

In order to allow for the analysis of possible interactions among these variables, Analysis of Variance was initially selected as the statistical technique to be used. However, it was assumed that students who had been successful in previous College courses in related subject fields would be more likely to score well in the experimental course than would those whose past record was one of failure, and that this factor could well overshadow any effects resulting from different methods.
of teaching the content. It could be argued, in fact, that measures of past success are measures of ability, of application, of interest in the subject field, and even of attitudes towards College. The desire to hold constant this factor led to the final choice of analysis of Co-variance as the statistical technique. Previous success was controlled as a variable by using, as the X scores in the analysis of Co-variance, the previous year's summed assessments for each student in the two related subject fields of Educational Psychology and Child Development. The Y scores in the analysis were the raw scores from the post-tests.

The validity of Co-variance Analysis rests upon certain assumptions. These were examined to evaluate the extent to which the essential conditions were met in the research.

1. **The characteristic or variable to be measured should be normally distributed in the universe.** This must hold at least approximately or probability levels are unreliable. The population from which the sample was drawn, second-year Division A students at Christchurch Teachers' College, showed distributions of Past Success and Reading variables according to an approximately normal curve of probability as indicated in Figures 1 and 2. Because not all second-year students were measured for in the Independence variable, the normality of this distribution depends upon the validity of the test used, and is accepted as appropriate. This acceptance is well supported by the distribu-
Figure 1

Distribution of Past Success in Total Second-Year Student Population

N = 298
Mean = 5.30
s.d. = 1.76
FIGURE 2

DISTRIBUTION OF READING COMPREHENSION
SCORES IN TOTAL SECOND-YEAR POPULATION

N = 298
Mean = 55.32
s.d. = 9.34
ution of scores of a large proportion of the population (238 out of 298) for whom results were available. This is shown in Figure 3.

Because Division A students in all New Zealand Teachers' Colleges are recruited under identical conditions of age, qualifications, etc., it is highly probable that they constitute a reasonably homogeneous group in which the variables relevant to this study are distributed similarly to the Christchurch population from which the sample was drawn.

2. The sample should be randomly selected. The selection procedure was discussed fully in an earlier section of this chapter. Within the restrictions imposed by the research design, the condition of randomness was considered to have been sufficiently well met by the random allocations of groups to treatment methods, and by the random selection of subjects in reducing the over-size cells in the analysis matrix.

The omission of Education 1 students from the sample suggested the possibility that a too large proportion of able students was excluded from sample selection. However, not all able students take Education as a university unit, and many able students do no university work at all during their College course. The distributions of relevant variables within the final sample, shown in Figures 4, 5 and 6, support the contention that the sample does, in fact, reflect the normal distribution of these characteristics in the larger
FIGURE 3

DISTRIBUTION OF COMPOSITE INDEPENDENCE
SCORES IN SECOND-YEAR POPULATION

NOTE: Scores were available for only 238 of the 298
students in the total second-year population.
<table>
<thead>
<tr>
<th>Number of Cases</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pact Success Assessments</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**FIGURE 4**

**DISTRIBUTION OF PAST SUCCESS IN RESEARCH SAMPLE**

- N = 135
- Mean = 5.29
- s.d. = 1.45
N = 135
Mean = 13.17
s.d. = 3.32

FIGURE 5
DISTRIBUTION OF COMPOSITE INDEPENDENCE SCORES IN SAMPLE
FIGURE 6
DISTRIBUTION OF READING COMPREHENSION SCORES IN SAMPLE
population.

1. The selection of any case should not determine the selection of any other case. All tests assume that the observations, and therefore the data, are independent. This assumption was accepted without testing in this study.

2. The measurement of variables should be by equal interval scales. In strict terms, none of the measurement scales used could be considered to be of equal intervals. However, as with most scales used in the behavioural sciences, the assumption of approximately normal frequency distribution of the variable provides sufficient grounds for the acceptance of this condition.

In general, then, it was considered that the necessary conditions had been sufficiently well met to allow the valid application of Co-variance Analysis to the data. This method of analysis, sensitive and powerful, was seen as providing the most efficient form of control of the variables involved. The working procedure for the analysis was adapted from that outlined by Noroney.²

The correlation between Part A Scores and Part B Scores

on the first post-test was calculated by the Product Moment method. This resulted in a correlation coefficient of +.49. Although this seemed a reasonable degree of correlation, it was considered that the skills involved in recognition and in recall were sufficiently different to assume that the variables might influence these two aspects of retention differentially. Consequently, when the analysis of the total raw scores of the first post-test had been completed, two further analyses were performed using as Y scores the separate results from Part A, Recall, and Part B, Recognition. The results of the second post-test were also analysed in these three forms so that, in all, the following six analyses were carried out:

POST-TEST 1: SHORT-TERM
   Part A, Recall
   Part B, Recognition
   Total Scores

POST-TEST 2: LONG-TERM
   Part A, Recall
   Part B, Recognition
   Total Scores

The results of these analyses are reported in Chapter V and the implications of the findings are discussed in detail.
in Chapter VI.

Product Moment correlations were also calculated for Parts A and B of the second post-test, and for the Total Scores of Post-Tests 1 and 2. These resulted as follows:

\[
\begin{align*}
\text{POST-TEST 1: Part A - Part B} & \quad + .49 \\
\text{POST-TEST 2: Part A - Part B} & \quad + .37 \\
\text{TOTAL SCORES: Post-Test 1 - Post-Test 2} & \quad + .44
\end{align*}
\]
CHAPTER V

ANALYSIS OF RESULTS

A. The Hypotheses to be Tested

Five Research Hypotheses have been formulated in previous chapters. These are:

1. That retention of the factual content of the course will vary according to the method used in presenting the material.

2. That retention of the factual content of the course will vary according to the level of reading comprehension of the students.

3. That retention of the factual content of the course will vary according to the level of independence of the students.

4. That retention of the factual content of the course over a long term will differ from retention of the factual content over a short term.

5. That retention of the factual content of the course will vary as a function of interaction effect between the variables of Reading, Independence, and Method.

The appropriate Null Hypotheses were formulated and tested by reference to the levels of significance resulting from each of the six analyses performed. In all cases, the level of rejection of the Null Hypotheses was set at $p < .05$. 
B. Results of the First Post-Test (Short-Term Retention)

1. TOTAL SCORES. The Past Success Scores (X) and the Total Scores (Y) on the first post-test are tabulated in Table IX (p. 151), and the results of the Analysis of Co-variance are summarized in Table X (p. 152).

The Null Hypothesis was accepted for the triple interaction effect of Treatment, Independence, and Reading, for all three double interaction effects of these variables, and for the main effects of Independence and Reading. Thus, the second Experimental Hypothesis, that retention of the factual content will vary according to the reading comprehension level of the students, the third Experimental Hypothesis, that retention of the factual content will vary according to the independence level of the students, and the fifth Experimental Hypothesis, that retention of the factual content will vary as a function of interaction effect, were all found to be untenable.

The Null Hypothesis was rejected for the main effect of Treatment at the .01 level of significance. Therefore, the first Experimental Hypothesis, that retention of the factual content will vary according to the method used in presenting the material, was accepted tentatively.

2. PART A, RECALL. The Past Success Scores (X) and the Part A
Scores (Y) on the first post-test are tabulated in Table XI (p. 153), and the results of the Analysis of Co-variance are summarized in Table XII (p. 154). The Null Hypothesis was accepted for the triple interaction effect, for all three double interaction effects, and for the main effects of Independence and Reading. Again, the second, third, and fifth Experimental Hypotheses could not be accepted as tenable.

The Null Hypothesis was rejected at the .05 level of significance for the main effect of Treatment, and, therefore, the first Experimental Hypothesis was again accepted tentatively.

3. PART B, RECOGNITION. The Past Success Scores (X) and the Part B Scores (Y) on the first post-test are tabulated in Table XIII (p. 155), and the Co-variance Analysis results are summarized in Table XIV (p. 156). The Null Hypothesis was accepted for the triple interaction effect, for all three double interaction effects, and for the main effects of Independence. Thus, the third and the fifth Experimental Hypotheses became untenable.

The Null Hypothesis was rejected at the .05 level of significance for both the main effect of Treatment and the main effect of Reading. Again, the first Experimental Hypothesis was acceptable, and, in addition, the second Experi-
mental Hypothesis became tenable for this aspect of retention.

The significance levels for all effects in the three different analyses for the first post-test are summarized in Table III below. A summary of the decisions on the appropriate Experimental Hypotheses arising from these analysis results is included in Table V (p. 67).

**TABLE III**

**SUMMARY OF SIGNIFICANCE LEVELS FOR FIRST POST-TEST**

<table>
<thead>
<tr>
<th></th>
<th>Triple</th>
<th>Double Interactions</th>
<th>Main Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TxIxR</td>
<td>TxI TxR IxR</td>
<td>T I R</td>
</tr>
<tr>
<td>Total Scores</td>
<td>N.S.</td>
<td>N.S. N.S. N.S.</td>
<td>.01 N.S. N.S.</td>
</tr>
<tr>
<td>Part A</td>
<td>N.S.</td>
<td>N.S. N.S. N.S.</td>
<td>.05 N.S. N.S.</td>
</tr>
<tr>
<td>Part B</td>
<td>N.S.</td>
<td>N.S. N.S. N.S.</td>
<td>.05 N.S. .05</td>
</tr>
</tbody>
</table>

In each of the three analyses, the most effective Treatment Method was Programmed Instruction. The Lecture Method was next, and the Directed Reading and Discussion Method was the least effective. In the one instance in which the main effect of Reading reached significance, above average readers scored significantly better than average readers, and the below average group was the least successful.
C. Results of Second Post-Test (Long-Term Retention)

1. TOTAL SCORES. The Past Success Scores (X) and the Total Scores (Y) on the second post-test are tabulated in Table XV (p. 157), and the results of the Analysis of Co-variance are summarized in Table XVI (p. 158).

The Null Hypothesis was accepted for the triple interaction effect of Treatment, Independence, and Reading, for the double interaction effect of Treatment and Reading, and for the main effects of Independence and Reading. All these failed to reach significant levels. Thus, the second Experimental Hypothesis, that retention will vary according to levels of reading comprehension, and the third Experimental Hypothesis, that retention will vary according to independence levels, were both found to be untenable. The fifth Experimental Hypothesis, that retention will vary as a function of interaction, was found to be untenable for the triple interaction TxIXR and for the double interaction TxR.

The Null Hypothesis was rejected for the double interaction TxI and for the double interaction IXR at the .01 and .001 levels respectively. The fifth Experimental Hypothesis, that retention will vary as a function of interaction, was accepted tentatively. In order to investigate more fully these interaction effects, a breakdown analysis was carried out and the results are considered in a later section of this chapter. The intrusion of interaction effects introduces the
problem of the legitimacy of accepting any significant results for main effects involved in the interaction. There is always the possibility that the interaction is an artefact produced by an unsuspected, systematic variable or by the unusual chance of a highly deviant sample. A logical consideration of the consequences of accepting the interaction as a real one led to the tentative acceptance of this possibility and to the re-analysis of Total Scores for the second post-test at each level of T, each level of I, and each level of R.

As Moroney points out:

"Conclusions arrived at in the sectional analyses of a breakdown analysis are valid for the level of the variable for which they are carried out."^2

The acceptance of the possibility that the TxI interaction was a real one renders invalid any attempt to interpret the significance of the main effect T, even though this was shown in the analysis to be significant at the .001 level.^3 Thus, the Null Hypothesis was accepted for the main effect T, and the first Experimental Hypothesis, that retention will vary according to method of presentation of the content, was considered to be untenable.

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1 Based, in part, upon examination of graphs of the interactions of Total Scores in the Second Post-Test. See Appendix B.


3 Ibid., pp. 413 - 416.
2. PART A, RECALL. The Past Success Scores \( (X) \) and the Part A Scores \( (Y) \) on the second post-test are tabulated in Table XVII (p. 159), and the results of the Analysis of Covariance are summarized in Table XVIII (p. 160). The Null Hypothesis was accepted for the triple interaction \( T \times I \times R \), and for the main effects \( I \) and \( R \). All these failed to reach significant levels. Thus, the second Experimental Hypothesis, the third Experimental Hypothesis, and the fifth Experimental Hypothesis with respect to triple interaction effects, were all found to be untenable.

The Null Hypothesis was rejected for the double interaction effects of \( T \times I \) (.01), \( T \times R \) (.05), and \( I \times R \) (.05). Thus, the fifth Experimental Hypothesis was tentatively accepted with respect to the double interactions. Again, the main effect \( T \) was significant at the .001 level, but, because of the intrusion of the interaction effects, the Null Hypothesis was accepted and the first Experimental Hypothesis was considered to be untenable.

3. PART B, RECOGNITION. The Past Success Scores \( (X) \) and the Part B Scores \( (Y) \) on the second post-test are tabulated in Table XIX (p. 161), and the Co-variance Analysis results are summarized in Table XX (p. 162). The Null Hypothesis was accepted for the triple interaction \( T \times I \times R \), for the double
interactions Txl and TXR, and for the main effects I and R. All these failed to reach significant levels. Thus, the second and third Experimental Hypotheses, and the fifth Experimental Hypothesis for all interactions except IxR, were found to be untenable.

The Null Hypothesis was rejected for the double interaction IxR (.05) and for the main effect T (.001) which was not involved in the interaction. Thus, the first Experimental Hypothesis, and the fifth Experimental Hypothesis with respect to the double interaction IxR, were both found to be tenable.

The significance levels for all effects in the three different analyses for the second post-test are summarized in Table IV below.

**TABLE IV**

**SUMMARY OF SIGNIFICANCE LEVELS FOR SECOND POST-TEST**

<table>
<thead>
<tr>
<th></th>
<th>Triple TxlxR</th>
<th>Double Interactions</th>
<th>Main Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Txl</td>
<td>Txr</td>
<td>IxR</td>
</tr>
<tr>
<td>Total Scores</td>
<td>N.S.</td>
<td>.01</td>
<td>N.S.</td>
</tr>
<tr>
<td>Part A</td>
<td>N.S.</td>
<td>.01</td>
<td>.05</td>
</tr>
<tr>
<td>Part B</td>
<td>N.S.</td>
<td>N.S.</td>
<td>N.S.</td>
</tr>
</tbody>
</table>

Decisions on the Experimental Hypotheses are summarized in Table V.
<table>
<thead>
<tr>
<th>Hypothesis 1</th>
<th>First Post-Test</th>
<th>Second Post-Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Part A Recall</td>
<td>Part B Recognition</td>
</tr>
<tr>
<td></td>
<td>Accepted (.05)</td>
<td>Accepted (.05)</td>
</tr>
<tr>
<td>Hypothesis 2</td>
<td>Rejected</td>
<td>Accepted (.05)</td>
</tr>
<tr>
<td>Hypothesis 3</td>
<td>Rejected</td>
<td>Rejected</td>
</tr>
<tr>
<td>Hypothesis 4</td>
<td>Rejected</td>
<td>Rejected</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Indicates rejection because of intruding interaction effects.

NOTE: Hypothesis 4 was accepted on logical grounds. See discussion on comparison of first and second post-tests, p. 68.
D. Comparison of the Two Post-Tests

On first inspection, results of the two post-tests appeared to equate reasonably well. Part A, Part B and the Total Scores for the two post-tests followed similar patterns with the second post-test results consistently higher than those of the first. A Product Moment correlation calculated for the Total Scores of the two post-tests resulted in \( r = +.44 \). Using the method suggested by Moroney, Student's \( t \) test showed the observed value of the correlation coefficient to be highly significant beyond the \( p = .001 \) level.

A logical consideration of the problem of acceptance or rejection of the fourth Experimental Hypothesis, that retention over a long term will differ from retention over a short term, would appear to support a decision based on the nature of the results rather than a mere statistical correlation and its level of significance. The use of the identical sample and tests to produce the results would lead one to expect a reasonably high degree of correlation in the two sets of scores.

The two post-tests differ quite markedly in two essential respects. Firstly, the extent to which interaction intrudes varies considerably. A comparison of Table III (p. 62) with Table IV (p. 66) clearly indicates this. In the first

post-test, no interaction effects reach significant levels. All the significant variances lie in the main effects. In the second post-test, however, six interaction effects reach significance, and of the three main effects which are of statistical significance, the importance of two is obscured by the intruding interaction effects.

Secondly, examination of the same two Tables confirms the fact that there is a considerable difference in the levels of significance reached. The highest level of significance found in the first post-test was \( p = .01 \), and this occurred only once, whereas in the second post-test a significance level of \( p = .001 \) occurred four times.

Factors of this kind suggest that there is a difference in the interplay of variables involved in the two tests. This research was conducted in order to study these very variables, and it was felt that results differed sufficiently to allow acceptance of the fourth Experimental Hypothesis on logical grounds. The possibility of intrusion of uncontrolled variables in the second post-test is considered more fully in Chapter VI.

E. Results of Breakdown Analysis

In an attempt to determine the significance of the interaction effects in the second post-test, a series of breakdown analyses was carried out using the Total Scores
which produced not only the highest significance level of an interaction, but also interactions involving all three main effect variables. No breakdown analyses were done for the Part A or the Part B Scores.

The sectional analyses were carried out to investigate the effect of Independence and Reading at each of the three levels of Treatment, the effect of Treatment and Reading at each of the three separate levels of Independence, and the effect of Treatment and Independence at each of the three separate levels of Reading. This form of breakdown analysis also allows examination of double interaction effects at each level. The results are summarized in Table VI.

**TABLE VI**

**SUMMARY OF BREAKDOWN ANALYSES FOR SECOND POST-TEST TOTAL SCORES**

<table>
<thead>
<tr>
<th></th>
<th>Double Interactions</th>
<th></th>
<th>Main Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TxI</td>
<td>TxR</td>
<td>IxR</td>
</tr>
<tr>
<td>T1</td>
<td></td>
<td></td>
<td>N.S.</td>
</tr>
<tr>
<td>T2</td>
<td></td>
<td>.05</td>
<td>N.S.</td>
</tr>
<tr>
<td>T3</td>
<td></td>
<td></td>
<td>N.S.</td>
</tr>
<tr>
<td>I1</td>
<td></td>
<td></td>
<td>N.S.</td>
</tr>
<tr>
<td>I2</td>
<td>.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I3</td>
<td>.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R1</td>
<td></td>
<td></td>
<td>N.S.</td>
</tr>
<tr>
<td>R2</td>
<td>.05</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R3</td>
<td></td>
<td></td>
<td>N.S.</td>
</tr>
</tbody>
</table>
As in the initial Analysis of Co-variance for the Total Scores on the second post-test, the intrusion of significant interaction effects precludes, in many cases, a valid interpretation of the significance of the main effects. Again accepting the interactions as likely to occur in reality, consideration of main effects is limited to the I effect at $T_3$, the R effect at $I_4$, the T effect at $R_4$, and the I effect at $R_3$. Examination of the sectional scores for each of these levels enables the following conclusions to be drawn:

1. When taught by the Lecture Method, students of Average Independence ($I_2$) score better than Above-Average ($I_4$) or Below-Average ($I_3$) students.

2. With students of Above-Average Independence, the ability to read well is significant. Above-Average Readers ($R_4$) score better than Average ($R_2$) or Below-Average ($R_3$) Readers. Scores indicate that there is a greater difference between Average and Below-Average than between Above-Average and Average students in this high Independence group.

3. With Above-Average Readers, Treatment Method is a highly significant variable. As in the first post-test, Programming is superior to the Lecture Method, which is, in turn, superior to the Directed Reading and Discussion Method.

4. With Below-Average Readers, students in the Average Independence category score better than those who are Above-Average or Below-Average in Independence.
F. Summary of Results

The first post-test yielded significant variances for the main effects of Treatment and Reading. Treatment was significant in all three analyses carried out, and, in each case, Programming proved to be the superior method, followed by Lectures and Directed Reading in that order. Treatment was also found to be highly significant in the Part B results of the second post-test, and again, in the Above-Average Reading level of the breakdown analyses. In these cases, too, the order of effectiveness was Programme, Lectures, and Directed Reading.

Reading was significant in Part B of the first post-test and in the Above-Average Independence level of the breakdown analyses. In each case, the order of effectiveness was Above-Average, Average, and Below-Average.

Independence was significant at two levels of the breakdown analyses, Below-Average Reading and Lecture Method of Treatment. In each case, students of Average Independence scored better than Above-Average or Below-Average students whose scores were very similar.
CHAPTER VI

DISCUSSION AND CONCLUSIONS

In the previous chapter, the analysis results were stated in detail and decisions on the five Experimental Hypotheses, based on the analysis results of each section of each post-test and of the breakdown analyses, were discussed.

The purpose of this chapter is to examine the validity of the findings. Included, too, are indications of some of the implications involved, discussion on the possibilities of the influence of uncontrolled variables, and suggestions for improvements in research design for further studies in this field. To achieve these aims, the results of the two post-tests will be considered separately, and then compared.

A. The First Post-Test

1. SIGNIFICANCE OF TREATMENT METHODS. The analyses have shown that, for short-term retention, Programming was significantly superior to other methods used in this study. Results of this kind must, however, be viewed with some caution for, as Williams¹ has pointed out, whenever a new teaching method has been compared with an established one, there is a possib-

ility that any difference in the results obtained from the two methods is due to the novelty of the new method rather than to qualities that would remain with the method after it, too, had become established. In the present study, attempts to counteract a Hawthorne effect by informing all students that they were participants in a research programme may have served to control, in some measure, the effect due to subjects being the focus of attention, but this does not imply that the novelty effect of a method was in any way controlled.

During the study, many students passed unsolicited comments indicating enthusiasm for the Programmed Text as a means of mastering course content. The short duration of the experimental application of this method did not allow the intrusion of a pall effect to counter-balance the apparent novelty effect. Students did not have time to become bored by the method as is reported in some studies. Schramm\(^2\) notes this factor, and Evans\(^3\) offers some evidence that favourable attitudes decline to a neutral level over a seven-week period.

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In order to control this novelty effect, it would be necessary to conduct a study over a considerable period of time. This contention is supported by data from a long-term comparison of the effectiveness of lectures and programmed text presentation of a University Stage II Education course in statistics. Results show no significant differences in the methods. Alternatively, repetition of the present study using students to whom programmed presentation is a familiar instructional method may provide a means of controlling the effect of novelty.

The significant variances due to Treatment Methods found in the present research do, however, suggest that this could be a fruitful area for further research in Teachers' Colleges.

A second complication lies in the variable of teacher effectiveness in relation to method. Although, in this study, it was hoped to eliminate the effect of teacher differences by using the same instructor for all methods, it cannot be assumed that all groups were actually matched for teacher effectiveness. It is very probable that the effectiveness of a teacher may depend upon the method he uses.

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4 Lenz, E. O. and Keeling, B. Personal communication of unpublished data being gathered at the University of Canterbury, July, 1966.
Williams suggests that a teacher who is authoritarian may be very good at teaching by a very formal, traditional method but may be quite unable to cope with a more permissive kind of teaching situation. Although the experimenter did all the teaching in this study, and is not conscious of any personal preferences for methods or of differential effectiveness, the possibility of a teacher-method interaction effect must be considered. Greater understanding of the contribution of this factor as a variable could be gained by repeating the study with several teachers and/or with a rotating groups design.

Both of these factors, novelty effect and differences in teacher effectiveness, are related to the wider problem of student motivation. Although, in this experiment, the Past Success factor (in part, a measure of motivation) was controlled as a variable, the problem of differential motivation to learn during a course of study remains largely unsolved. Hurst sees this problem of motivation as one major cause of


6 For comments on the significance of Past Success measures as used in this study, see p. 90.

conflicting and ambiguous results in many researches. Further aspects of this problem are considered in a later section of this chapter in which results of the first and second post-tests are compared and discussed.

First post-test results showed that the Directed Reading and Discussion Method as used in this study was, in each case, inferior to the other methods used. Observations during the experiment suggest that lack of experience in free group discussion techniques contributed in no small way to the poor results. To improve performances, it would be necessary to give prior training in these discussion techniques, or, alternatively, to offer more positive teacher direction. Both Programming and Lectures offer positive direction to students' activities and to the organization of the learning content in contrast to the largely undirected Free Group Discussion. During the study, only a small proportion of the students involved in this method gave indications in discussion periods of having positively and systematically organized their reading or prepared adequately for each period in advance. It seems probable that more effective work could be done in such a presentation if the teacher gave positive direction by specifying sections of reading to be done for each period, outlining set questions for discussion, allocating specific sub-topics to individuals for investigation, demanding written assignments, and controlling the discussion periods more
formally. It must be remembered, of course, that this study was concerned with only the retention of factual content; more positive teacher direction may prevent the development of other student qualities and the attainment of other equally important educational objectives.  

2. SIGNIFICANCE OF READING LEVEL. The emergence of Reading as a significant variable in the Recognition section of the post-test alone may be an indication that results derived solely from this type of objective test cannot be regarded as adequate measures of content retention. It would appear that, regardless of his actual level of retention, the able reader gleans cues from the very wording of the test items which enable him to score well. It is possible that too much reliance is placed upon this type of test at this College, and that what is being tested is as much reading ability as knowledge of course content. The evidence from the present study suggests that there is a need to measure content knowledge by recall rather than recognition tests, or, at least, to include sufficient recall items to balance the advantages of a high

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8 A current study by I. W. Jenkin at the Palmerston North Teachers' College is examining lecturers' beliefs about objectives of Teachers' College courses. Five kinds of outcomes are being investigated: (a) Personal Development; (b) Experience and Ability in Original and Creative Work; (c) Academic; (d) Sensibility; and (e) Classroom Applications.
level of reading comprehension.

3. LACK OF INTERACTION BETWEEN INDEPENDENCE AND METHOD. One basic assumption in the research was that students of above-average independence would prefer, and be more successful in, methods which allowed greater scope for individual organization of the course material and of the learning. Results from the first post-test do not support this assumption. The Treatment Method seen as offering the greatest scope for highly independent students to organize their own learning was the Directed Reading and Discussion Method. The lack of interaction between Independence and Method could again be a reflection of the inadequate use of free group discussion techniques. More positive specification and direction by the teacher may be necessary to give the initial impetus to students using this method.

Perhaps, though, Hechinger offers an alternative reason for the inferior results of this group when she suggests that democratic discussion often consists of a pooling of ignorance. It is quite possible that second-year students at this College have insufficient background knowledge to allow

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9 See "Selection of Personality Factors." pp. 15 - 17.

them freely to pursue their own studies in such a specialized topic, and to recognize, systematize, and memorize the important facts.

Furthermore, objective tests offer little scope for independent thinking. Thus, it is quite possible that the very nature of the post-test prevented the highly independent thinker from displaying his knowledge. Future studies should include essay-type items to allow scope for the independent student to pursue divergent opinions and facts. The post-test was, however, typical of the objective tests frequently used at this College. Although their use is probably dictated by expediency, their frequency of use would appear to encourage conservative, convergent thinking and to suppress independent thought by failing to reward it. This is not necessarily a condemnation. A basis of convergence, of traditional knowledge, could readily be supported as essential in a teacher, and, therefore, insistence upon this may well be vital in the training of young teachers. What may be indicated, however, is a need for lecturers to pay greater attention to the specific purposes for which a test is given, and to avoid the assumption that an objective test is equally fair to all students.

4. LACK OF INTERACTION BETWEEN READING AND METHOD. Another basic assumption in the research design was that high-ability
readers would be more likely to succeed in methods which allowed them scope to utilize their skill. While all of the methods used demand a certain level of reading ability, it was felt that the Directed Reading and Discussion Method would probably make the greatest demands in this respect. Results from the first post-test do not support this assumption of interaction between Reading and Method. It is possible that the greater dependence upon reading ability inherent in the Directed Reading and Discussion Method may have been off-set by the inadequate conduct of this method of presentation as already discussed. The students in this Treatment Group may have suffered from too much freedom. The removal of too many restrictions and obligations may have involved a removal of incentive to apply conscientious effort to the task. Being aware of participation in a research may not have been sufficient motivation to fill the void created by the removal of direction and obligation. Thus, it is possible that failure in this method may be due, in part, to the lower levels of content mastery set by each student for himself compared with the higher levels imposed by, and communicated through, the Lectures and the Programmes.

B. The Second Post-Test

1. SIGNIFICANCE OF TREATMENT METHODS. The results of the second post-test confirm Programming as the most effective
method used in the study. Interpretation of the significance of these results, however, is obscured by the many interaction effects.

Much of the discussion on Treatment Methods in the first post-test applies also to the second post-test. In addition, several important factors relating to the differences in test conditions must be considered. These factors may serve to explain both the higher levels of significance reached in the second post-test and the intrusion of interaction effects which were not apparent in the first post-test. In a later section of this chapter, these factors are fully discussed in comparing the conditions under which the two post-tests were conducted.

2. SIGNIFICANCE OF INTERACTION EFFECTS. The second post-test was characterized by the emergence of complex double interaction effects. Even after a series of breakdown analyses was carried out for the Total Scores, many of the relationships involved remained uninterpretable. Rather than merely accept the interaction hypothesis for those variables to which it applied, a logical examination was made of factors influencing the experiment which could have systematically affected the results. Many of the subjects were interviewed in an effort to determine possible causes for the significant interactions. The various factors considered are discussed
fully in the following section.

G. Comparison of Post-Test Conditions

In comparing the conditions under which the first and the second post-tests were conducted, the problem of student motivation again arises. When course examinations are used as the criterion of effectiveness, the influence of inefficient procedures may be masked or even misinterpreted because of the degree of motivation of the students. Passing the course is important to students. Because of this, students may compensate for ineffective teaching by additional study in order to pass the course at the level to which they aspire. McKeachie\textsuperscript{11} comments on this problem and reports a study in which differences according to method were found on surprise quizzes but not on a final examination. This would seem to indicate that when students are aware of the requirements for the examination, they are differentially motivated to undertake additional personal study in order to master the material, and thus, any differences in effectiveness of methods may be negated. In the present research, this factor may have been controlled to a large extent by not giving students prior

notification of the first post-test. The second post-test, however, was held in conjunction with the normal College examinations, the prescriptions for which were notified to students several weeks in advance. It seems highly probable, therefore, that results of the second post-test were influenced by this factor.

The system under which College examinations are conducted may be of importance in yet another respect. The major examinations for second-year students in most subjects in their course are held during a single week towards the end of the second term. With several hours of examinations each day during this week, time to study for each test becomes a major problem and leads many students who rely on last-minute efforts to seek the most concise and precise summary of the examinable material from which to study. It seems probable that the Programmes, retained for reference by students in this Treatment Group, provided the course content in the form most suited to such time-limited study. This may account for the higher levels of significance in Treatment Methods variation found in the second post-test. It could also offer some possible explanations for the interaction effects. In order to pass a course, a student may seek information from any legitimate source, and, because friendships cut across Treatment Group boundaries, it was thought probable that a considerable amount of exchange of information took place. This was
checked through a series of interviews, the results of which are reported in a later section of this chapter. It may not be unreasonable to suppose that students with greater initiative and/or independence have been more active in seeking access to the Programmes for study purposes.

A further possibility lies in the fact that high-ability readers may have been able to cover the necessary revision of course material in a more competent manner in the limited time which could be devoted to the experimental topic as one section of one examination facing them during the week.

It seems reasonable to assume that at least part of the complex interactions in the second post-test spring from causes such as these.

Future studies of long-term retention would need to take into consideration the consequences of basing analyses on data gathered from course examinations. The control of this variable would appear to lie in accumulating data from tests of which the students have not been given prior notification.

The possibility that in preparing for the second post-test students from different Treatment Groups collaborated, exchanged information, and read additional material led to the conduct of a series of structured interviews to probe the extent to which such exchanges actually occurred. In the interviews, students were asked whether they had had access
to information beyond that available to their Treatment Group during the experiment, and were requested to estimate the extent of any advantage gained because of the availability of additional information. Emphasis was placed in the interviews on the rights of examination candidates to draw study material from any legitimate source. As a consequence, the subjects were quite candid in their responses.

Of the 234 participants in the study from among whom the final sample was drawn, 165 were interviewed. The main findings are summarized in Table VII below.

**TABLE VII**

PER CENT OF INTERVIEWED STUDENTS REPORTING ACCESS TO INFORMATION FROM SOURCES OTHER THAN THEIR OWN TREATMENT METHOD

<table>
<thead>
<tr>
<th>Type of Additional Information</th>
<th>Programme Group</th>
<th>Lecture Group</th>
<th>Reading Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access to Programmes</td>
<td></td>
<td>18%</td>
<td>21%</td>
</tr>
<tr>
<td>Access to Lecture Notes</td>
<td>1.5%</td>
<td></td>
<td>5%</td>
</tr>
<tr>
<td>Access to Reading Notes</td>
<td>1.5%</td>
<td>6%</td>
<td></td>
</tr>
<tr>
<td>Own Additional Reading</td>
<td>3%</td>
<td>2%</td>
<td>7%</td>
</tr>
<tr>
<td>Total Having Access to Any Additional Information</td>
<td>6%</td>
<td>26%</td>
<td>33%</td>
</tr>
</tbody>
</table>
The general trend of information exchange is quite consistent. The less teacher-structured the content associated with a Treatment Group, the more often students from that group sought additional material. In a very large proportion of cases, the extra material involved was of a more highly structured nature. Thus, students in the Reading and Discussion Group most often sought material from the Lecture and the Programme Groups, and students from the Lecture Group most often sought material from the Programme Group. In only isolated instances did Programme Method students seek aid from Lecture or Directed Reading and Discussion material, or Lecture Method students seek additional material from the Reading and Discussion Group.

These obvious trends, together with volunteered comments from students during the interviews, strongly suggest that the major factor influencing information exchange was expediency -- an effort to gain highly organized, relevant material which would minimize the time and effort needed to prepare for the examination.

Was the availability of additional information of value to the students in their examination preparation? Of those students who reported access to additional material, nearly half claimed considerable advantage from it, over one-third claimed moderate advantage, and very few claimed only little help from the extra information. Two students,
both from the Programme Group, reported that the additional information tended to confuse and hinder their learning.

In addition to the actual exchange of written information, all of the students interviewed reported some advantage from informal discussions and comments from other members of their own Treatment Groups. Most stated that their own understanding of the content was modified by the discussions but the extent to which the results may have been influenced by this factor would be impossible to determine. As a frequent occurrence among students faced with examination commitments, this form of information exchange would appear to be common to all methods of teaching course content.

It is possible that the experiment as a whole may have been influenced by differences in the College courses to which the Treatment Groups were exposed before and during the research, and between the first and the second post-tests. During this period, some College groups had been undertaking teaching practice in schools, and some had been engaged in a lecture programme of an academic nature. By prior arrangement with other members of the College staff, none of the lecture topics taken during this period contained any reference to material or ideas related to the content of the research. A survey carried out after the second post-test confirmed that this arrangement had been adhered to, and the possibility of
contamination of the research results from this source was discounted. In any case, differential exposure to the various normal College courses is a feature of the treatment to which all College groups are subject during their training, and any experiment which aims to investigate the effectiveness of any methods of presenting the content of any course must either take this into account as a variable, a very difficult factor to control, or accept it as part of the normal conditions under which any course must operate. The methods selected for use in any College course must be effective regardless of the influence of other courses being conducted at the same time. The value of any method depends upon its effectiveness under normal College teaching conditions, a factor which implies that the method must be sufficiently adaptable to be applicable under a wide variety of conditions. In addition, such practical considerations as the costs in time, in effort, and in money may be the ultimate factors which determine whether or not a method of instruction shall be adopted for general use.

The results of the present research strongly support the Programmed Text as a method of presenting course material. The practical costs are not prohibitive for the type of programme used, and, despite the obvious need for caution in their acceptance, the results are sufficiently significant to justify further studies aimed at investigating the value
of programmed instruction, under a wide variety of conditions, as a method of presenting course content at Teachers' Colleges. The potential value of programmes in individualizing rates of progress and in reducing learning time adds further weight to this contention.

In evaluating the outcomes of the research, there remains the question of the adequacy of the Past Success measurements used. These were derived from a composite score based on previous results in two related subject fields. In order to determine the extent of their contribution to the analyses, correlation coefficients were calculated for the three sections of each of the two post-tests, and the significance of each correlation decided by Student's t test. The results are summarized in Table VIII below.

### TABLE VIII

**CORRELATION OF X AND Y SCORES IN THE POST-TESTS**

<table>
<thead>
<tr>
<th></th>
<th>First Post-Test</th>
<th>Second Post-Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Correlation Coefficient</td>
<td>Significance Level</td>
</tr>
<tr>
<td>Total Scores</td>
<td>.32</td>
<td>.001</td>
</tr>
<tr>
<td>Part A</td>
<td>.25</td>
<td>.01</td>
</tr>
<tr>
<td>Part B</td>
<td>.32</td>
<td>.001</td>
</tr>
</tbody>
</table>
The consistency and the high significance levels of the correlations would appear to justify the selection of Past Success as the co-variable in the analyses. The measurements as used formed a systematic variable, controlling the effects of which added considerably to the discriminatory power of the statistical technique used.
CHAPTER VII

SUMMARY

A. Decisions on the Hypotheses

HYPOTHESIS 1: That retention of the factual content of the course will vary according to the method used in presenting the material.

The research results support the acceptance of this hypothesis for short-term retention, but acceptance should be modified by an awareness of the possible influence of a novelty effect. For long-term retention, the hypothesis is accepted for the Recognition aspect and for Above-Average Readers on the Total Scores. Further interpretation is obscured by interaction effects.

HYPOTHESIS 2: That retention of the factual content of the course will vary according to the level of reading comprehension of the students.

This hypothesis could be accepted only for the Recognition section of short-term retention. For long-term retention, it was rejected for all aspects in the main analyses but the breakdown analyses suggest that it could be significant for students of Above-Average Independence.

HYPOTHESIS 3: That retention of the factual content of the course will vary according to the level of independence of the students.
This hypothesis was rejected for all aspects of short-term retention. For long-term retention, it was rejected for all aspects in the main analyses, but results of the breakdown analyses suggest that it could be significant in the Lecture Method of presenting material, and for students who are Below-Average Readers.

HYPOTHESIS 4: That retention of the factual content of the course over a long term will differ from retention of the factual content over a short term.

This hypothesis was accepted because of the differences in the nature of the results of the two post-tests.

HYPOTHESIS 5: That retention of the factual content of the course will vary as a function of interaction effect between the variables of Reading, Independence, and Method.

This hypothesis was rejected for all aspects of short-term retention. For long-term retention, highly significant interaction effects between these three variables were apparent.

E. Decisions on the Post-Tests

THE FIRST POST-TEST: Apart from some reservations because of the likelihood of the intrusion of a novelty effect, the results of the first post-test would appear to be valid. The significant superiority of the Programmed Text presentation and the inferiority of the Directed Reading and Dis-
cussion presentation, as these methods were used in the study, therefore offer convincing reasons for College lecturers to consider carefully their use in presenting factual content in College courses. Further research on methods of instruction to determine the applicability of the results of this study in a variety of teaching situations is certainly justified.

THE SECOND POST-TEST: The use of College examinations with advance notification of prescriptions to gather the data for the second post-test introduced unforeseen problems. It is probable that the purpose of the research with regard to long-term aspects of retention was invalidated by the extent of information exchange between Treatment Groups. It is possible that many of the interaction effects resulted from this exchange. While it is possible that the outcomes of the second post-test need not be ignored entirely, it is obvious that the results should be viewed with extreme caution.

C. Limitations of the Study

1. NOVELTY EFFECT: The design of the research did not make allowances for the intrusion of novelty effect. Future studies should be so conducted that this very important variable is controlled. This could be achieved by extending the length of the experimental period, or, alternatively, by using subjects to whom the method being investigated is a familiar form of instruction. The results of the present
study certainly suggest the value of an extended trial of the Programmed Text approach.

2. INADEQUACY OF DISCUSSION: The marked inferiority of the Directed Reading and Discussion Method seemed to be, in part, due to the inability of students to make adequate use of the discussion periods. Prior training in this technique may have enabled the students involved to gain more benefit from this method of presentation. Any future researches making use of this form of teaching may need to take this factor into account. In addition, such studies could well be designed to measure outcomes in terms of broader educational objectives than the retention of factual content used in the present research.

3. INADEQUACY OF POST-TESTS: The post-tests used in this study allowed little scope for the expression of independent thinking. It is quite possible that the failure of the Independence variable to reach significant levels may have been due to this inadequacy. It seems advisable that future studies make use of post-tests which include some essay-type items allowing scope for divergence of opinions.

4. LIMITED VALUE OF SECOND POST-TEST: The problems created by the prior notification of the second post-test, even though the students were not aware that it consisted of a repeat of the first post-test, seriously devalue the results and point to the need for future studies to control the
interchange of information. The most appropriate means of accomplishing this would appear to be by gathering data from unannounced tests rather than from College examinations.

D. Conclusion

This research has been of value in clarifying some of the many complex variables which influence retention of factual information in Teachers' College courses, and in indicating some methods of instruction worthy of further investigation. The advanced planning for three-year courses for primary school teacher-trainees recognizes the need for some departures from the traditional lecture methods of presentation. By comparing the effectiveness of two alternative methods with the lecture approach, this study may serve as a basis for future researches at the Christchurch Teachers' College. By indicating the limitations of the design used, it is hoped that other researches may probe the many problems more adequately. By the significance of its results, this study may convince teachers of the value of attempting alternative methods in their presentation of course content, the implication being that the more carefully structured the material, the greater degree of retention and the more valuable for study purposes the material becomes in the eyes of the students.
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BIBLIOGRAPHY


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APPENDIX A

THE PROGRAMME
PROGRAMME FORMAT

Thesis format imposes limitations which prevent the programme being reproduced here in the original form as presented to the students in the study. In this Appendix, therefore, the Response Frames alternate with the Instruction Frames, whereas, in the original format, the Response Frames were aligned with their corresponding Instruction Frames on facing pages. This involved cyclostyling back-to-back. In the original, too, correct responses for each frame in the Answer Block were contained in a Check Column, one and one-half inches wide, on the right-hand side of the Answer Page. Here, however, they are placed below each frame.

In small type, single-spaced on quarto paper, the whole programme formed a thirty-three page, side-stapled booklet.
COGNITIVE DEVELOPMENT

THE DEVELOPMENT OF LOGICAL THINKING ACCORDING TO JEAN PIAGET

NOTE: This programme has been devised to help you to master the content of the first section of your College course in Cognitive Development. The responses you make in the Answer Sections of this programme will not be marked or assessed in any way; they are solely for your benefit and are intended to assist you in judging the progress of your own learning of the material.

HOW TO USE THE PROGRAMME: The left-hand page contains the material to be learned. This is the INSTRUCTION BLOCK. It is divided into small sections called FRAMES. Each frame is numbered for your reference. The right-hand page contains the ANSWER BLOCK. This is also divided into frames. The numbers of the ANSWER BLOCK FRAMES correspond to the numbers of the INSTRUCTION BLOCK FRAMES. On the extreme right of the ANSWER BLOCK is a column headed CHECK. You should cover this with a ruler while you are working.

PROCEDURE: Read FRAME 1 of the INSTRUCTION BLOCK. When you think that you have mastered the ideas contained in this frame, move across to FRAME 1 of the ANSWER BLOCK and fill in the details as required in this ANSWER FRAME. When you are satisfied that you have completed the ANSWER FRAME correctly, check your answer by referring to the correct answer in the CHECK COLUMN. (In doing so, you should try not to expose answers to following frames.) If your answer is correct, proceed to FRAME 2 in the INSTRUCTION BLOCK. Then move to FRAME 2 in the ANSWER BLOCK, etc.. If your answer is wrong, you should re-read FRAME 1 of the INSTRUCTION BLOCK and then repeat the ANSWER FRAME. You may repeat frames in this way as often as you like in order to master the material. Proceed through the programme reading and trying to master the material in each frame, and completing each corresponding ANSWER FRAME, before moving on to the next. If you cannot understand why your own answer is incorrect, it is quite in order for you to re-read any previous frames.

GENERAL: Please work by yourself; remember that other students will be working at their own speed and may not welcome interruptions.
You have four periods to complete the programme. To prevent the programmes being lost or forgotten, they will be collected at the end of each period. Please put your name on your copy.
At the start of each new period, you are advised to re-commence work at the last previous REVIEW FRAME.
1. Intelligence can be measured, and the results can be stated in figures as an IQ or a Mental Age (M.A.). These indicate a general level of intellectual functioning but they do not imply that the nature of this intellectual functioning is necessarily understood. Measurements measure but they do not explain.

1A. MARK THE ANSWER YOU THINK IS CORRECT.

We cannot assume that:
(a) ..... IQ can be measured
(b) ..... M.A. can be measured
(c) ..... IQ and M.A. are related
(d) ..... measurement indicates understanding
(e) ..... IQ measures a general level of intelligence.

The correct answer is (d).

2. The workings of the human mind are extremely complex and many views are put forward to attempt to explain just how intelligence functions. One popular view in the past was that the ability to think logically was innate, i.e. that from birth, there exists in the child the potential to think logically.

2A. A common view in the past has been that the capacity for thinking is in the child. This means that the potential to think logically exists in the child from birth.

(a) logical (b) innate (c) potential (d) logically (e) birth

3. This popular view assumed that the child merely awaited the development of language which would enable him to manipulate ideas or concepts in a logical way. Thus, this view supported maturation as the key factor: it assumed that as the child matured and the power of language developed, he automatically progressed in his ability to think with adult-type logic. This view also implied that development was merely an increase in complexity of thinking.
3A. To accept this view, one would have to believe that the child needs only the development of (a) to enable him to use ideas or (b) logically. This implies that the sole determinant of intellectual development is (c), and that progress is an (d) process which involves only an increase in (e) of thinking.

(a) language (b) concepts (c) maturation (d) automatic (e) complexity

4. This popular view has been challenged by Jean Piaget, a Swiss psychologist. He has developed an extensive and comprehensive body of theory, supported by a wealth of experimental evidence, to explain the nature of intellectual development.

4A. The work of (a) (b) challenges this view. His work is based on both (c) and (d) evidence.

IS THIS STATEMENT TRUE OR FALSE? "Piaget is mainly concerned with developing accurate measurements of intelligence." (e)

(a) Jean (b) Piaget (c) theory (d) experimental (e) False

5. Piaget believes that intelligence takes many forms. Deliberate physical actions involve a level of intelligence, but the highest level of intelligence is demonstrated in the ability to think logically.

5A. ONLY SOME OF THESE STATEMENTS ARE CORRECT. MARK THESE ONLY.

(a) .... Piaget believes that intelligence manifests itself in a variety of ways.
(b) .... Physical actions cannot be viewed as intelligent acts.
(c) .... Adults can progress beyond the level of logical thinking.
(d) .... The ability to think logically is the highest form of intelligence.

The only correct statements are (a) and (d).
6. Piaget's view is that there are clear-cut stages in intellectual development. He believes that the power of logical thinking is NOT present at birth, i.e. logical thinking is NOT a process which is inherent in the structure and mode of functioning of the brain.

6A. Piaget's theory is that intellectual development proceeds in a series of definite s...........(a). He thinks that the power of lo...........(b) th............ing (c), the highest form of intelligence, is not in............ (d) in the brain structure.

(a) stages (b) logical (c) thinking (d) inherent or innate

7. He believes that the child ACTIVELY CONSTRUCTS his own style of thinking as he interacts with his environment. He also believes that maturation does play a part, and that, therefore, experience alone is not a sufficient explanation. (Maturation as a topic, however, will not be considered in this section of the course. It will be dealt with as a separate topic later.)

7A. MARK ALL THE FOLLOWING STATEMENTS EITHER TRUE OR FALSE.

(a) Because the power of logical thinking is not inherent in the child, maturation plays no part in the development of intelligence. (.........)

(b) Experience alone is not a sufficient explanation of the development of intelligence. (.........)

(c) The child aids the development of his own thinking by his own activities. (.........)

(d) The environment in which the child exists plays no part in his intellectual development. (.........)

(a) False (b) True (c) True (d) False
8. In Piaget's theory, a child does not merely register the sights and sounds of his environment in a passive way. He reacts to them and operates on them. He must continually adjust and re-adjust to the situations in his environment which are created by both objects and people.

8A. In Piaget's view, the child is not merely a p.........(a) recipient of stimulation from his env.............(b). There is a continuous process of adj.............(c) and re-adjustment. The child reacts to situations and ob.............(d), and oper.............(e) on them.

(a) passive (b) environment (c) adjustment (d) objects (e) operates

9. He can react in two ways: physically and/or mentally. Mainly when young, he may react physically by biting, pulling, grasping, etc.. These may be termed PHYSICAL OPERATIONS, for he is operating on his environment by physical actions. When older, he may react mentally, thus operating through thought. These may be termed MENTAL OPERATIONS. Earlier physical operations lead to later mental operations.

9A. Reactions to the environment may be either phy..........(a) or m..........(b). Physical actions occur chiefly in earlier years, and may be termed physical op..........(c) because the child is operating on his env.............(d) by means of these activities. Older children tend to operate more through thought, and these activities may be termed m..........(e) o..........(f).

(a) physical (b) mental (c) operations (d) environment (e) mental (f) operations

10. Piaget stresses three basic principles of intellectual development. The first of these is the PRINCIPLE OF OPERATIONS OR ACTIONS.
10A. How many basic principles of intellectual development does Piaget stress? (............)

What is the first of these principles? (............)

(a) three (b) operations (or actions)

11. The mental operations of the older child are faster and more efficient than the physical operations of the younger child, but they spring from and depend upon these earlier physical activities. Mental operations are superior because they allow a situation to be explored by mental trial and error, thinking up and mentally evaluating a large number of possible solutions to a problem, rejecting some, following up others by considering what their consequences might be, much more rapidly and thoroughly than could be done if each possibility had to be followed through by physical trial and error methods. Because they are more efficient, adults usually think by applying LOGICAL OPERATIONS, i.e. systematic mental operations to explore all possible aspects of a situation.

11A. M............(a) operations are faster and more efficient than p............(b) operations because they allow a pr............m (c) to be explored by m............(d) experimentation. This allows many pos............(e) to be considered almost simultaneously. The use of systematic mental operations to consider all aspects of a situation may be termed l............(f) operations.

(a) mental (b) physical (c) problem (d) mental (e) possibilities (f) logical

12. REVIEW FRAME. RE-READ FRAMES 1 TO 11 INCLUSIVE AND THEN COMPLETE THE ANSWER BLOCK FOR FRAME 12.
12A. **REVIEW FRAME. CIRCLE THE CORRECT ALTERNATIVE IN EACH PAIR.**

(a) Piaget believes that the power of thinking is 
    (a process of maturation/actively constructed).

(b) He thinks that intelligence develops (in clear-cut stages/in automatic progression).

(c) In his theory, the child (reacts to the stimuli of his environment/registers stimuli passively).

(d) The principle of operations stresses that the child 
    (is always moving about/manipulates objects or ideas).

(e) Physical trial and error methods are (more/less) 
    efficient than mental trial and error methods.

(a) actively constructed  (b) in clear-cut stages 
(c) reacts to the stimuli  (d) manipulates objects or ideas  (e) less

---

13. The most serious stumbling block to clear thinking is the incapacity to see something from any other viewpoint than one's own. The young child is limited by this.

---

13A. A major limitation to the thinking of a younger child is his inability to see a situation from any but his own v...............(a). His thinking could therefore be described as s...........(b) - centred.

(a) viewpoint  (b) self

---

14. At first, the infant is all "self" and the whole world is seen from this viewpoint only. To the child at this stage, when an object disappears it ceases to exist because it no longer affects him. He is influenced solely by what he can see, feel, hear, taste, etc..
14A. When the young child can no longer perceive an object, he feels that it no longer exists\(\text{(a)}\). This is because it no longer stimulates his senses, and he is affected only by what he can perceive through his senses of taste\(\text{(b)}\), smell\(\text{(c)}\), touch\(\text{(d)}\), and sight\(\text{(e)}\), etc.

(a) exists (b) taste (c) smell (d) touch (e) sight (last four in any order)

15. As he grows older, he learns that objects have constancy, i.e. that people and things continue to exist even when he is not affected by them. He learns, too, that he himself is only one object among many others, and that objects are related to each other quite apart from any relationship they have with him.

15A. MARK THE CORRECT ENDING TO THE STATEMENT.

"Constancy" means that objects:
(a) maintain a constant position
(b) move at a constant rate
(c) continue to exist even when beyond the child’s perceptions
(d) constantly influence the child.

The correct ending is (c)

16. Thus he begins to learn that there are viewpoints other than his own. Only when he can consider a situation from many different viewpoints can he begin to think logically. Piaget therefore stresses the principle of viewpoints as the second of his three basic principles of intellectual development.

16A. As the child grows older he learns that he is only one object\(\text{(a)}\) among many others in the environment, and thus he begins to learn that there are other viewpoints\(\text{(b)}\) than his own. He cannot think logically\(\text{(c)}\) until he can view a situation from many different viewpoints\(\text{(d)}\). This is Piaget’s second basic principle\(\text{(e)}\).

(a) object (b) viewpoints (c) logically (d) viewpoints (e) principle
17. The young child's mental operations are rigid rather than flexible and mobile; they are embedded in the here-and-now, the immediate situation, rather than freed from the restrictions of time and space. His thinking cannot be extended to ideas beyond these limits.

17A. The young child can think only of the situation (a) which immediately concerns him. His ideas are limited (b) by the restrictions of time (c) and space (d). His mental operations (f) are therefore rigid (g) rather than flexible and mobile (e).

18. Adult mental operations are not restricted in this way; we are free to think of the future or the past, the immediate situation or a long-term goal, a close-at-hand object or something out of sight, real things or imagined situations. Piaget therefore stresses the Principle of Mobility as the third of his three basic principles of intellectual development.

18A. Adult operations are not restricted (b) in this way. Mobility (c) of thinking means that there is freedom to consider ideas which are not tied to the immediate (d) situation. The adult is free to think of real or imagined (e) situations, immediate objects or long-term (f) goals. The third of Piaget's principles is that of mobility (g).

19. These three basic principles can be traced through all stages of intellectual development. In the earlier stages they occur in physical operations; in the later stages they occur more commonly in mental operations. At each stage, the child learns to develop his intellectual activity in terms of these three basic principles.
19A. ANSWER YES OR NO.

(a) Are Piaget's three basic principles limited to a particular stage?  
(b) Are these three principles traceable through all stages of development?  
(c) Do they commonly occur in mental operations in the young child?  
(d) Does the child's intellectual activity need to develop in terms of these principles?

(a) No  (b) Yes  (c) No  (d) Yes

20. True logical operations involve all three of the basic principles: they result from actions; they involve a variety of viewpoints; and they are flexible, mobile, and capable of infinite variation.

20A. True (a) operations involve all three of the basic principles (b) because they are based on (c) and a variety of (d), and are completely (e).

(a) logical  (b) principles  (c) actions  (d) viewpoints  (e) mobile


21A. REVIEW FRAME. Piaget's three basic principles of intellectual development are:

(a) ...........................................  
(b) ...........................................  
(c) ...........................................

The Principle of (d) indicates that the child actively operates on his environment. The Principle of  (e) involves the ability to see a variety of ways of looking at a problem. The Principle of (f) implies freedom from restriction in one's thinking.
(a) actions or operations (b) viewpoints (c) mobility
(these three in any order) (d) actions or operations
(e) viewpoints (f) mobility

22. Piaget's three basic principles may be regarded as
genral mechanisms, but the teacher is more concerned
with HOW these mechanisms operate at particular age
levels. Piaget helps us in this respect by outlining
five main stages of intellectual development. (Some
texts divide some of these stages into substages. This
can be confusing.)

22A. ANSWER TRUE OR FALSE.

(a) The three basic principles show how intelligence
operates at different age levels. (......)
(b) Piaget outlines three stages of intellectual
development. (......)
(c) The basic principles indicate the general machinery
of intellectual thinking. (......)
(d) Teachers are more interested in how this machinery
operates for children at different age levels.
(......)

(a) False (b) False (c) True (d) True

23. Piaget is mainly concerned with the SEQUENCE of the
development of logical thinking rather than with the
precise AGES at which characteristics of thinking
appear. For this reason, any ages cited should be
regarded as only approximate.

23A. Piaget's concern is to trace the s............(a) of
intellectual development rather than to pinpoint the
precise s............(b) at which thinking skills appear.

(a) sequence (b) ages
24. The five main stages of intellectual development are:
   1. SENSORY-MOTOR STAGE (birth to 18 months)
   2. PRE-CONCEPTUAL STAGE (18 months to 4 years)
   3. INTUITIVE THOUGHT STAGE (4 years to 7 years)
   4. CONCRETE OPERATIONS STAGE (7 years to 11 years)
   5. FORMAL OPERATIONS STAGE (11 or 12 years onwards)

24A. The SENSORY-MOTOR STAGE is from birth to ..........(a).
     The ............(b) STAGE is from 18 months to 4 years.
     The INTUITIVE THOUGHT STAGE is from ........(c) to
     ............(d). The ............(e) OPERATIONS STAGE is
     from ........(f) years to about 11 years. The ........(g) OPERATIONS STAGE is from 11 or 12 years on.
     (a) 18 months  (b) PRE-CONCEPTUAL  (c) 4 years
     (d) 7 years    (e) CONCRETE     (f) 7 (g) FORMAL

25. SENSORY-MOTOR STAGE: During the first 18 months, the
     infant learns to perceive objects and the framework
     within which objects exist - namely, space. But objects
     are not transitory and isolated; they persist through
     periods of time, and the actions of one object influence
     the actions of other objects. The child must learn to
     recognize and allow for these two fundamental character-
     istics of existence - TIME and CAUSALITY.

25A. During the first ..........(a) months, the infant must
     learn two fundamental characteristics of existence:
     1. That objects per........(b) through t........(c).
     2. That the actions of one object infl........(d) the
        actions of other objects.
     (a) 18 (b) persist (c) time (d) influence

26. SENSORY-MOTOR STAGE: These two fundamental character-
     istics (time and causality) are obvious to us as adults,
     and because even very young children seem to have some
     understanding of them, we may be tempted to attribute
     their appearance in the child to maturation, i.e. the
     unfolding of ideas which arise from the very nature of
     the nervous system itself.
26A. The basic ideas of t........(a) and c..........(b) are quite obvious to adults. Because even young children seem to understand them, we are tempted to assume that they arise solely through m..............(c).

27. SENSORI-MOTOR STAGE: Piaget makes it quite clear that such concepts are achieved by the young child only after a period of fumbling, partial understanding, and experimentation. He CONSTRUCTS these ideas from his own experience - his knowledge of objects is the result of his own searching actions. For example, efficient orientation in space implies that the "self" be recognized and managed as one object among others; but this recognition can only be achieved as the child learns (through his own actions) to adopt an objective viewpoint towards his own body, and to see himself and the objects around him as part of a common space.

27A. Piaget stresses that these concepts of time and causality are the result of the child's own exp........(a). The ideas are con...........(b) as a result of his own searching a............(c).

(a) experimentation (or experience) (b) constructed (c) actions

28. Intellectual growth is characterised by CYCLES, i.e. the problems and processes of one stage are repeated (in different contexts and with different materials) at later stages. There is a functional relationship between activities at different stages of intellectual growth. For example, by the end of the Sensori-motor Stage, the infant can orient himself in space reasonably well, but the same fumbling, partial understanding, and experimenting are repeated in his attempts, at a later stage, to understand and use spatial relationships in symbolic or abstract contexts. (e.g. as in drawing or geometry.)
28A. MARK THE ONE CORRECT STATEMENT.

Cyclic development implies:
(a) that higher stages of development are never reached.
(b) that behaviour found adequate at one stage is adequate at higher stages.
(c) that thinking processes of one stage re-occur in different forms at higher stages.
(d) that the same problem re-occurs at each successive stage.

The correct statement is (c).

29. REVIEW FRAME. The Sensori-motor Stage is from birth to about 18 months. During this time, the infant must learn that objects have permanence; that objects have causal effects on other objects; that he is but one object among many others; and that he shares a common space with other objects. This knowledge comes about NOT through maturation alone, but by the active manipulations and experimentations of the child. This is essentially a stage of sensations and motor activities, hence the name "Sensori-motor Stage."

29A. REVIEW FRAME. ONLY SOME OF THESE STATEMENTS ARE CORRECT. MARK THESE ONLY.

(a) During the Sensori-motor Stage, the child learns that objects have permanence.
(b) During this stage he learns that objects have causal effects on other objects.
(c) He also learns that he is but one object among many others in his environment.
(d) This knowledge comes about through the process of maturation.
(e) The child must manipulate and experiment with objects in order to learn.

The correct statements are (a), (b), (c) and (e).

30. PRE-CONCEPTUAL STAGE: This is a stage of rapid development of knowledge and experience of the natural and social environment. At the same time, a whole new world is opening for the child - the world of LANGUAGE.
30A. During this stage, the child rapidly increases his knowledge of the nat........(a) and the soc........(b) environment. A vital new factor also enters. This is the rapid development of l.............(c).

(a) natural  (b) social  (c) language

31. PRE-CONCEPTUAL STAGE: It would be easy to assume that the rapid development of the child's thought processes at this stage is merely a reflection of his language development, but this is not so. Words do NOT provide the child with the concepts underlying the words: we cannot assume that once he learns the appropriate word the child understands the thought embodied in it.

31A. ANSWER YES OR NO.

(a) Are the child's thought processes a natural reflection of his language development?  (.....)
(b) Does the fact that the child knows the word indicate that he understands the concept involved?  (.....)
(c) Is this a stage of rapid development of the child's thought processes?  (.....)

(a) No  (b) No  (c) Yes

32. PRE-CONCEPTUAL STAGE: Words are learnt, become mobile, and represent concepts as a result of the child's own experience with them. For example, to the young child, the word "cat" may mean anything with four legs and the approximate shape of a cat. (Thus, it may include cats, dogs, rabbits, etc..) Only as he gains much experience with these animals can he learn the various characteristics that distinguish dogs from cats, and cats from rabbits, and even then his concept may not extend to include lions, and therefore may remain for a long time limited to the domestic variety.

32A. What is the key factor in the development of concepts from words?  ........................................

The child's own experience with words. (Any answer which expresses this idea is acceptable.)
33. **PRE-CONCEPTUAL STAGE:** It follows, then, that words at this stage are merely the material out of which concepts will eventually be built, but they are not yet true concepts. For this reason, this stage is called the "Pre-conceptual Stage."

33A. At this stage, words are not yet tr........(a) c........(b) but they are, however, the raw mat........(c) out of which concepts will later be built. Hence the name P................(d) for this stage.

   (a) true   (b) concepts   (c) material   (d) Pre-conceptual

34. **PRE-CONCEPTUAL STAGE:** From one point of view, this stage is the culmination of the developments of the previous Sensori-motor Stage: instead of acting out his thoughts, the child can now represent these actions with symbols. Therefore, he can perform mental experiments as well as physical ones.

34A. The child no longer needs to act out all his thoughts because he now has sy........(a) which he can use as a substitute. He can now use both ph........(b) and m........(c) experimentation.

   (a) symbols   (b) physical   (c) mental

35. **REVIEW FRAME.** The Pre-conceptual Stage involves rapid development of language, but the acquisition of words does not mean that the child understands the concepts implied by the words. Language, however, does form the basis from which concepts will later develop. The child can begin to use symbols (i.e., words) to represent actions, and so mental or thought actions and experiments can now be used as well as physical actions.

35A. **REVIEW FRAME.** The Pre-conceptual Stage is characterised by the rapid development of l........(a). However, the ability to use words does not necessarily mean that there is an understanding of the c........(b) which underlie them. L........(c) does, however, form the basis for the later development of concepts. Symbols can now
be used to represent physical a... (d).
(a) language (b) concepts (c) language (d) actions

36. INTUITIVE STAGE: Here the child begins to extend and refine his concepts, and to show more interest in the events and characteristics of the world around him. He is forever asking "Why?" questions, and he loves to imitate the events he sees. He can solve quite complicated practical problems.

36A. During this stage, concepts are being ext... (a) and ref... (b).
   Is the child able to solve abstract problems? (Yes/No)(c)
   (a) extended (b) refined (c) No

37. INTUITIVE STAGE: The child now appears to have all the intellectual skills he needs, and the use of these skills seems to be limited only by the lack of experience and knowledge, but this is not so. He does not feel as confident with his newly acquired ability to use symbols and concepts as he does with his perceptions and physical actions. For this reason, he readily abandons logic when in doubt. If an adult sees something which is illogical, he distrusts his vision; if a child at this stage sees something which is illogical, he abandons his logic— he prefers to trust his perceptions (in this case his vision) because these are more familiar to him.

37A. ANSWER: TRUE OR FALSE
   (a) The child now has all the necessary intellectual skills, the use of which is limited only by lack of experience.
      (......)
   (b) The child uses symbols quite confidently.
      (......)
   (c) The child would rather believe what he sees or hears than what his reasoning tells him is correct.
      (......)
   (a) False (b) False (c) True
38. INTUITIVE STAGE: Parents and teachers often despair because of the apparent ease with which the child at this stage blandly contradicts himself. The reason for this is that his newly acquired and fast developing symbolic and conceptual powers are very shaky and he can handle only one viewpoint at a time. His single viewpoint distorts his reasoning, and his logic is unpredictable; what he perceives or experiences is compelling, and thus he is governed more by his own intuition than by logical necessity. Hence the term "Intuitive" for this stage.

38A. At this stage, the child sees nothing wrong in contradicting himself because he can handle only ................
............................ (a) (complete in own words). His single viewpoint distorts his reason........(b). Logic is dominated by his own intuition......(c). His logic is therefore unpredictable.(d):

(a) one viewpoint at a time (or your own words containing this idea) (b) reasoning (c) intuition (d) unpredictable

39. INTUITIVE STAGE: During this stage, the child is introduced to and prepared for two basic academic skills: READING and ARITHMETIC. Both of these require the availability of certain intellectual skills. Piaget has made one of the very few serious attempts to analyze the fundamental logical operations which underlie effective use of these two methods of communication.

39A. Two basic academic skills are introduced at this stage. They are r.............(a) and a.............(b). Piaget tries to analyze the fundamental l.......(c) operations which are necessary for the effective use of these two methods of communication.

(a) reading (b) arithmetic (c) logical

40. INTUITIVE STAGE: LANGUAGE: The young child lives in a world which is centred around himself. It has already been explained how his response to the environment is limited by his inability to move easily from one viewpoint to another. This limitation is reflected in his initial use of language which is EGOCENTRIC, i.e. it is centred on his own needs and activities. The great
limitation of egocentric language is that it is not true communication, but only a commentary on the child's own needs and activities.

40A. The limitations of a single viewpoint (a) are clearly seen in the child's early use of language (b) which is egocentric (c). Egocentric language is not true communication (d): it is self-centred commentary on the child's own needs (e).

(a) viewpoint (b) language (c) egocentric (d) communication (e) needs

41. INTUITIVE STAGE: LANGUAGE (continued): As the demands of the environment grow, and the interactions with parents and other children increase, the child's language becomes more a means of communication, i.e. it becomes socialised. This comes about because the very act of communicating forces one to take account of the viewpoint of the other person. Through experiences in discussion, argument, explanation, narration, etc., the child learns gradually to free himself from the restrictions of a single viewpoint and learns to see things from several perspectives, i.e. he achieves a greater measure of decentration in his thinking.

41A. When language develops into true communication, it is said to have become socialised (a). Seeing other people's viewpoint is essential to true communication (b). Only experience in discussion (c), argument (d), etc. can free the child from the limitations of a single viewpoint. Through this he achieves decentration (f) in his thinking.

(a) socialised (b) communication (c) discussion (d) argument (e) single (f) decentration

42. INTUITIVE STAGE: NUMBER: Piaget used simple yet ingenious experiments to show that the use of the basic skills of arithmetic depend upon two fundamental logical operations: CLASSIFICATION and SERIATION. CLASSIFICATION means that a given number is a constant class regardless of the order or the nature of the objects. e.g. Number 5 means five things no matter what sequence
they are patterned in, and regardless of whether they are apples, dots, cars, pencils, ideas, etc.

SERIATION means that a given number occupies a given position in serial order.

c.e.g. Number 5 means that the object is fifth in a series regardless of what the objects may be.

42A. Two basic logical operations are involved in arithmetic. These are cl ..........(a) and se ............(b).

When the number 7 is used to indicate that an object is seventh in a series, the concept of ..............(c) is involved. When the number 7 indicates how many things are included in a group, the concept of ..............(d) is involved. It is essential that the child understand that these are constant factors, that is, they apply regardless of what kind of objects are being considered.

(a) classification (b) seriation (c) seriation
(d) classification

43. INTUITIVE STAGE: NUMBER (continued): These two fundamental ideas are so obvious to adults that we are tempted to overlook the fact that this deceptively simple understanding is dependent upon complex logical operations, and that these are only gradually freed from the distortions of the child's own perceptions during the Intuitive Stage. For this reason, the child's understanding of number is at first very primitive and easily disturbed.

43A. Classification and seriation are obvious to adults .........(a).

The child's understanding of them, however, is distorted by his own per ............(b) at this stage. His ability to understand the basic concepts of number is therefore very easily distur ............(c). Freeing one's thinking from perceptual distortions is a very grad ............(d) process.

(a) adults (b) perceptions (c) disturbed (d) gradual
44. INTUITIVE STAGE: NUMBER (continued): The child's visual perceptions over-rule his concept of the constancy of a class.

EXAMPLE: Given a row of vases, the child can place one flower beside each vase, and then agree that there are the same number of flowers as vases. But if the flowers are bunched together while the vases are left in a row, he believes that there are now more vases than flowers. (He can see that they occupy more space.) When again spread out, one flower to each vase, he agrees that there are as many flowers as vases again. This occurs even though the child can see that no additions or subtractions have been made to the number of flowers or vases. Similarly, if the flowers are left spread out while the vases are bunched together, he will state that there are more flowers than vases. He fails to see that the number of things involved has a constant value no matter how the objects are arranged.

44A. MARK ONLY THE CORRECT STATEMENTS.

(a) Logical concepts outweigh what is seen.
(b) The sample shows that the concept of constancy is dominated by the child's sense impressions.
(c) Classification involves the idea that a number has a value which persists regardless of the arrangement of the objects.
(d) At this stage, the child readily grasps the basic concepts of number.

The only correct statements are (b) and (c).

45. INTUITIVE STAGE: NUMBER (continued): Nor can the child reconcile two different viewpoints. He can consider only one at a time.

EXAMPLE: Two rods of equal length are placed before the child. One is moved so that one end protrudes beyond the end of the other rod. The child believes that one rod is now longer than the other because it protrudes at one end. Or, when his attention is drawn to the fact, he will say that the same rod is now shorter than the other because it is not as long at the other end. He cannot cope with two changes at once and realize that a change at one end is balanced by a change at the other end, i.e., he cannot hold in mind two or more variables simultaneously, nor can he
compensate for changes and see that the constancy of the rod lengths is maintained regardless of the positions they occupy.

45A. The child at this stage cannot bal........(a) the change at one end of the rod against the ch........(b) at the other end because he is unable to hold two var........(c) in mind sim..............(d). He cannot comp..........(e) for changes in one variable with changes in the other.

(a) balance (b) change (c) variables (d) simultaneously (e) compensate

46. INTUITIVE STAGE: NUMBER (continued): The child is unable to hold two systems of classification in mind at the same time.

EXAMPLE: A child is shown about 20 wooden beads, most of which are brown, but a few of which are white. He shows that he understands quite clearly that they are all made of wood. When asked whether there are more brown or more wooden beads, he will answer that there are more brown ones. He cannot hold in mind both the colour category and the material category together. The two different systems of classification can be considered only one at a time.

46A. ANSWER YES OR NO.

(a) Did the child in the example understand the concept of the classification category "wood" adequately? (Yes/No)

(b) Did the child adequately understand the concept of the colour classification? (Yes/No)

(c) Was the child able to consider both of these categories at the same time? (Yes/No)

(d) Does this show that the child at this stage is unable simultaneously to hold in mind two different systems of classification? (Yes/No)

(a) Yes (b) Yes (c) No (d) Yes
47. REVIEW FRAME. The Intuitive Stage involves a rapid development of concepts and symbols, but a lack of confidence in their use. Perceptions are reverted to whenever logic fails. More dependence is placed upon intuition than on logical reasoning; personal wishes overshadow any rules of logic, and little decentration of thought is yet apparent. Language is only gradually becoming socialised. The two fundamental logical operations involved in arithmetic, classification and seriation, are only gradually freed from perceptual distortions during this stage, and so constancy of class, and simultaneous consideration of multiple viewpoints or systems of classification is not yet possible.

47A. REVIEW FRAME. SELECT THE CORRECT WORD IN EACH BRACKET.

(a) When logic fails the child at the Intuitive Stage, he tends to revert to (reason, concepts, perceptions).
(b) He depends more on (reason, intuition, language) than he does on logic.
(c) Language is slowly becoming (symbolic, egocentric, socialised) through experience with its use.
(d) The basic arithmetical concepts of classification and seriation are being freed from (perceptual, symbolic, logical) distortions.

(a) perceptions (b) intuition (c) socialised (d) perceptual

48. By about the mental age of seven, the child begins to show more consistency in his thinking. We talk to him in a more sophisticated way and assume that he can think about things in much the same way as we do ourselves. At primary school, the tasks we give the child assume that he can perform quite complex logical operations. At first, the child’s responses to these tasks are tied to the particular concrete situation in which they occur. This is the stage of CONCRETE OPERATIONS.

48A. From about the age of seven, the child enters the stage of C............(a) Op............(b), and begins to show more con........cy (c) in his thinking. During the middle primary school years, his logical thinking is tied to particular con...........(d) situations.

(a) Concrete (b) Operations (c) consistency (d) concrete
49. CONCRETE OPERATIONS STAGE: This stage is from about seven to about eleven years, i.e. the middle primary school period. At this stage, responses are tied to the particular situations in which they occur, i.e. they are not transferred to other situations. The child is reasonably consistent in dealing with situations with which he is familiar, but in unfamiliar situations, or when new elements are added to the situation, his responses are easily upset.

49A. ANSWER TRUE OR FALSE.

During the Concrete Operations Stage:
(a) Responses are tied to the particular situations in which they occur. (True/False)
(b) Responses are not easily transferred from one situation to another. (True/False)
(c) The child is inconsistent in dealing with even familiar situations. (True/False)
(d) The addition of new elements to a situation upsets the child's logical operations. (True/False)

(a) True (b) True (c) False (d) True

50. CONCRETE OPERATIONS STAGE: The child is consistent in his explanations of a more difficult problem only if he can ignore those parts of it which he cannot understand. EXAMPLE: He is consistent in explaining that wood floats and metal sinks, conveniently ignoring a demonstration that a steel needle can be made to float. He does not attempt to find an explanation that will include the possibility of floating metal, but deals with this fact by dismissing it completely.

50A. When some parts of a problem are beyond the child's understanding, he will tend to ignore these parts and to explain the situation including only those aspects with which he feels he can cope. He does not feel the necessity to seek an explanation which will account for the elements in the problem.

(a) ignore (b) explanation (c) all
51. CONCRETE OPERATIONS STAGE: Although he can perform logical operations in isolation, he cannot view all the variables in the problem simultaneously and weigh one against the other. In fact, he does not feel the logical necessity to look at the problem as a whole and to allow for every part of it in seeking a solution.

51A. He is now capable of performing log.....(a) operations but only in isol.....(b). He still cannot view all the var.....(c) at once and weigh one against the other. He does not see the need to view the problem as a wh.....(d) and to allow for every part of it.

(a) logical (b) isolation (c) variables (d) whole

52. CONCRETE OPERATIONS STAGE: At this stage, too, the child uses logic and reasoning only in the manipulation of concrete objects, not in application to verbal propositions. 
EXAMPLE: Eight- and ten-year-olds have no trouble in arranging a series of stick dolls in order of height, for this is a concrete situation using concrete objects. But they do have difficulty in dealing with a similar problem expressed in words, e.g. "Edith is taller than Susan; Edith is shorter than Lilly; who is the tallest of the three?"

52A. ANSWER YES OR NO.

At the Concrete Operations Stage:
(a) Is the child able to use logic at all? (Yes/No)
(b) Is he able to apply reasoning to verbal problems? (Yes/No)
(c) Is he able to use reasoning in the solving of problems using concrete materials? (Yes/No)
(d) Could he solve this problem through logical reasoning? "John can run faster than Bill; Bill is slower than Tom; who is the fastest?" (Yes/No)

(a) Yes (b) No (c) Yes (d) No
53. REVIEW FRAME. At the Concrete Operations Stage, the child can cope well with familiar situations, and can reason logically using one variable at a time. He cannot balance all the variables by viewing the problem as a whole, and he deals with extra elements by ignoring them. He can apply logic to concrete problems (using concrete objects), but he cannot solve by logic similar problems stated as verbal propositions.

In brief, the child at the Concrete Operations Stage can cope well with familiar situations, use logic in solving concrete problems, and display quite consistent reasoning with one variable at a time providing he can ignore other elements in the problem. He cannot balance all the variables by viewing the problem as a whole.

(a) familiar (b) logic (c) concrete (d) ignore (e) variables (f) whole

54. FORMAL OPERATIONS STAGE: The ability to deal with the verbal expression of logical relationships, and to apply logical rules and reasoning to abstract problems begins to develop from about the age of 11 or 12 years. At this stage, instead of conveniently ignoring what he cannot understand, the adolescent can take into consideration all the evidence in a situation, i.e., he is capable of coping with more than one variable at a time.

The child is not capable of considering all the elements in a situation until he reaches the stage of Formal Operations (b). This does not occur until he is about 11 or 12 years old. He is now able to apply logic to verbal and abstract problems.

(a) Formal (b) Operations (c) 11 or 12 (d) verbal (e) abstract

55. FORMAL OPERATIONS STAGE: Not only is he now capable of dealing with many concrete variables, he is now able to consider general laws and to envisage what is hypothetically possible as well as what is real. He is guided in these mental operations by the logical form of the
problem and the necessary rules that this form imposes. Hence the term "Formal" for this stage.

55A. Now he can not only deal with real situations, he can also consider what is hypothetically (a) possible. He is bounded in his mental operations by the logical form (b) of the problem only, i.e. the necessities of the particular type of logical reasoning which such a problem imposes.

(a) hypothetically (b) form

56. FORMAL OPERATIONS STAGE: He can now proceed with a problem by trying out various hypotheses and rejecting them in the light of the evidence. He is able to do this by the most efficient means - LOGICAL OPERATIONS, in which he thinks out the possible consequences of various solutions by using symbols. In other words, he can "operate with operations" i.e. he can use symbolic propositions. This could be termed "If........, then..." type of logic.

56A. When faced with a problem, he can now use logical operations (a) in the fullest sense, i.e. he can view every possibility and try out each one by using symbolic (b) propositions to decide on the probable consequences (c) of each solution proposed.

(a) operations (b) symbolic (c) consequences

57. REVIEW FRAME. Only when the child has reached the stage of Formal Operations is he capable of applying logic and reasoning to symbolic or abstract situations, of creating and testing hypotheses by using symbols, of considering all the possibilities in the situation, and of being governed in his thinking by the logical form of the problem. He is now capable of performing logical operations, in Piaget's view, the highest form of intellectual development.
57A. REVIEW FRAME. ANSWER TRUE OR FALSE.

(a) At the Concrete Operations Stage, the child is able to use logic in symbolic operations. (True/False)
(b) At the Formal Operations Stage, he is able to use logic in abstract situations. (True/False)
(c) A sixteen-year-old should be capable of creating hypotheses. (True/False)
(d) A sixteen-year-old should be capable of testing hypotheses symbolically. (True/False)
(e) In Piaget's opinion, there is a stage of intellectual development beyond the Formal Operations Stage. (True/False)

(a) False (b) True (c) True (d) True (e) False

58. The basic theory of Piaget may be of little direct value to the teacher who is more interested in exactly what thinking skills are involved, how these develop, and how he (the teacher) can control or provide the experiences out of which the particular skills will develop. These skills are essentially logical rather than psychological. This is why Piaget so often uses the language of logic in his works.

58A. The teacher is concerned to know exactly what thinking skills are involved, how they develop, and how he can provide the experiences which will aid their development. These skills are logical rather than psychological.

(a) skills (b) develop (c) experiences (d) logical

59. In any teaching which goes beyond mere rote memorization, a major part of the teacher's job is concerned with helping children to refine their concepts; to categorize data; to avoid logical contradictions and incomplete or inappropriate classifications; and to follow a chain of "If... then..." type of reasoning. All of these depend upon precise logical skills, particularly the ability to classify data and to link data into a system of relationships.
59A. A major part of the teacher's job lies in assisting children to refine their concepts (a), to categorize or classify data (b), to avoid logical contradictions (c), and to follow a chain of reasoning of the "If..., then..." type. All these depend upon precise logical skills, especially the ability to classify data, and to link data together into systems of relationships (e).

(a) concepts (b) data (c) contradictions (d) classify (e) relationships

60. The implications of Piaget's work for the teacher are:
(a) He must bear in mind what basic skills he is trying to develop in the child.
(b) He must vary his methods of presentation of material in whatever subject he is teaching, so that pupils may see the problems from a variety of viewpoints.
(c) He must offer a variety of examples and problems in presenting the concepts involved.

60A. The teacher must keep in mind what skills (a) he is trying to develop (b) in the child. He must vary his methods of presenting material (c) and offer a variety of examples (d) in presenting the concepts (e) involved.

(a) skills (b) develop (c) presentation (d) examples (e) concepts

61. The need for the teacher to be concerned with these factors is apparent when one considers that only with much experience plus the onset of the ability to operate formally can the child develop fully adult-type thinking in which he can create hypotheses, test them systematically, and arrive at logical solutions to problems.

61A. Two factors are essential before the child is able to use fully adult-type thinking. One is development to the Formal (a) Operations (b) Stage. The other is experience in the use of formal logic.

(a) Formal (b) Operations (c) experience
62. This adult ability implies that a problem can be grasped as a whole and its logical structure perceived and held in mind. Only when this is possible can all the elements be varied systematically according to the logical possibilities of the situation so that all aspects of the problem can be explored.

62A. ANSWER YES OR NO.

(a) Is the adult able to see a problem in its entirety? (Yes/No)
(b) Does adult ability imply that the logical form of a problem can be recognized? (Yes/No)
(c) Does adult thinking allow for the systematic variation of elements of a problem in order to explore all possible solutions? (Yes/No)

(a) Yes (b) Yes (c) Yes

63. Thus, the adult is not limited in his thinking by personal viewpoints alone, by the concrete limitations of the particular situation, by lack of confidence in the use of symbols, or by rigidity of ideas. He is ACTIVE, DECENTRATED, FLEXIBLE, and MOBILE.

63A. MARK ONLY THOSE CHARACTERISTICS WHICH DO NOT APPLY.

Adult thinking is characterised by:
(a) concrete limitations (b) mobility
(c) confidence with symbols (d) flexibility
(e) activity (f) rigidity
(g) decentration (h) personal viewpoints

Only (a), (f) and (h) do not apply.

64. Teachers and parents can aid the development of logical thinking in children by providing an environment which stimulates mental activity, encourages a multiplicity of viewpoints, and breeds confidence in using mobile thought.
64A. The development of logical thought is aided by an appropriate env.........(a) which should encourage mental act.........(b), multiple v.............(c), and m.......(d) in thinking.

(a) environment  (b) activity  (c) viewpoints  (d) mobility

65. The whole of the nature of intelligence is not yet understood. Piaget's work has laid the foundations for a fuller understanding of the functioning of the intellect, but much remains to be done. Others are beginning to build on his work, and in this respect he has made a major contribution to educational psychology.

65A. ANSWER YES OR NO ACCORDING TO WHETHER YOU AGREE OR DISAGREE WITH THE STATEMENT.

(a) Piaget's work has added to our knowledge of how the mind works.  
   
   (Yes/No)

(b) We now understand just how the mind works. (Yes/No)

(c) Piaget has given incentive to other research workers in this field.  
   
   (Yes/No)

(d) We must accumulate much more knowledge before we really understand the workings of the human mind.  
   
   (Yes/No)

(a) Yes  (b) No  (c) Yes  (d) Yes

66. REVIEW FRAME. RE-READ FRAMES 58 TO 65 INCLUSIVE AND THEN COMPLETE THE ANSWER BLOCK FOR FRAME 66.

66A. REVIEW FRAME. Piaget's theories may not be of dir.......(a) value to teachers who are mostly concerned with how to give their pupils the exp.............(b) which are necessary for full intellectual dev.............(c). To do this, teachers must know what sk.......(d) to develop, and what experiences are most likely to encourage the development of these skills. His ultimate aim as a teacher is to aid the development of ad.......(e) type thinking which is characterised by fo.......(f) operations.

(a) direct  (b) experiences  (c) development  (d) skills  
   (e) adult  (f) formal
67. **GENERAL REVIEW FRAME.** The ability to measure intelligence does not explain the nature of intelligence. Piaget has made a major contribution to our understanding of intellectual development. His view stresses the importance of the child's actions (both physical and mental) in his environment; the need to develop the ability to see things from many points of view; and the development of mobility of thought.

67A. **GENERAL REVIEW FRAME.** Measuring intelligence does not explain its nature (a). Piaget's theory stresses the importance of activity (b), the need to see things from many different viewpoints (c), and the need for thought to be mobile (d).

(a) nature (b) actions (c) viewpoints (d) mobile

68. **GENERAL REVIEW FRAME.** Piaget outlines five clear-cut stages in the development of logical thinking. These are:

- **SENSORI-MOTOR STAGE** (from birth to 18 months)
- **PRE-CONCEPTUAL STAGE** (from 18 months to 4 years)
- **INTUITIVE THOUGHT STAGE** (from 4 years to 7 years)
- **CONCRETE OPERATIONS STAGE** (from 7 years to 11 or 12 years)
- **FORMAL OPERATIONS STAGE** (from 11 or 12 years onwards)

68A. **GENERAL REVIEW FRAME.**

The (a) Stage is from (b) to 18 months.
The (c) Stage is from 7 to (d) years.
The (e) Stage is from 18 months to (f).
The (g) Stage is from 11 years onwards.
The (h) Stage is from (i) to 7 years.

(a) Sensori-motor (b) birth (c) Concrete Operations (d) 11 (or 12) (e) Pre-conceptual (f) 4 years (g) Formal Operations (h) Intuitive Thought (i) 4

69. **GENERAL REVIEW FRAME.** The first stage is largely one of sensory perception and physical manipulation, during which the child learns to see himself in relation to other objects in his environment, and begins to gain an understanding of the fundamentals of time and causality.
in his physical world. The second stage introduces the potent field of language, the material which will provide the basis for the later development of concepts as the child gains experience with words - the symbols of thought.

69A. **GENERAL REVIEW FRAME.** The Sensori-motor Stage is one of sensory p. (a) and physical m. (b). The child learns to see the rel. (c) between himself and other objects and to acquire a basic understanding of t. (d) and causality. The Pre-conceptual Stage is one in which the child begins to acquire l. (e) from which con. (f) will later develop.

(a) perceptions (b) manipulations (c) relationship (d) time (e) language (f) concepts

70. **GENERAL REVIEW FRAME.** The third stage involves the refinement of concepts but the child still lacks confidence in the use of conceptual and symbolic logic, and prefers to trust his perceptions still. He is introduced to the academic skills of reading and number which demand complex intellectual skills. Language must become socialised. The basic logical skills of classification and seriation necessary for number are only gradually being freed from perceptual distortions.

70A. **GENERAL REVIEW FRAME.** At the I. (a) Thought Stage, two basic academic skills are introduced - R. (b) and A. (c). These demand complex logical skills, especially those of classification and (d). But these skills are only gradually being freed from perceptual dist. (e).

In the illustration, would the child say that there are more flowers or less flowers than vases? (more/less)

\[
\begin{align*}
\text{(a) Intuitive} & & \text{(b) Reading} & & \text{(c) Arithmetic} & & \text{(d) seriation} \\
& & \text{(e) distortion} & & \text{(f) less}
\end{align*}
\]
71. **GENERAL REVIEW FRAME.** The fourth stage finds the child capable of coping in concrete situations but unable to consider all the possibilities at once or to apply logical thought to verbal problems. In seeking solutions, the child may ignore those parts of the problem which he cannot understand.

71A. **GENERAL REVIEW FRAME.** At the Concrete Operations Stage, the child is able to apply logic to (a) situations but not to (b) propositions. He cannot cope with all the possibilities (c), and will ignore (d) those aspects of a problem which he is unable to explain (e).

(a) concrete  (b) verbal  (c) possibilities  (d) ignore  (e) explain

72. **GENERAL REVIEW FRAME.** The final stage is reached when the child is able to consider all possibilities, and to form and test symbolically a systematic series of hypotheses. He is now capable of performing logical operations, the highest stage of intellectual development.

72A. **GENERAL REVIEW FRAME.** The child reaches the stage of Formal Operations when he can consider (a) all possibilities, form (b), and test these hypotheses symbolically (c) in a systematic manner. He has then reached the highest (d) stage of intellectual development (e) according to Jean Piaget (f) P.

(a) consider  (b) hypotheses  (c) symbolically  (d) highest  (e) development  (f) Jean (g) Piaget

---

YOU HAVE NOW COMPLETED THE PROGRAMME.
YOU MAY RETAIN THE SCRIPT AND USE IT FOR REVISION PURPOSES.
APPENDIX B

READING LIST
READING LIST

PIAGET'S APPROACH TO INTELLECTUAL DEVELOPMENT

All of the texts mentioned below are available in both the University and the Teachers' College libraries.

Compulsory Reading

   (These articles have been cyclostyled and will be issued to students.)

   (This is a text for Education 1 and could be borrowed from students doing this unit at University. As indicated above, it is also available from both libraries.)

Recommended Additional Reading


5. Flavell, J. H. THE DEVELOPMENTAL PSYCHOLOGY OF JEAN PIAGET. Princeton: Van Nostrand, 1963. See Part 1 for full account of theory. Also see summary on pp. 264 - 266. (This is a more difficult text and is probably suited only to the more able students).

Further References


10. Some isolated reference paragraphs appear in your textbook as under:

Stone, L. J. and Church, J. *Childhood and Adolescence*. New York: Random House, 1957. pp. 86; 124; 164; para. 3; 187; para. 3; 211; 245.
CLASS TEST

COGNITIVE DEVELOPMENT

NAME: ________________________ GROUP: _____ DATE: ______

SECTION A

1. Piaget outlines three basic principles of intellectual development. These are:
   (a) ______________________________
   (b) ______________________________
   (c) ______________________________

2. Complete the following information about Piaget's stages of intellectual development.

<table>
<thead>
<tr>
<th>STAGES (in order of development)</th>
<th>APPROXIMATE AGE</th>
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<tbody>
<tr>
<td>(a)</td>
<td>From _____ to _____</td>
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<td>(c)</td>
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<td>(e)</td>
<td>From _____ to _____</td>
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</table>

3. The child's knowledge of his environment is the result of his own activities in his environment. This illustrates the principle of ________________________ .

4. Mental trial and error which is capable of infinite variation illustrates the principle of ________________________ .

5. The limitations to thinking imposed by one's own particular experiences or attitude involve the principle of ________________________ .

6. If an adult sees something which is illogical, he distrusts his vision; if a five-year-old child sees something illogical, he ________________________ .
7. An ability to blandly contradict himself is a feature of a child at the _______________ Stage of development.

8. To the child at the _______________ Stage, words are only gradually being generalised to represent a class; they are not yet true concepts.

9. During the early primary school years, the child is at the _______________ Stage. At this stage, he is introduced to the two basic academic skills of _______________ and _______________.

10. The development of the ability to orient himself in space occurs during the _______________ Stage.

11. If two rods, equal in length, are placed side by side but with the end of one protruding, a young child will say that they are unequal in length because he is unable to hold in mind two different _______________ at once.

12. The older primary school child who does not feel the logical necessity to take into account all the relevant data in trying to solve a problem is still functioning at the _______________ Stage.

13. The child whose logic and reasoning is efficient only in real situations is at the _______________ Stage.

14. Piaget's highest stage of intellectual development is characterised by the ability to reason _______________.

15. The ability to apply logic and reasoning to verbal problems is typical of the _______________ Stage.

16. Piaget stresses two kinds of operations: _______________ OPERATIONS which are dominant in the earlier stages of childhood, and _______________ OPERATIONS which are more typical of the older child.
CLASS TEST

COGNITIVE DEVELOPMENT

NAME: __________________________ GROUP: ___________ DATE: ________

SECTION B: WRITE THE LETTER OF THE ANSWER YOU CHOOSE IN THE BRACKETS ON THE RIGHT-HAND SIDE OF THE PAGE.

1. IQ is a convenient and useful label which indicates:
   (a) the nature of intelligence
   (b) how the mind works
   (c) a general level of intellectual functioning
   (d) the effects of education on intelligence

2. Piaget's view is that intelligence:
   (a) develops with the beginnings of language
   (b) is present from birth, with development bringing an increase in complexity
   (c) is not present until maturity
   (d) develops in stages characterised by the emergence of new logical operations

3. Piaget believes that the power of logical thought is:
   (a) innate
   (b) completely dependent upon experience
   (c) dependent upon both experience and maturation
   (d) completely dependent upon maturation

4. Piaget has shown that between the physical activities of a baby and the mental activities of an older child, there is:
   (a) no relationship
   (b) a dependence of later functions upon the earlier functions
   (c) the same mental activity involved
   (d) a relationship which has no significance

5. The principle of operations or actions implies that:
   (a) knowledge of the environment is the result of the child's own actions
   (b) activity is essential for good physical development
   (c) the child learns by a passive registering of sights and sounds
   (d) knowledge is the result of the environment acting upon the child
6. The principle of viewpoints means that:
   (a) problems are best solved by following a single viewpoint
   (b) mature thought results from giving due weight to every possible viewpoint in a problem
   (c) we should always try to see the "other fellow's" view
   (d) one's own viewpoint is the most appropriate basis of clear thinking

7. The principle of mobility implies that:
   (a) travel broadens the mind
   (b) children are very active physically
   (c) physical manipulation of the environment is the most efficient form of learning
   (d) mental trial and error is more flexible than physical experimentation, and is therefore a superior form of thinking

8. In developing his ideas of stages of intellectual development Piaget is most concerned with:
   (a) sequences of development
   (b) age limits for each stage
   (c) the neural processes involved
   (d) relating physical to social development

9. During the Sensori-motor Stage, the infant gradually learns that:
   (a) he can think things out for himself
   (b) objects cease to exist when he loses sight of them
   (c) objects persist through time and influence each other
   (d) all objects are related to him

10. The Pre-conceptual Stage is characterised by:
    (a) adult forms of thinking
    (b) rapid language development
    (c) complete understanding of the physical environment
    (d) the onset of abstract thinking

11. When a pre-school child uses a word correctly, we can rightly assume that:
    (a) he has grasped the concept involved
    (b) he has no understanding of the concept involved
    (c) he has used the word correctly by chance
    (d) the concepts will be constructed from the word as he gains experience in using it

12. The Pre-conceptual Stage is a great advance on the Sensori-motor Stage because:
    (a) the child is now much bigger physically
    (b) mental experiments replace slower physical experiments
    (c) practical experimentation can be done more rapidly
    (d) words completely replace actions
13. During the Intuitive Stage, the child:
(a) feels great confidence in his new-found conceptual and symbolic power
(b) is consistent in his logic
(c) can consider only one view at a time, a fact which distorts his reasoning
(d) is governed in his reasoning by the logical necessities of a problem

14. The language of children at the Intuitive Stage is:
(a) egocentric
(b) true communication
(c) socialised
(d) mature

15. The concept of conservation or constancy is distorted in the Intuitive Stage by:
(a) the child's perception of the grouping of the objects
(b) his lack of knowledge
(c) his inability to count
(d) the teacher's failure to explain the underlying concept

16. The use of the basic skills of arithmetic is dependent upon two fundamental logical operations:
(a) intuition and reasoning
(b) explanation and experiment
(c) classification and seriation
(d) compensation and intuition

17. The thinking of the middle-primary school child is characteristically:
(a) highly mobile
(b) able to cope with all elements in a problem
(c) limited to things he can actually do
(d) tied to concrete situations and easily disturbed by the addition of new elements

18. During the Concrete Operations Stage, the child uses elementary logic and reasoning but cannot apply them to:
(a) verbal propositions
(b) concrete situations
(c) simple counting
(d) classification systems

19. The ability to apply Formal Operations implies that the child is able to:
(a) reason concretely
(b) apply general principles to specific situations
(c) conduct practical experiments on a problem
(d) think in a stereotyped manner
20. By late adolescence, the child can characteristically:
   (a) ignore elements in a problem which do not fit his reasoning
   (b) reason intuitively
   (c) use hypothetical reasoning to explore all possibilities
   (d) use one viewpoint exclusively

21. The ability to create hypotheses and to systematically test their consequences implies that:
   (a) the stage of Intuitive Thought has been reached
   (b) a situation can be grasped as a whole
   (c) "formal" thinking has been superceded
   (d) the logical necessity inherent in a problem can be ignored

22. Piaget's work represents:
   (a) pure theory unsubstantiated by experimental findings
   (b) pure experimental findings un-unified by theory
   (c) an impressive body of both experiment and theory
   (d) brilliant intuitive deductions

23. As a result of Piaget's work, we now have:
   (a) a basis of understanding upon which others can build
   (b) little of practical value for educationists
   (c) a complete understanding of the development of the intellect
   (d) greater confusion than ever in understanding the workings of the human mind

24. Piaget's three basic principles are:
   (a) each applicable to a separate developmental stage
   (b) all applicable to the Sensori-motor Stage only
   (c) all traceable to the Intuitive Stage only
   (d) all traceable through all stages of development

25. The thinking power of the late adolescent will vary partly according to individual ability and partly according to:
   (a) an environment which stimulates the child to mental activity
   (b) an environment which encourages the multiplying and co-ordinating of viewpoints
   (c) an environment which aids the development of confidence, flexibility and mobility of thought
   (d) all three above
26. To help the child to free himself from the restrictions of a single viewpoint, we should:
(a) give him ample opportunities to discuss, explain, and collaborate
(b) insist that he follows adults' orders and emulate their actions
(c) point out the opposite side of every view he puts forth
(d) all three above

27. A major part of a teacher's work is to help the child to:
(a) refine concepts and categorize data
(b) avoid inappropriate classifications and to co-ordinate appropriate ones
(c) follow a chain of "If......, then......" reasoning
(d) all three above

28. The skills of thinking are essentially skills of:
(a) a psychological nature
(b) a logical nature
(c) an intuitive nature
(d) an innate nature

29. Teachers are most concerned with knowing:
(a) how basic skills develop
(b) how to provide experiences to aid the development of basic skills
(c) what thinking skills they demand of their pupils
(d) all three above

30. A child is considering how to refloat a rowing boat stranded on the sand. He reasons like this: 'I could try to pull it down to the water.......no, it would be too heavy for me. Perhaps I could dig a channel up to the boat so that the water will float it free.......no, that would involve a channel too deep and too long. If I dig a shallow channel around the boat and then wait for the tide to come in, there should then be enough water to take the weight of the boat while I pull it into deeper water." This child is displaying reasoning typical of:
(a) the Pre-conceptual Stage
(b) the Intuitive Stage
(c) the Concrete Operations Stage
(d) the Formal Operations Stage
APPENDIX D

ANALYSIS OF CO-VARIANCE TABLES
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Total in Sample: 135  For each sub-cell N=1
### Table X

**Summary of Analysis of Co-Variance and of Variance of Adjusted Values for Total Scores on First Post-Test**

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<th>Double Interactions $\text{TXI} \text{TXR} \text{IXR}$</th>
<th>Main Effects $\text{T} \text{I} \text{R}$</th>
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Total in Sample: 135  For each sub-cell N=1
### TABLE XII

**SUMMARY OF ANALYSIS OF CO-VARIANCE AND OF VARIANCE OF ADJUSTED VALUES FOR PART A SCORES ON FIRST POST-TEST**

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Total in Sample: 135  For each sub-cell N=1
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<td>FOR PART B SCORES ON FIRST POST-TEST</td>
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TABLE XV

RAW DATA FOR ANALYSIS OF CO-VARIANCE ON TOTAL SCORES FOR SECOND POST-TEST

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Total in Sample: 135   For each sub-cell N=1
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<th>Double Interactions</th>
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**Total in Sample: 135** For each sub-cell N=1
### TABLE XVIII

**SUMMARY OF ANALYSIS OF CO-VARIANCE AND OF VARIANCE OF ADJUSTED VALUES FOR PART A SCORES ON SECOND POST-TEST**

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### TABLE XIX

RAW DATA FOR ANALYSIS OF CO-VARIANCE ON PART B SCORES OF SECOND POST-TEST

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Total in sample: 135 For each sub-cell N=1
### TABLE XX

Summary of Analysis of Co-Variance and of Variance of Adjusted Values for Part B scores on Second Post-Test

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<th></th>
<th>Replica</th>
<th>Triple $TxIxR$</th>
<th>Double Interactions $TxI$ $TxR$ $IxR$</th>
<th>Main Effects $T$ $I$ $R$</th>
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<td>$a^2$</td>
<td>267</td>
<td>21 12 3</td>
<td>4 23 11</td>
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<td>2.</td>
<td>$b^2 = a^2$</td>
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<td>10.73 6.13 1.53</td>
<td>2.04 11.75 5.62</td>
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<td>3.</td>
<td>$c^2$</td>
<td>786</td>
<td>11 13 57</td>
<td>82 21 26</td>
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<td>4.</td>
<td>line 2+line 3</td>
<td>922</td>
<td>21.73 19.13 58.53</td>
<td>84.04 32.75 31.62</td>
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<td>5.</td>
<td>$d = XY$</td>
<td>151</td>
<td>0 11 -4</td>
<td>-5 18 16</td>
<td>230</td>
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<tr>
<td>6.</td>
<td>$2b = XY$</td>
<td>273.13</td>
<td>0 15.73 -5.72</td>
<td>-7.15 25.74 22.88</td>
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<td>7.</td>
<td>$e^2$</td>
<td>649.31</td>
<td>21.73 3.4 64.25</td>
<td>91.19 7.01 8.74</td>
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<td>8.</td>
<td>$e^2$ d.f.</td>
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<td>9.296 5.43 .85 16.06</td>
<td>45.59 3.5 4.37</td>
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<td>.89 .14 2.65</td>
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<td>N.S.</td>
<td>N.S. N.S. N.S.</td>
<td>.05 N.S. N.S.</td>
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</table>
APPENDIX E

GRAPHS OF INTERACTIONS
GRAPHICAL CONSIDERATION
OF INTERACTION EFFECTS

In interpreting the following graphs, it should be noted that the presence of interaction is indicated by the extent to which the lines do not parallel each other. As Moroney points out, in the absence of interaction we should expect all three lines in each graph to follow the same kind of trend as they pass from $T_1$ to $T_3$ (or $I_1$ to $I_3$; $R_1$ to $R_3$). The trends need not all be straight lines, but they should all resemble each other.

---

FIGURE 7
IXT EFFECTS FOR TOTAL SCORES
OF SECOND POST-TEST
FIGURE 8

IxR EFFECTS FOR TOTAL SCORES
OF SECOND POST-TEST