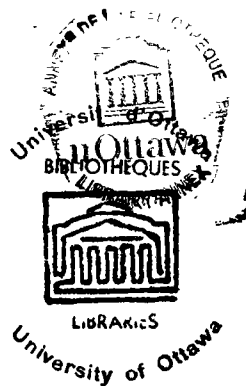


A STUDY OF DIFFERENCES IN ACHIEVEMENT RESULTING
FROM PROGRAMMED INSTRUCTION AS A FUNCTION OF
ROYCE'S PSYCHO-EPISTEMOLOGICAL STYLES

by Richard Rancourt

Thesis presented to the School of
Graduate Studies of the University
of Ottawa as partial fulfillment
of the requirements for the degree
of Doctor of Philosophy



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CURRICULUM STUDIORUM

Richard Rancourt was born May 8, 1941, in North Bay, Ontario. He received the degree of Bachelor of Arts in Philosophy from Laurentian University, Sudbury, Ontario, in 1966. He received the degrees of Bachelor of Education in 1967 and of Master of Education in 1968 from the University of Ottawa, Ottawa, Ontario. The title of his upgrading paper was Leadership: Some Philosophical Considerations.

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INTRODUCTION

The suggestion that education should be tailored to meet the needs of students is not of recent date. Some two thousand years ago, Quintilian wrote:

It is generally and not unreasonably regarded as the sign of a good teacher that he should be able to differentiate between the abilities of his respective pupils and to know their natural bent. The gifts of nature are infinite in their variety, and mind differs from mind almost as much as body from body.¹

Since that time much effort has been expended in searching for ways to adapt education to individual learners. Within the last seventy years, North American education has been very sensitive and concerned in its attempt to harmonize educational goals to the individual learner.

Many organizational, curricular and teaching reforms have been implemented towards this end. In general, the results of such efforts appear to be disappointing. Using variability in achievement as a criterion for evaluating the effectiveness of learning, the conclusions of research findings appear to be either generally contradictory in nature or too scattered to permit some kind of confident conclusions.

The individualization movement of the last two decades, committed to the elimination of variability in achievement,

¹ Quintilian, "The Teacher's Work", in R. Gross, (ed.), The Teacher and The Taught, New York, Delta, 1963, p. 21.

also appears to have produced little success and much controversy. The need to investigate such a persistent problem in education has become more pressing. Massive empirical efforts along with the implementation of varied individualized approaches have not reduced appreciably the variability in achievement. Authors such as Satterly and Brimer,² Lumsden,³ Hoban⁴ and Cronbach and Snow⁵ have suggested that some unknown trait or group of traits may be responsible for variability, and that these traits may very well be found in the area of learning styles.

In answer to this need, the present study will attempt to explore theoretically a presently overlooked area in instructional development, psycho-epistemology, and to establish some possible relationships to variability in achievement. For the purpose of this study, programmed instruction was chosen as an example of a teaching method to

2 D. J. Satterly, M. A. Brimer, "Cognitive Styles and School Learning", in The British Journal of Educational Psychology, Vol. 41, No. 3, 1971, p. 294-303.

3 D. B. Lumsden, "Individualizing Instruction Through the Use of Programmed Instruction", in Educational Forum, Vol. 38, No. 2, 1974, p. 145-152.

4 C. F. Hoban, "Man, Ritual, The Establishment and Instructional Technology", in Educational Technology, Vol. 8, No. 20, 1968, p. 5-11.

5 L. J. Cronbach and R. E. Snow, Aptitudes and Instructional Methods, New York, Irvington Publishers, 1977, p. 6.

be examined. Two reasons motivated the selection. 1) The enormous amount of research generated by this teaching strategy, along with its inclusion into the individualized instruction movement, represents a good example of a teaching method that claims to erase variability in achievement. 2) The close relationship of the strategy to specific behavioural learning principles permits greater theoretical possibilities of analysis and renders the strategy somewhat more susceptible to empirical investigation.

Although this study draws its information from many sources, including philosophical epistemology, a single theoretical perspective is employed throughout. The framework chosen for this study is the Multi-Factor Theory of Individuality,⁶ and especially, the section dealing with psycho-epistemic styles. This psycho-theoretic model was developed by J. R. Royce of the Center for Advanced Study in Theoretical Psychology of the University of Alberta.

It should be noted, however, that Royce's model is the instrument rather than the object of the present study. The intention is to use the psycho-epistemic styles model not to test it. Nevertheless, in utilizing the model, information regarding its veracity and its holistic power as

6 J. R. Royce, "The Conceptual Framework of a Multi-Factor Theory of Individuality", in J. R. Royce (ed.), Multi-variate Analysis and Psychological Theory, New York, Academic Press, 1973, p. 305-407.

an instrument for the analysis of educational concerns may be obtained as a secondary benefit. ↙

The purpose of the present study is to examine theoretically the possible relationship between Royce's psycho-epistemic styles and variability in achievement in programmed instruction. Some empirical evidence will be offered to support the postulated theoretical relationships. More specifically, the problem posed examines achievement in programmed instruction as measured by post-test scores to ascertain whether subjects labelled as the low metaphoric group achieve significantly higher scores on a programmed instruction post-test than do subjects known as the high metaphoric group.

The study is organized into five chapters. Chapter I presents the polemics that lead to the problem. The first section of the chapter describes the problem of variability in achievement in education. The second section examines in detail programmed instruction as one particular teaching strategy that claimed to eliminate variability in achievement. Chapter II presents possible reasons put forth by some authors to explain variability in achievement. Royce's Multi-Factor Theory of Individuality is justified and explained in the second section of this chapter. The isolation of a problem along with the theoretical rationale is discussed in the first section of Chapter III. The second and third sections

of the chapter respectively reformulate the problem in terms of empirical research and the statement of a hypothesis relevant to that problem is presented. Chapter IV is an exposition of the experimental design. A description of the two instruments and the treatment, the sample and extreme groups, the procedure employed to collect the data and the statistical techniques used in the analysis of the data is provided. The results of the empirical investigation are presented and discussed in Chapter V. The study closes with a summary and the presentation of conclusions.

CHAPTER I

THE PROBLEMATIC SITUATION

This chapter has two objectives. The first is to describe the persistent problem of variability in achievement in education. The second objective of this chapter is to select, describe and review the literature concerning one particular teaching strategy that claims to have largely eliminated variability in achievement.

The chapter is divided into two sections corresponding to the two objectives.

1. General Concern.

Individual differences in education have always concerned teachers, administrators and researchers alike. The history of public education in North America is well documented with accounts outlining results of such heterogeneity of student variability in achievement.

During the last twenty years, described as a transitory phase between the mass education of individuals to the individual education of the masses, the study of individual differences in learning has become the focus of psychological and educational concern. In a society such as ours, very few individuals have denounced the legitimacy of accentuating individuality in favour of conformity. Yet, schools have by

and large resisted efforts in providing students with instruction tailored to their particular individual differences.

a) Variability in Achievement in Education

One of the oldest pieces of evidence we have that demonstrates the existence of individual differences is probably the report card. In the beginning of public education in North America, the effort to give students the same subject matter in the same length of time, showed variance in the quality and quantity of students' assignments and the degree of mastery as attested by report cards and the drop-out rate.¹

It has become palpably absurd to expect to achieve uniform results from uniform assignments made to a class of widely differing individuals. Throughout the educational world there has therefore awakened a desire to find some way of adapting schools to the differing individuals who attend them.²

Various attempts were made to solving the problem of variability in achievement. One of the earliest attempts, and still being utilized today, postulated that those who had ability would succeed and others would drop off along the way. This form of pedagogical organization is characteristic of

¹ In 1909 approximately 90% failed to complete high school. In 1960 about 30% did not graduate. Ref. J. C. Flanagan, "Individualizing Education", in Education, Vol. 90, No. 3, 1970, p. 191-206.

² C. Washburne, "Adapting the Schools to Individual Differences", in Yearbook of the National Society for the Study of Education, Vol. 24, Part II, 1925, p. x.

nearly sixty years of public mass education. Modifications and refinements to this approach included such things as vocational and homemaking curricula for the less gifted, special classes for the handicapped as well as supplementary and enrichment programmes. More recently, this programme-oriented adaptation has included organizational adaptation as typified by modular scheduling, variable grouping, non-gradeness and physical flexibility of schools and furniture. These various approaches had one thing in common; they were aimed at erasing individual differences by selecting more homogeneous groupings for instruction or by varying the rate of instruction in the case of enriched or remedial instruction.

The end of World War II gave rise to the development of a multitude of new teaching methods. This particular approach in the search for a solution to the problem of variability in achievement rested on the hope that some "best" method would erase variability. In terms of educational research, the decades of the fifties and sixties became characterized by the comparative methods experiments to find that "one" best teaching method that would ensure mastery learning for everyone. A review of the literature in this area seems pointless as the Dubin and Taveggia study concluded that:

The results of our intensive reanalysis of data on comparative college teaching methods make it very clear that our intended goal has been achieved. We are able to state decisively that no particular method of college instruction is measurably to be preferred over another, when evaluated by student examination performances. We may also conclude that replication of the 91 studies examined in detail in this survey would not produce conclusions different from ours.³

Since the nineteen sixties a third approach has gained much momentum. Capitalizing on a lack of research payoff in the two previously mentioned approaches, educational researchers began looking at individual differences in the learner. This approach in education became known as Individualized Instruction, and was generally defined as:

The adaptation of the educational environment to individual differences; put another way, the use of information about individual differences to prescribe appropriate educational environments.⁴

The adaptation of the educational environment, to the learner took many different forms. Some were educational programmes that stressed differentiated assignments, others stressed adaptation to individual differences by varying the rate of learning while still others attempted to match methods, media and materials to learning styles. These various

3 R. Dubbin and T. C. Taveggia, The Teaching-Learning Paradox, Eugene, Oregon, Center for the Advanced Study of Educational Administration, 1968, p. 10.

4 J. O. Bolvin and R. Glaser, "Developmental Aspects of Individually Prescribed Instruction", Audiovisual Instruction, Vol. 13, No. 8, 1968, p. 829.

adaptations took such forms as:

1. The Program for Learning in Accordance with Needs (Project Plan)⁵
2. Individually Prescribed Instruction (I.P.I.)⁶
3. The Learning Activity Package (L.A.P.)⁷
4. Personalized System of Instruction (P.S.I.)⁸

Common to these different individualized programmes is the notion of mastery learning; that is by varying the time, most students should reach the pre-established performance criterion.⁹

The common criticism of such approaches is that it reveals a disappointing amount of true individualization.¹⁰

5 J. C. Flanagan, "The Goals of Project Plan", in R. A. Weisgerber, Developmental Efforts in Individualized Learning, Itasca, Illinois, Peacock Publishers, 1971, p. 4-26.

6 C. M. Lindvall and J. O. Bolvin, "Programmed Instruction in the Schools: An Application of Programming Principles in Individually Prescribed Instruction", in P. C. Lange (ed.), Programmed Instruction, Sixty-sixth Yearbook of the National Society for the Study of Education, Part II, 1967, p. 217-254.

7 J. McNeil and J. E. Smith, "The Learning Activity Package Approach at Nova", in Educational Screen and Audio-visual Guide, Jan. 1968, p. 16-19.

8 J. G. Sherman, Personalized System of Instruction: A Selection of Readings on the Keller Plan, Menlo Park, Calif., W. A. Benjamin, 1974, p. xiv-225.

9 Usually 80/80. That is eighty per cent of students should achieve a minimum of 80% on an achievement test.

10 F. T. Wilhems, "The Curriculum and Individual Differences", in the Sixty-First Yearbook of the National Society for the Study of Education, 1962, Part II, p. 65-66.

The tendency to ignore traits and to individualize with respect to a little more than rate of progress were the consequences of individualized instruction relying too heavily on a behavioural technology that ignored such individual differences. It is in this sense that it has failed to come to grips with the fundamental differences amongst students and has cast some doubt as to the success of the mastery learning concept.¹¹ As Glaser wrote in 1967:

Proof will have to be forthcoming that the selection and designing of instructional methods does indeed interact with individual differences so that student achievement is significantly greater than if an average-best method were employed.¹²

In an attempt to find such proof, Cronbach and Snow's¹³ study outlining the results of a reanalysis of a significant period of exploration of individual differences and instructional methods is of considerable importance. The statement by Allen that "little evidence exists to substantiate any relationship between students possessing certain characteristics and particular instruction strategies"¹⁴

11 A. R. Buss and W. Poley, Individual Differences: Traits and Factors, New York, Gardner Press, 1976, p. 194-196.

12 R. Glaser, The New Pedagogy, Learning Research and Development Center, University of Pittsburgh, 1967, p. 4.

13 L. J. Cronbach and R. S. Snow, Aptitudes and Instructional Methods, New York, Irvington, 1977, xviii-574 p.

14 W. H. Allen, "What Do 60 Years of Media Research Tell Us", Audiovisual Instruction, Vol. 18, 1973, p. 49.

is reaffirmed by the Cronbach and Snow study.¹⁵ The results of reanalysis of some six hundred studies involving aptitude-treatment-interaction (ATI) indicate that very few true ATI's have been found and that the authors' continuing hope for such relationships rest with methodological improvements and new strategies for future investigations.

It would then seem justifiable at this point to suggest that variability in achievement still appears to be the rule rather than the exception in spite of massive theoretical and experimental research on the problem. The question that can be asked is what possible explanations could account for such failure to reduce variability in achievement in education? Assuming that the statistical tools of the researcher are sophisticated enough to detect traits and demonstrate differential response according to treatment; and assuming that the multitude of instructional methods along with their mediated modes of presentation are sufficiently numerous to match varying individual learning styles; why have researchers not been very successful in reducing variability in achievement?

For some authors, the fact remains, that although we have literally identified hundreds of traits, some undiscovered traits combined with existing ones in a comprehensive

15 L. J. Cronbach and R. E. Snow, Op. Cit., p. 6.

theoretical framework is probably responsible for the lack of success in reducing variability in achievement. Cronbach and Snow would seem to agree that "new kinds of aptitudes probably need to be detected and measured".¹⁶ This area of investigation is also suggested rather strongly by Lewis when he wrote:

What is wanted, I suspect, is a moratorium on all ATI research until someone has done some hard and effective thinking on the kinds of individual differences that matter the most.¹⁷

One of the stark realities of ATI research and confirmed by Cronbach and Snow¹⁸ is the acknowledgement of recurrent inconsistencies in results and the difficulty of replication in those studies that do show some disordinal interaction. The molecular approach has to some extent prevented the possibility of offering some form of generalization within a theoretical framework on the one hand, and on the other, has shown the necessity for having a holistic theoretical framework that could incorporate existing traits and indicate avenues for the discovery of new ones.

16 Idem, ibid., p. 6.

17 B. N. Lewis, "Commentary: Avoidance of Aptitude-Treatment Trivialities", in S. Messick and Associates, Individuality in Learning, Washington, Jossey-Bass, 1976, p. 303.

18 L. J. Cronbach and R. E. Snow, Op. Cit., p. 6.

The following section will attempt to examine more closely the problem of variability in achievement. For this purpose, one particular instructional method will be selected, described and reviewed.

2. Specific Concern.

This section is divided into two sub-sections. The first justifies the selection, examines the characteristics, and describes the achievement claims of programmed instruction. The second sub-section will selectively review the literature on achievement in programmed instruction.

a) Programmed instruction: Characteristics and Claimed Achievement Outcomes

The selection of programmed instruction as the instructional method to be examined in this study is based on several reasons. Theoretically, the strategy is one of the few to have been studied both conceptually and empirically in detail. Developed in the laboratory and resting on explicit behavioural learning principles, programmed instruction is one of the most investigated and controversial instructional methods of the last twenty years. More recently, the method has been incorporated into a more comprehensive instructional design known as individualized or personalized instruction. Programmed instruction along with its successor, individualized instruction, have as their main goal the elimination of

variability in achievement.

Empirically, the instructional method lends itself readily to closer examination because of the advantages inherent in a teaching strategy that is nomothetic rather than ideographic in substance and form. More specifically, it has some technical advantages. Compared with more conventional teaching methods, there is more consistency of treatment among learners, and less possibility of confounding variables.

Finally, an important criterion for the selection of programmed instruction as the instructional method to be theoretically examined in this study rests on the claimed equivalent achievement outcomes for all learners. Proponents of the strategy have claimed that programmed instruction would wipe out variability in achievement.

In terms of characteristics, programmed instruction differs greatly from the more conventional methods of instruction. In contrast to others, it is an individualized instructional process whereby the learner accepts the responsibility for his own learning and at his own chosen rate. This programme requires an observable response from the learner and in turn, he is provided with an immediate reinforcement for his effort. The programme also ensures for the learner successful mastery of each increment in learning before proceeding to the next.

More specifically, programmed instruction could be described as having six basic characteristics.^{19,20,21}

1. behavioural objectives
2. logical sequence of small frames
3. active responding
4. immediate feedback of response
4. individual pacing
6. constant self-evaluation

Although agreement is general on the characteristics and their underlying psychological principles, there does not appear to be unanimity on how they should be applied in actual programming. This lack of agreement in terms of programming techniques has produced several models of programmed instruction that can be divided into two main types: the constructed-response type of programme developed by B. F. Skinner and the multiple-choice type of programme developed by N. Crowder.

Skinner²² affirmed that reinforcement was the primary basis of programmed instruction. His technique was designed to present the subject matter in very small steps called frames and to guide the learner under the control of various

19 E. B. Fry, Teaching Machines and Programmed Instruction, New York, McGraw-Hill, 1963, p. 2-3.

20 W. Schramm, Programmed Instruction Today and Tomorrow, Washington, The Fund for Advancement of Education, 1962, p. 1.

21 J. P. Lysaught and C. M. Williams, A Guide to Programmed Instruction, New York, Wiley, 1963, p. 16-20.

22 B. F. Skinner, "Science of Learning and the Art of Teaching", in Harvard Educational Review, Vol. 24, 1954, p. 86-87.

stimuli conditions. The learner utilizing this technique is presented with a bit of information of which he must respond overtly usually by filling in a blank (constructed response). The correctness of the response is immediately confirmed for the learner before he proceeds to the next increment of information. This unbroken, structured, sequence of information, question and answer, is what is also referred to by many as a linear programme.

The multiple-choice type programme although used less frequently is somewhat similar to the constructed-response type. The response mode is what generally distinguishes the two types of programmes. After having selected from a multiple-choice question what he considers to be a correct response, the learner is directed to a source of information to find the correct response. This type of programmed procedure is also referred to as "branching".²³ Crowder is primarily responsible for the development of this type of programme.²⁴ It is to be noted however that the learning principles behind both types of programmes are similar. They both demand an active state of the learner and both

23 D. Rowntree, Basically Branching: A Handbook for Programmers, London, Macdonald, 1966, p. 5-35.

24 W. S. Can, "A Review of the Literature on Certain Aspects of Automated Instruction", in W. I. Smith and W. Moore (eds.), Programmed Learning: Theory and Research, New Jersey, D. van Nostrand, 1962, p. 58-61 and 68-70.

provide reinforcement for correct responses. Branching is usually employed when comprehension of information is desired and the linear type or constructed-response type when recall is the desired objective.

To recapitulate, programmed instruction was defined as a means of presenting instructional material in a pre-determined logical sequence so that the learner received immediate confirmation of his learning as he proceeded frame by frame in a programme. The end product could be a programmed text, a programmed lecture, an audiovisual presentation or computer-assisted instruction.

There are also more functional characteristics common to both types of programmed instruction. Glaser²⁵ listed the following three: 1) they are reproducible and definitive; 2) they are quantitatively tested and their effectiveness made a matter of record; 3) they are built on the basis of what we currently know about behavioural learning principles.

Mostly because of these three functional characteristics, proponents of programmed instruction claimed this teaching strategy superior to the more conventional instructional methods. Experimental accessibility, innovative

²⁵ R. Glaser et al., "An Evaluation of Textbooks in Terms of Learning Principles", in A.A. Lumsdaine and R. Glaser, (eds.), Teaching Machines and Programmed Learning, Washington, D.C., National Education Association, 1960, p. 437-445.

technology, and society's fears of mass education in the early sixties encouraged achievement claims that ranged from euphoria to cynicism.

Since the appearance of Skinner's article²⁶ in 1954, programmed instruction has won wide acclaim. Thomas²⁷ in 1963, suggested that no single development in education held as much promise as programmed instruction. Scriven²⁸ seconded Thomas and further suggested that the use of programmed instruction provided the teacher with a tremendous opportunity of increasing his teaching effectiveness. On this latter point, he added that the individual teacher would improve his own teaching by gaining a greater insight into the learning processes of different students at different levels.

Programmed instruction was also acclaimed as the "most important technological advance [...] since the intelligence test".²⁹ It seems reasonable then from the previous statement, to accept the fact that early proponents claimed

26 B. F. Skinner, "The Science of Learning and the Art of Teaching", in Harvard Educational Review, Vol. 24, 1954, p. 86-87.

27 C. A. Thomas et al., Programmed Learning in Perspective; A Guide to Program Writing, Chicago, Educational Methods, 1963, p. 11.

28 M. Scriven, "The Case for and Use of Programmed Texts", in A. Calvin, Programmed Instruction: Bold New Venture, Bloomington, Indiana, Indiana University Press, 1969, p. 16-20.

29 L. E. Homme, "The Rationale of Teaching by Skinner's Machines", in R. Glaser and A. A. Lumsdaine (eds.), Op. Cit., p. 133.

that it could teach almost anything specified in behavioural terms, to almost everyone to a degree of achievement unmatched by other more conventional methods. This enthusiasm led programmed instruction advocates to develop what was known in some circles as a pre-established performance criterion. Essentially, this criterion, also called the 90/90 criterion, meant that ninety per cent of a target population would attain, after having completed instruction, a minimum of ninety per cent achievement as measured on a post-test.^{30,31,32,33,34}

In terms of variables involved in a programmed learning situation, proponents claimed that the systematic and exhaustive classification of these variables helped produce achievement results in programmed instruction superior to the more conventional, teaching strategies. One particular

30 H. Kay, B. Dodd, M. Sime, Teaching Machines and Programmed Instruction, Baltimore, Penguin Books, 1968, p. 103.

31 J. Hartley, "Evaluation", in Strategies for Programmed Instruction: An Educational Technology, London, Butterworths, 1972, p. 142 and 155.

32 J. Pocztar, The Theory and Practice of Programmed Instruction, Paris, UNESCO, 1972, p. 134.

33 P. A. Friesen, Designing Instruction, Ottawa, F.K.A. Publications, 1971, p. 147.

34 G. P. Gavini, Manuel de formation aux techniques de l'enseignement programmé, Paris, Editions Hommes et Techniques, 1965, p. 241.

proponent developed a non-hierarchical classification that included over two hundred variables.³⁵

With such potential possibilities put forth by proponents of programmed instruction, educational and psychological researchers turned their attention to examining these claims made for programmed instruction.

The next section will selectively sample the literature on achievement in programmed instruction.

b) Variability in Achievement in Programmed Instruction

The amount of generated and relevant literature in the area of programmed instruction is voluminous. Considering the literally thousands of articles, research monographs, books, and theses written on the subject since the appearance of B. F. Skinner's famous article in 1954, it is not the aim of this section to scrutinize in detail such documentation. As in most areas in the field of human sciences, cautiousness and judiciousness must be displayed in the selection of relevant material. In any one area, the quantity is usually great, the quality sometimes irregular and the results generally inconclusive.³⁶

³⁵ E. B. Fry, Teaching Machines and Programmed Instruction: An Introduction, New York, McGraw-Hill, 1963, p. 199-206.

³⁶ S. Strasser, Phenomenology and the Human Sciences, Pittsburgh, Duquesne University Press, 1963, p. 205.

For the purposes of this study, an overview of the relevant research literature relating achievement claims to programmed instruction will be more illustrative than exhaustive.

This section of the chapter will be divided into three sub-sections: 1) the contradictory findings in achievement in programmed instruction in those studies comparing programmed instruction to "conventional" methods; 2) the contradictory findings in achievement in those studies regarding the programme variables, and 3) the contradictory findings in achievement in those studies regarding programming and individual differences.

i) Achievement in Programmed Instruction in Comparative Studies

The decade of the fifties was characterized by the comparative study of programmed instruction with other "conventional methods". This movement lasted nearly a decade and it was only in the early part of the nineteen sixties that serious reservations were made about this type of comparative research. Stolurow expressed concern in 1962 about this "blind repetition, if not stubborn persistence"³⁷ in the use of the comparative method which seemed inappropriate when so

³⁷ L. M. Stolurow, "Implications of Current Research and Future Trends", in Journal of Educational Research, Vol. 55, No. 9, 1962, p. 520.

little was known about a complex phenomenon. His criticism is quoted at length:

With the comparative study, each of the specific conditions being compared is not the condition, but rather a sample of just one condition from a population of essentially infinite variations. Consequently what is needed in the beginning is the parametric study rather than the comparative study. We need to know what we are comparing in order to make a meaningful comparison, and we don't know what we are comparing unless we know what the population is like.³⁸

Smith and Moore summed up the situation in another way:

Predictably, the first studies of programmed instruction tended to be evaluative; i.e., the purpose of the studies was to compare programmed materials and conventional instruction on their efficiency as teaching devices. Quite predictably, for the majority of such studies, "no significant difference" was the conclusion. Once it had been determined that programmed materials could teach, attention was directed toward research which could isolate some of the parameters of learning of this type.³⁹

Keeping in mind the Dubkin and Taveggia quotation reported earlier in this chapter (p. 4) that indicated no clear superiority of one college teaching method over another, the following investigations reported must be carefully imbedded in cautious conclusions. Nevertheless, it is the scores obtained on post-tests in programmed instruction in

³⁸ Idem, ibid., p. 520.

³⁹ W. I. Smith and J. W. Moore, "Editors Note", in Programmed Learning; Theory and Research; An Enduring Problem in Psychology, Princeton, Van Nostrand, 1962, p. 109.

this sub-section that is relevant to this study and not the comparative design aspect.

For the proponents of programmed instruction, a broad range of scores on a post-test would indicate a serious blow to one of its principal claims. More specifically, programmed instruction had claimed, as mentioned previously, that it could bring a specific population to terminal behaviour more successfully than any known teaching strategy. This claim, referred to as the pre-established performance criterion, meant that ninety per cent of a target population would attain after instruction, a minimum of ninety per cent achievement as measured on a post-test. The following studies will confirm that the 90/90 criterion has seldom been achieved, if at all, and that programmed instruction produced as Silberman claimed as much variability in achievement as with other conventional methods.⁴⁰

Gotkin in his study⁴¹ affirmed that little evidence existed of the greater promise of assuring mastery at every stage in the programme. He concluded that upon completion of

40 H. F. Silberman, "Self-Teaching Devices and Programmed Materials", in Review of Educational Research, Vol. 32, No. 2, 1962, p. 185.

41 L. G. Gotkin, "Programmed Instruction in the Schools: Individual Differences, The Teacher and Programming Styles", in A. de Grazia and D. A. Sohn, Programs, Teachers, and Machines, New York, Bantam Books, 1962, p. 166.

most programmed texts, the range of achievement would not be narrowed as radically as suggested by the pre-established performance criterion. In another study using the English 2600, An Automated Instruction Text, Reed and Hynnan⁴² found no significant differences between gains made by the teacher-taught groups and the groups using the programmed texts. The highest ability level groups learned the most and the lowest ability level group learned the least regardless of the teaching strategy.

The studies of Smith,⁴³ and Feldhusen and Birt⁴⁴ comparing programmed instruction to other conventional methods indicated no significant differences in achievement. In an extensive review of 110 studies comparing teachers and programmed instruction, Hartley⁴⁵ concluded that programmed instruction achieves no better results than conventional

42 J. E. Reed and J. L. Hynnan, "An Experiment Involving the Use of English 2600, An Automated Instruction Text", in Journal of Educational Research, Vol. 55, No. 9, 1962, p. 476-484.

43 N. H. Smith, "The Teaching of Elementary Statistics by the Conventional Classroom Method Versus the Method of Programmed Instruction", in Journal of Educational Research, Vol. 55, No. 9, 1962, p. 417-420.

44 J. F. Feldhusen and A. Birt, "A Study of Nine Methods of Presentation of Programmed Learning Material", in Journal of Educational Research, Vol. 55, No. 9, 1962, p. 461-471.

45 J. Hartley, "Evaluation", in Strategies for Programmed Instruction; An Educational Technology, London, Butterworths, 1972, p. 165-166.

methods. Of the 110 studies, he found 54 that produced no significant differences in achievement and 15 studies that produced significantly worse results in achievement than "conventional methods". The revolutionary promise that each student proceeding at his own rate would reach successfully terminal behaviour as long as he completed the programme⁴⁶ was not fulfilled. The range of performance on achievement tests did not narrow radically. As Gotkin wrote in conclusion to his study "Results like these seem to be the rule rather than the exception".⁴⁷

Although, as stated earlier, many authors after a decade of comparing programmed instruction with conventional methods, decried the weakness of such comparative designs, the fact remained that in so far as achievement was concerned in programmed instruction, the results were disappointing.

In an attempt to determine what caused such variability in achievement in programmed instruction, researchers in the area turned their attention to such programme variables as ordered sequence, size of steps, active response, immediate confirmation of results, and rate of learning. The

46 B. F. Skinner, "Teaching Machines", in A. A. Lumsdaine and P. Glaser (eds.), Teaching Machines and Programmed Learning, Dept. of A. V. Instruction, N.E.A., Vol. 1, 1960, p. 137-158.

47 L. G. Gotkin, "Programmed Instruction in the Schools: Individual Differences, the Teacher, and Programming Styles", in A. de Grazia and D. A. Sohn, Op. Cit., p. 167.

following sub-section describes the review of the literature in that area.

ii) Achievement in Programmed Instruction in Studies
Concerned with Programme Variables

This sub-section will show that experimental investigation of the programme variables mentioned above did not conclusively help narrow the range of achievement scores on programmed instruction. Instead, the review of the literature will indicate the contradictory nature of findings resulting from those investigations. Thus, it will be suggested that variability in achievement still persists and that this research in this area did not offer conclusive evidence in the explanation of such variability in outcomes.

Zucherman, Marshall, and Crowsberg in a study quoted by Silberman⁴⁸ investigated ordered sequence in a sixty-item programme in electricity. They found no significant difference between the learning of those who followed the ordered sequence and those who studied the random sequence. Roe and others⁴⁹ found no significant difference between the achievement of those students who used an ordered sequence programme, comprising seventy-one frames in elementary probability. On

48 H. F. Silberman, Op. Cit., p. 185.

49 K. V. Roe et al., "Scrambled vs Ordered Sequence in Auto-Instructional Programs", in Journal of Educational Research, Vol. 53, No. 2, 1962, p. 101-104.

the other hand, Roe⁵⁰ found that an ordered sequenced programme, introducing certain probability concepts, resulted in more learning than did the random presentation of the same programme. This programme consisted of one hundred and seven frames. Commenting on these results, Schramm⁵¹ indicated that it was reasonable to suppose that the longer programme would have greater need of ordered sequence.

With respect to step size, the investigations of Evans, Glaser and Homme⁵² on the topics of number theory and fundamentals of music, revealed that better performance, better retention, and fewer response errors resulted from small step than from large step programmes. The findings of Coulson and Silberman⁵³ who experimented with a linear programme in behaviour analysis, corroborated those of Evans, Glaser and Homme. Coulson and Silberman found that small steps yielded higher test scores than did the larger steps.

50 Arnold Roe, "A Comparison of Branching Methods for Programmed Learning", in Journal of Educational Research, Vol. 55, No. 9, 1962, p. 407-416.

51 Wilbur Schramm, Programmed Instruction, Today, and Tomorrow, New York, Fund for the Advancement of Education, 1962, p. 6.

52 J. L. Evans, Robert Glaser, and Lloyd E. Homme, "A Preliminary Investigation in the Properties of Verbal Learning Sequence of the 'Teaching Machine' Type", in A. A. Lumsdaine and R. Glaser (eds.), Op. Cit., p. 446-451.

53 J. E. Coulson and H. F. Silberman, "Results of an Initial Experiment in Automated Teaching", in idem, ibid., p. 452-462.

In contradistinction to the two studies just quoted, Smith and Moore⁵⁴ found the large step programme as effective as the small step programme in teaching spelling to fifth grade students. In addition, the large step programme sustained more interest and proved less boring. Bruner⁵⁵ has urged huge leaps, alternating on occasion with small steps. Pressey⁵⁶ objected to the fractionalization of learning into small steps, preferring the larger, learner-determined, flexible size of steps.

Regarding constructed versus multiple-choice responses, Coulson and Silberman⁵⁷ reported no significant difference between the two types of responses. In their experiment with eight groups of junior college students who received instruction in teaching-machine operation, they noted that the multiple-choice type took less time. Fry,⁵⁸ using the criterion of recall, found the constructed response yielded better results than the multiple-choice items on a grade nine

54 Wendell I. Smith and J. William Moore, "Size of Step and Cueing", in idem, ibid., p. 202-206.

55 Jerome S. Bruner, "Needed: A Theory of Instruction", in Educational Leadership, Vol. 20, 1963, p. 523-532.

56 Sydney L. Pressey, "Re-Program Programming?", in Psychology in the Schools, Vol. 4, 1967, p. 234-239.

57 J. E. Coulson and H. F. Silberman, Op. Cit., p. 452-468.

58 Edward F. Fry, "Teaching Machines: An Investigation of Constructed Versus Multiple-Choice Methods of Response", in A. A. Lumsdaine and R. Glaser (eds.), Op. Cit., p. 163-165.

Spanish vocabulary list. On the other hand, Hough⁵⁹ found no significant difference between constructed and multiple-choice response modes when the criterion was the amount of learning on a linear programme at the secondary school level. The group tested was forty-one junior students in education. Summarizing the findings in the area of response types, Schramm⁶⁰ stated that there was no clear superiority of either the constructed or multiple-choice type.

With respect to the effectiveness of immediate confirmation of results, there are puzzling findings. Pressey,⁶¹ one of the earliest supporters of machine teaching, attributed the superiority of the teaching machine over the "usual" teaching procedures to the fact that the teaching machine gave the learners immediate knowledge of results. Deese⁶² reported a study by Saltzman who found that delay between response and its confirmation greatly improved learning of a rote verbal task. According to that study, a short delay

59 John B. Hough, "An Analysis of the Efficiency and Effectiveness of Selected Aspects of Machine Instruction", in the Journal of Educational Research, Vol. 55, No. 9, 1962, p. 557-571.

60 Wilbur Schramm, Op. Cit., p. 10.

61 S. L. Pressey, "Development and Appraisal of Devices Providing Immediate Automatic Scoring of Objective Tests and Concomitant Self-Instruction", in A. A. Lumsdaine and R. Glaser (eds.), Op. Cit., p. 69-88.

62 James Deese, The Psychology of Learning, New York, McGraw-Hill, 1958, p. 199.

of six seconds yielded a fifty per cent error rate. Meyer's⁶³ findings substantiated those of Saltzman. Meyer found significantly more learning by those students who received confirmation of results in an English vocabulary programme at the grade eight level, than by those who waited until the next class to ascertain their results. Moore and Smith,⁶⁴ however, found that the confirmation of knowledge made no difference in the amount of learning of spelling at the fifth grade level.

Finally, self-pacing, a feature of programmed instruction, did not necessarily improve learning as the following studies demonstrated. Gropper and Kress⁶⁵ presented data that suggested self-pacing could be non-adaptive to the needs of the learner. According to the authors, some students needed to be speeded up and some needed to be slowed down to improve the effectiveness and efficiency of learning. If the pace of presentation was increased for the total group, the error rate increased (linear programme) and the achievement gap between the low IQ student and the high IQ

63 Susan R. Meyer, "Report of the Initial Test of a Junior High School Program", in A. A. Lumsdaine and R. Glaser (eds.), Op. Cit., p. 229-246.

64 J. William Moore and Wendell I. Smith, "Knowledge of Results in Self-Teaching Spelling", in idem, ibid., p. 150-162.

65 George Gropper and Gerald C. Kress Jr., "Individualizing Instruction Through Pacing Procedures", in A. V. Communication Review, Vol. 13, No. 2, 1965, p. 165-182.

student increased. On the other hand, Suppes⁶⁶ reported that in computer-assisted instruction individual differences in rate were even larger than previously thought. In his study using Russian-English word pairs as drill material paced in rate by the computer, college and junior high school students did better practicing a list of 108 items than a list of six when time for mastery of the total list was the criterion.

It would appear, then, that the review of the literature of the above variables, namely, ordered sequence, size of step, active response, immediate confirmation of results, and rate of learning, has produced disappointing results for those researchers searching for some possible answers to the broad range of performance on achievement tests in programmed instruction. As Schramm⁶⁷ predicted, research in the area of programmed instruction began merging with the mainstream of educational research when it became evident that such analytical studies of the programme variables produced such inconsistent and contradictory results. Studies such as those described previously gave way to studies relating personality,

66 Patrick Suppes, "Modern Learning Theory and the Elementary School Curriculum", in American Educational Research Journal, Vol. 1, No. 2, 1964, p. 79-93.

67 Wilbur Schramm, The Records on Programmed Instruction: An Annotated Bibliography, U.S. Dept. of Health, Education and Welfare, Washington, 1964, p. 4.

intellectual, and cultural variables in the learner to achievement using programmed instruction. The following subsection will outline the results of a review of the literature in the area of learner characteristics and programmed instruction.

iii) Achievement in Programmed Instruction in Studies
Concerned with Learning Characteristics

In 1962, Silberman⁶⁸ reviewed the literature on programmed instruction and individual differences and commented that it had not been very much adapted to individual learners. The research that has been done since has attempted to remediate this weakness although the studies reviewed in this sub-section will show much controversy and contradictory findings when related to achievement outcomes.

From the beginning, the area of study in individual differences demonstrates a total lack of structure. A cohesive, unified framework underlying the topic does not appear to exist. The theoretical shifts are well illustrated by the change in the titles of two reviews of the psychological literature in the field. In the 1960 edition of the Annual Review of Psychology, the topic of individual differences was entitled "Individual Differences".⁶⁹ Five years later, the

68 H. F. Silberman, Op. Cit., p. 179-193.

69 Philip A. Dubois, "Individual Differences", in Annual Review of Psychology, Vol. 11, 1960, p. 225-253.

title used to describe the same subject was "Human Abilities".⁷⁰

One explanation for the diversity and the contradictory findings surrounding individual differences lies in the imperfection of the main source which has supplied most information about it. That source of difficulty is the delineation of individual differences centered on the identification and isolation of the most significant traits or abilities for study. What happens in practice as Powell put it is:

that a researcher selects for study those variables which are related to his area of expertise. Thus, the neurologist seeks specific brain lesions as the cause of differential performance; the medical practitioner - physical and metabolic explanations; the vision specialist - ocular defects and dominance; the psychiatrist - personality aberrations.⁷¹

As previously mentioned, the literature concerned with individual differences is highly fragmented, especially in the area of individual differences and programmed instruction. The following studies will attempt to clearly demonstrate the contradictions in the conclusions and the continued persistence of variability in achievement in programmed instruction. In an extensive review of the literature

⁷⁰ George A. Ferguson, "Human Abilities", in Annual Review of Psychology, Vol. 16, 1965, p. 39-62.

⁷¹ William R. Powell, "The Nature of Individual Differences", in Robert A. Weisgerber, Perspectives in Individualized Learning, Itasca, Illinois, Peacock Publishers, 1971, p. 104.

concerning individual differences and programmed instruction Fry stated that: "Programmed instruction has shown little improvement over other methods of adapting training to other interests, aptitudes, motivations and background characteristics of the learner."⁷²

One of the reasons for Fry's comment may be the lack of conclusive research findings relating achievement in programmed instruction to student characteristics. Those studies which did touch upon individual differences indicated significant differences only between high and low ability students although there were studies which denied this difference. More specifically, Campbell et al.⁷³ conducted a study in which it was found that there was a high correlation between ability and achievement. Shay⁷⁴ in his study of the relationship between size of step and intelligence found that intelligence was positively related to the post-test scores at the .001 level of significance. In another study comparing linear and branching techniques in programmed

72 Edward B. Fry, Op. Cit., p. 26.

73 V. N. Campbell, L. W. Givens and D. F. Terry, "Effects of Mathematical Ability, Pretraining, and Interest on Self-Direction in Programmed Instruction", American Institutes for Research Technical Report: AIR-DIO-10/63-TR, October 1963 as quoted in James D. Hand, Matching Programmed Instruction Packages and Instructional Setting to Students, in Terms of Cognitive Style: An Exploratory Study, Michigan State University, Ph.D. Thesis, 1972, p. 42.

74 D. B. Shay, "Relationship of Intelligence to Size of Step on a Teaching Machine Program", in Journal of Educational Psychology, Vol. 52, No. 2, 1962, p. 98-103.

instruction, Beane⁷⁵ concluded that in each treatment the high ability students exceeded the low ability students in achievement, retention and efficiency. A similar study, conducted by Hampton⁷⁶ yielded results which also indicated that there was a direct relationship between learning and ability level.

In contradistinction to these studies there were investigations the results of which did indicate no significant difference. Porter⁷⁷ in a year long study in 1959 revealed that in the teaching of spelling there was no significant relationship between intelligence scores and the achievement of the group taught with machines. The findings of Detambel and Stolurow,⁷⁸ and later extended by Stolurow⁷⁹

75 Donald G. Beane, "A Comparison of Linear and Branching Techniques of Programmed Instruction in Plane Geometry", in Journal of Educational Research, Vol. 58, No. 7, 1965, p. 319-326.

76 J. D. Hampton, "Evaluating Programmed Instruction Techniques", in California Journal of Education, Vol. 18, No. 1, 1967, p. 49-60.

77 D. Porter, "Some Effects of Year Long Teaching Machine Instruction", in Edward B. Fry, Op. Cit., p. 83.

78 M. H. Detambel and L. M. Stolurow, "Stimulus Sequence and Concept Learning", in Journal of Experimental Psychology, Vol. 51, 1956, p. 34-40.

79 M. Stolurow, "Social Impact of Programmed Instruction: Aptitudes and Abilities Revisited", paper presented at the American Psychological Association Annual Convention, Symposium on Programmed Instruction: St. Louis, Missouri, 1962 as quoted in Charles Suchett-Kaye, "Personality Factors and Self-Instruction; A Survey", Programmed Learning and Educational Technology, Vol. 9, No. 4, July 1972, p. 207.

in 1962 found that mental age did not correlate significantly with any of the scores based on self-instructional material. Traweek,⁸⁰ Jamieson et al.,⁸¹ Dick and Latta,⁸² and Jenson⁸³ also concluded in their studies that IQ did not serve as an adequate predictor of learning ability. However a study by Tuel⁸⁴ places the problem of intelligence and achievement in proper perspective. Within the restricted range (IQ 96-115) he found that the correlation between intelligence and achievement to be zero. But when he took in consideration the full range (IQ 70-140) a highly significant correlation emerged. The point worth making here is that as Cronbach⁸⁵

80 M. W. Traweek, "The Relationship Between Certain Personality Variables and Achievement Through Programmed Instruction", in California Journal of Educational Research, Vol. 15, No. 5, 1964, p. 215-220.

81 G. H. Jamieson, P. E. James and G. W. H. Leytham, "Comparisons Between Teaching Methods at the Post-Graduate Level", in Programmed Learning and Educational Technology, Vol. 6, No. 4, 1969, p. 243-249.

82 W. Dick, R. Latta, "Comparative Effects of Ability and Presentation Mode in Computer-Assisted Instruction and Programmed Instruction", in A. V. Communication Review, Vol. 18, No. 1, 1970, p. 33-45.

83 A. Jenson, "Learning Ability in Retarded, Average and Gifted Children", in Merrill Palmer Quarterly Review of Behaviour and Development, Vol. 9, No. 2, 1963, p. 124-140.

84 J. K. Tuel, "Overt Versus Covert Responding in Programmed Instruction", as quoted in Charles Suchett-Kaye, Op. Cit., p. 208.

85 Lee J. Cronbach, "How Can Instruction Be Adapted to Individual Differences?", in Robert M. Gagné (ed.), Learning and Individual Differences, Columbus, Ohio, Charles Merrill, 1967, p. 30.

suggested, general ability is likely to be a poor criterion for differentiating instruction because it correlated with success in most types of instruction.

There were some investigations the results of which do indicate somewhat weak but positive correlation effects between individual differences and achievement in programmed instruction. Flynn⁸⁶ in a study of freshmen in a college educational psychology course, found that programmed instruction yielded greater gains in learning for high achievers, but did not result in greater retention than the lecture-discussion method. Knight and Sassenrath⁸⁷ reported that high-achievement motivated students performed significantly better on three criteria⁸⁸ than did students with low-achievement motivation. Woodroff, Faltz and Wagner⁸⁹ also found a positive correlation between achievement motivation

86 J. T. Flynn, "The Influence of Programmed Instruction Upon Learning in Educational Psychology", in The Journal of Educational Research, Vol. 59, No. 9, 1966, p. 387-391.

87 Howard R. Knight and Julius M. Sassenrath, "Relation of Achievement Motivation and Test Anxiety of Performance in Programmed Instruction", in Journal of Educational Psychology, Vol. 57, No. 1, 1966, p. 14-17.

88 1) Time to complete the programme; 2) number of errors; 3) short-term retention scores.

89 A. B. Woodruff, C. Faltz and D. Wagner, "Effects of Learner Characteristics on Programmed Learning Performance", in Psychology in the Schools, Vol. 3, No. 1, 1966, p. 72-77.

and scores using a programmed instruction text. Their study correlated subscores on two personality tests with responses on programmed frames.

Some authors have compared achievement in programmed instruction with a cluster of variables. Doty and Doty⁹⁰ in their study examined five such variables with a population of college undergraduates. Looking at cumulative grade point average, creativity, achievement need, social need, and attitude towards programmed instruction, the authors noted low but significant positive correlations between such variables as achievement and G.P.A., attitude towards programmed instruction, and social need and achievement on programmed instruction, and creativity. The authors also found no correlation between achievement in programmed instruction and attitude toward it. In another study, test anxiety, general anxiety, withdrawal tendencies, nervous symptoms and self-reliance were tested by Traweek⁹¹ in relation to the strategy. The results indicated that for successful students, test anxiety was significantly higher. Also these same

90 Barbara A. Doty and Larry A. Doty, "Programmed Instruction Effectiveness in Relation to Certain Student Characteristics", in Journal of Educational Psychology, Vol. 55, No. 6, 1964, p. 334-338.

91 M. W. Traweek, "The Relationship Between Certain Personality Variables and Achievement Through Programmed Instruction", in California Journal of Educational Research, Vol. 15, No. 5, 1964, p. 215-220.

students, showed more withdrawal tendencies than other students tested. Successful learners exhibited less self-reliance. There was no difference between successful and unsuccessful learners with respect to general anxiety, nervous symptoms or IQ. Three other studies which take into account personality variables in relation to achievement in programmed instruction namely those of Ripple et al.⁹², Sutter and Reid,⁹³ and Alter,⁹⁴ indicated no significant differences among the variables studied.

Six years after the Silberman review of the literature on individual differences and achievement in programmed instruction, another review of the literature indicated that the results "were not particularly clear-cut or consistent among similar studies."⁹⁵

The enthusiastic endorsement of Dole who wrote in 1967:

92 R. E. Ripple, J. Millman and M. D. Glock, "Learner Characteristics and Instructional Mode: A Search for Disordinal Interactions", in Journal of Educational Psychology, Vol. 60, No. 2, 1969, p. 113-120.

93 E. G. Sutter and J. B. Reid, "Learner Variables and Interpersonal Conditions in Computer-Assisted Instruction", in Journal of Educational Psychology, Vol. 60, No. 3, p. 153-157.

94 M. Alter, "Retention as a Function of Length of Retention Interval, Intelligence and Training Time", in Journal of Programmed Instruction, Vol. 2, No. 2, 1963, p. 7-17.

95 Leslie J. Briggs, "Learner Variables and Educational Media", in Review of Educational Research, Vol. 38, No. 2, 1968, p. 172.

We conclude in view of historical developments that programmed instruction by reason of its research emphasis, its empirical nature, its efficiencies, its exploitation of new materials, media, and technologies --and especially through its emphasis on the clarification of instructional objectives--will be a major force in educational innovation.⁹⁶

and echoed by Gleason,⁹⁷ Skinner,⁹⁸ Blyth⁹⁹ and Cronbach¹⁰⁰ was not supported. In fact, the preceding review of the literature seemed to indicate clearly that variability in achievement was as common a problem as with the more "conventional" instructional methods. The claim that programmed instruction could successfully guarantee that ninety per cent of students completing a programme would achieve a minimum of ninety per cent on a post-test proved to be the exception rather than the rule.

The earlier studies of a "comparative-type" did demonstrate that achievement outcomes produced as much

96 Edgar Dole, "Historical Setting of Programmed Instruction", in P. C. Lange (ed.), Programmed Instruction, the 66th Yearbook of the National Society for the Study of Education, 1967, p. 54.

97 Gerald Gleason, "Will Programmed Instruction Serve People?", in Educational Leadership, Vol. 23, No. 6, 1966, p. 471.

98 B. F. Skinner, "Reflections on a Decade of Teaching Machines", in Teachers' College Record, Vol. 65, No. 2, 1963, p. 177.

99 J. M. Blyth, "Teaching Machines and Human Beings", in Educational Record, Vol. 41, No. 2, 1960, p. 125.

100 Lee J. Cronbach, Educational Psychology, New York, Harcourt, Brace & World, 1963, (second edition), p. 412.

variability on achievement scores as "conventional" methods. Research efforts then turned to the study of the characteristics of programmed instruction in an attempt to explain and remediate such differential achievement. Although these studies concerned with the programme variables did not in most cases note the range of post-test scores, nevertheless the fact that their conclusions were of such a contradictory nature, it is assumed that the results of those studies did not contribute to narrowing the range of scores on post-tests. In those studies dealing with learner characteristics, the conclusions are similar. In general, researchers are still uncertain as to the kinds of traits that do produce results and in particular they are convinced that the variables used are not the ones needed to solve the problem.¹⁰¹

The contradictory nature of the evidence accumulated in this section leads to the conclusion that variability in achievement still persisted despite serious efforts to reduce it. The important question, albeit an old one that teachers have been asking for a long time, was why such a standardized, iteratively validated,¹⁰² teaching strategy with a claimed 90/90 criterion still produced considerable variability in

101 Leslie R. Briggs, Op. Cit., p. 160.

102 G. L. Geis, "A Comment on Validated Instruction", in Improving Human Performance, Vol. 3, 1973, p. 161.

achievement.

The criticism of programmed instruction in terms of its failure to produce the results as claimed are many and varied. They range from theoretical arguments^{103,104,105,106,107} suggesting the limitative nature of the behavioural learning laws supporting programmed instruction, to more empirical arguments suggesting the difficulty of experimentally studying what now appeared to be a very complex

103 W. D. Hitt, "Two Models of Man", in American Psychologist, Vol. 24, No. 7, 1969, p. 651-658.

104 A. van Kaam, Existential Foundations of Psychology, New York, Image Books, 1966, 396 p.

105 I. Scheffler, Science and Subjectivity, New York, Bobbs-Merrill, 1967, p. 76.

106 Ludwig von Bertalanffy, General System Theory, New York, George Braziller, 1968, p. 105-107.

107 C. R. Rogers, Freedom to Learn, Columbus, Ohio, Charles E. Merrill, 1969, p. 140-141.

problem.^{108,109,110,111,112} Yet, in the literature on programmed instruction very few reasoned arguments are put forth to explain such variability in achievement outcomes. The strategy has been either condemned theoretically, abandoned experimentally or again incorporated in various individualization movements.¹¹³

The empirical and theoretical evidence reported in this chapter permits two possible conclusions. First, variability in achievement in education has been a continuing problem in North American education. The selection of one particular teaching strategy that claimed equivalent achievement

108 L. J. Cronbach, "The Two Disciplines of Scientific Psychology", in American Psychologist, Vol. 12, No. 11, 1967,

109 A. Bondwoodruff, et al., "Effects of Learner Characteristics on Programmed Learning Performance", in Psychology in Schools, Vol. 3, No. 1, 1966, p. 72.

110 R. Dallos, "Programmed Learning and Personality: A Review and a Preliminary Study", in Programmed Learning and Educational Technology, Vol. 12, No. 1, 1975, p. 12.

111 L. J. Cronbach, "How Can Instruction be Adapted to Individual Differences", in R. M. Gagné (ed.), Learning and Individual Differences, Columbus, Ohio, Charles Merrill, 1967, p. 167.

112 N. Wallen and R. M. Travers, "Analysis and Investigation of Teaching Methods", in Handbook of Research on Teaching, edited by N. L. Gage, Chicago, Rand McNally, 1963, p. 464-465.

113 N. H. Moore, "Research Themes in Instruction Theory", in Individualization of Instruction, London, MacMillan, 1970, p. 82-85.

outcomes for all learners was examined closely and found that it also produced variability in achievement. Second, the review of the literature has also provided us with some directionality for searching out possible explanations to variability in achievement.

The following chapter will report the results of a search of the literature in the area of a possible explanation that might account for variability in education and more specifically in programmed instruction.

CHAPTER II

TOWARDS A STATEMENT OF THE PROBLEM AND HYPOTHESIS

The goal of this chapter is to bring into focus the raison d'être of this study. More specifically, the chapter has two objectives. The first is to present evidence that in searching for a possible explanation to the persistent problem of variability in achievement, some authors have suggested that a promising area called epistemology has been overlooked by researchers in the field of instructional development and educational psychology. The second objective of this chapter is to selectively review some epistemological models and present one such model that might offer a possible explanation to the problem of variability in achievement. Royce's Multi-Factor Theory of Individuality with its psycho-epistemic styles was chosen because of its theoretical comprehensiveness and its possibilities for empirical investigation. The chapter is divided into two sections corresponding to the two objectives.

1. A Search for Reasons which Might Explain Variability in Achievement.

Although the literature in the area of variability in achievement is voluminous, some authors have indicated possible avenues of explanation that have been overlooked in

empirical research. One such author¹ suggested that different underlying assumptions of studies were in part the cause of the many isolated and often contradictory findings. Suchett-Kaye further suggested that empirically oriented research was not in general interested in attempts to synthesize findings nor to integrate them in some theoretical context. To regard such variables as innate intelligence, social background, educational background and emotional make-up as separate molecular entities to be examined independently was according to the author definitely insufficient. The answer to the problem according to Suchett-Kaye would be to recognize the interdependence of these variables within a theoretical orientation that would account for their influence on achievement. Similarly, Winn,² Downey,³ Marler⁴ and Silberman⁵ echoed Suchett-Kaye in suggesting that the

1 C. Suchett-Kaye, "Personality Factors and Self-Instruction: A Survey", in Programmed Learning and Educational Technology, Vol. 9, No. 4, 1972, p. 206.

2 William Winn, "An Open-System Model of Learning", in A-V Communication Review, Vol. 23, No. 1, 1975, p. 23.

3 Lawrence Downey, The Secondary Phase of Education, Toronto, Blaisdell, 1965, p. 65.

4 C. D. Marler, Philosophy and Schooling, Boston, Allyn and Bacon, 1975, p. 19-24.

5 Robert E. Silberman, "Theories and Models and their Utility", in Educational Technology, Vol. 3, No. 19, 1967, p. 2.

interplay between educational practice and the scientific study of learning had not been very successful. For those authors, there did not appear to be much grounds as yet for expecting psychological theories, developed in the laboratory to be directly applicable to heuristic learning situations until a more complete inventory of variables and their interaction was put forth.

Within the last decade a renewed interest has developed in both philosophy and psychology in an area that might possibly offer an explanation to the problem of variability in achievement in education. This area, known as epistemology, is gaining some influence particularly in terms of its application to education. Briefly stated, both philosophical and psychological epistemology are concerned with a concept variously labelled as "knowing", "thinking", or "modalities of inference". Authors such as Bruner,⁶ Sheffler,⁷ Morris and Pai,⁸ Pai,⁹ and Wirsing¹⁰ suggest that there may be a

6 Jerome Bruner, On Knowing: Essays for the Left Hand, Cambridge, Harvard University Press, 1962, p. 123-125.

7 Israel Sheffler, Conditions of Knowledge: An Introduction to Epistemology and Education, Chicago, Scott, Foresman, 1965, p. 1-6.

8 Van Cleve Morris, Young Pai, Philosophy and the American School, Boston, Houghton Mifflin, 1976, p. 102-265.

9 Young Pai, Teaching, Learning, and the Mind, Boston, Houghton Mifflin, 1973, 226 p.

10 Marie Wirsing, Teaching and Philosophy: A Synthesis, Boston, Houghton Mifflin, 1972, 226 p.

definite relationship between epistemological commitments on the part of learners and teachers on the one hand, and learning and teaching effectiveness on the other. Although terminology may vary from author to author, the conceptual idea underlying the terms appears to be quite similar. In general, many authors agree¹¹ that there are possibly three basic modalities of "knowing". Briefly stated, an inductive process of knowing is generally regarded as inductive thinking or empirical thinking;^{12,13} a deductive process of knowing is considered as logical or rational thinking,^{14,15} and a creative or analogical process of knowing is referred to as intuitive or metaphorical thinking.^{16,17,18} These definitions do not represent a consensus of opinion but merely a general agreement on three broadly defined modalities of "knowing".

11 There are some notable exceptions: J. Piaget, Epistémologie des sciences de l'homme, Paris, Gallimard, 1970, 380 p.

12 J. S. Bruner, The Process of Education, New York, Vintage Books, 1960, p. 57-58.

13 Van Cleve Morris and Young Pai, Op. Cit., p. 161-165.

14 Idem, ibid., p. 179-190.

15 Marie Wirsing, Op. Cit., p. 49-54.

16 M. Bunge, Intuition and Science, Englewood Cliffs, New Jersey, Prentice-Hall, 1962, p. 78-79.

17 Israel Scheffler, Science and Subjectivity, New York, Bobbs-Merril, 1967, p. 16-19.

18 Jerome S. Bruner, Op. Cit., p. 58.

Authors such as Morris and Pai,¹⁹ Wirsing²⁰ and Bruner²¹ have attempted to show in some of their writings, theoretical relationships between modalities of knowing on the one hand, and the structure of disciplines and the teaching and learning on the other.

Though the research is confined to theorizing in philosophy and psychology, very few authors have ventured opinions about possible epistemological problems involved in teaching-learning situations. One such author, McClelland²² suggested that the ultimate accomplishment of Skinner's science of verbal behaviour may well be the development of an empirical and logical epistemology. But he further suggested and cautioned that Skinner's epistemology in his technology of education, model used in most programmes involving individualized instruction, would have to account for the educator's concern, namely how is knowing in mathematics different from knowing in science and in poetry.²³

19 Van Cleve Morris, Young Pai, Op. Cit., p. 102-350.

20 Marie Wirsing, Op. Cit., p. 42-57.

21 Jerome S. Bruner, Op. Cit., p. 55-68.

22 J. M. McClellan, "Automated Instruction: A Philosophical Approach", in A. de Grazia and D. A. Sohn, Programs, Teachers, and Machines, New York, Bantam Books, 1962, p. 103-116.

23 Idem, ibid., p. 107.

Because methodological behaviourism postulates that what is not observable is to be ignored,²⁴ it has much difficulty in explaining metaphorical or intuitive thinking. For behaviourists, the same principles of learning operate whether we are learning algebra, poetry, chemistry or geography. At present they are not raising the question of how thinking in science and mathematics may differ from thinking in art.

In another article, Tanner²⁵ cautioned that in preparing individualized learning materials, that more attention should be paid to the particular learning modes of students. Gowin reinforced the point when he wrote:

Are the propositions one goes through to test the proposition that atoms split the same as, or similar to, the operations involved in testing the proposition that Columbus discovered America? The assumption of logical equivalence of a subject matter would suggest that in general the patterns of inquiry necessary to establish knowledge are the same.²⁶

Vernon went even further by deploring the fact that at present there is no empirical data relating predisposition to an epistemological style of thinking with the characteristics of a learning strategy.²⁷ Further reinforcement of a possible

24 B. F. Skinner, Verbal Behaviour, New York, Appleton-Century-Crofts, 1957, p. 443.

25 D. Tanner, "The Machine Teacher and the Human Learner", in A. de Grazia and D. A. Sohn, Op. Cit., p. 303.

26 D. B. Gowin, "Teaching--Its Logic and its Language", in Elementary School Journal, Vol. 61, No. 4, 1960, p. 189.

27 M. D. Vernon, The Psychology of Perception, Baltimore, Penguin, 1962, p. 302.

link between different epistemological commitments on the part of learners, and achievement in learning is suggested by Thelen,²⁸ Hoban²⁹ and Sutter and Reid.³⁰ They note that there may be incompatibility between the structured, concrete and sequential nature of some teaching strategies and learners who are characterized as "intuitive", "creative", "analogical" thinkers.

The possible incompatibility of the "intuitive", "analogical" type learners and the structured, concrete, sequential nature of some learning strategies offers plausible reasons that may help to explain some of the variability in achievement in education. This suggested incompatibility has not to the writer's knowledge been explored theoretically nor empirically.

Within these parameters then, a review of the literature was undertaken to find a comprehensive conceptual model that might help explain different modalities of knowing and

27 M. D. Vernon, The Psychology of Perception, Baltimore, Penguin, 1962, p. 302.

28 H. A. Thelen, "The Triumph of 'Achievement' Over Inquiry in Education", in Elementary School Journal, Vol. 60, 1960, p. 190-197.

29 C. F. Hoban, "Man, Ritual, The Establishment and Instructional Technology", in Educational Technology, Vol. 8, No. 20, 1968, p. 5-11.

30 E. G. Sutter and J. B. Reid, "Learner Variables and Interpersonal Conditions in Computer-Assisted Instruction", in Journal of Educational Psychology, Vol. 60, No. 3, 1969, p. 153-157.

offer empirical possibilities for testing. The next section of this study reports the results of a review of the literature in the area of epistemological styles of knowing, justifies the selection of one particular psycho-theoretic model and examines in some detail the various information processing routes of the model's psycho-epistemic styles.

2. Royce's Multi-Factor Theory of Individuality.

The review of the literature in the area of epistemological modalities of knowing has revealed only two comprehensive models providing instruments for empirical verification. The first model, developed by Hill³¹ and called the Educational Sciences was not considered useful for this particular study. The overriding principle of "practicality" of the Educational Sciences model was judged by the writer to be a serious weakness in terms of this study. Hill did not want the Educational Sciences framework to be considered a fundamental discipline.³²

The second model found in the literature and used in this study was developed by J. R. Royce at the Center for

31 Joseph E. Hill, The Educational Sciences, Oakland, Institute for Educational Sciences, Oakland Community College Press, 1974, 21 p.

32 P. A. Scholl, "The Educational Sciences: A System for Thinking About Individual Differences", In International Journal of Instructional Media, Vol. 2, No. 3, 1975, p. 253.

Advanced Study in Theoretical Psychology of the University of Alberta. Entitled a Multi-Factor Theory of Individuality,³³ the conceptual framework attempts according to the author to "accommodate all psychological differences such as reaction time and conditionability to molar differences such as values and world views".³⁴ For Royce, it had to include all organisms and their total life span along with the hereditary, environmental and biological variations.

The approach utilizes the theory and the methodology of factor analysis to develop the hierarchy of traits along with system theory to provide the necessary explanation of the dynamic complexity of the behaving organism in interaction with the environment. Thus, the theory views the total psychological system as "a multi-dimensional, organized system of processes by means of which an organism produced mental and behavioral phenomena".³⁵ This elaborated supra-system

33 J. R. Royce, "The Conceptual Framework for a Multi-Factor Theory of Individuality", in J. R. Royce (ed.), Multi-variate Analysis and Psychological Theory, New York, Academic Press, 1973, p. 305-407.

34 J. R. Royce, "Epistemic Styles, Individuality, and World-View", Educational Testing Services, Princeton, N.J., Dec. 1973, p. 3.

35 J. R. Royce, "Personality Integration: A Synthesis of the Parts and Wholes of Individuality Theory", Unpublished manuscript, Center for Advanced Study in Theoretical Psychology, University of Alberta, 1977, p. 2.

subsumes six major systems, namely: sensory, motor, cognitive, affective, evaluative, and style.

Each system is defined by Royce as follows:³⁶

1. The cognitive system is a multi-dimensional, organized system of processes by means of which an organism produces cognitions.
2. The sensory system is a multi-dimensional, organized system of processes by means of which an organism produces sensations.
3. The affective system is a multi-dimensional, organized system of processes by means of which an organism produces affective phenomena.
4. The style system is a multi-dimensional, organized system of processes by means of which an organism manifests cognitive or/and affective phenomena.
5. The evaluative system is a multi-dimensional, organized system of processes by means of which an organism manifests normative phenomena.
6. The motor system is a multi-dimensional, organized system of processes by means of which an organism produces outputs.

What Royce is describing is a theory of individuality that is multi-dimensional, interactional and hierarchical. Within each of the six systems are subsumed traits that have been factorially identified. So far Royce has identified and isolated some one hundred and fifty factors³⁷ considered as

36 J. R. Royce and A. R. Buss, "The Role of General Systems and Information Theory in Multi-Factor Individuality Theory", in Canadian Psychological Review, Vol. 17, No. 1, Jan. 1976, p. 6-7.

37 A. Powell and J. R. Royce, "A Brief Overview of MultiFactor-Systems Theory of Individuality", unpublished manuscript, Center for Advanced Study in Theoretical Psychology, University of Alberta, 1977, p. 2.

reliable traits of individual differences. These traits are to be found hierarchically arranged within each of their respective systems. Figure 1 provides a graphic illustration of the cognitive system along with the hierarchically arranged traits and their hypothesized interactions. What is to be noted in the hierarchy of traits is what Royce postulates as higher-order personality integrators. The closer a trait or cluster of traits is to the apex of a system the greater its possible influence on the system and the greater its role as a personality integrator.³⁸ Similarly, the closer a system is to the supra-system, the greater its possible influence on personality. Figure 2 indicates that the style system would according to Royce be of more importance as a personality integrator than the cognitive system which it subsumes. Likewise the cognitive system would be necessarily of more importance as a personality integrator than the sensory and motor systems. This system domination is dependent on the type of information being processed. As Royce wrote:

If the behavioral events in question are primarily of an 'emotional' character, such as fear from just having perceived a dangerous animal a short distance away, the ongoing information processing, even though it involves the cognitive system to a considerable extent and both styles and values to a minimal extent, occurs primarily via the affective system.³⁹

38 J. R. Royce, A. R. Buss, Op. Cit., p. 8.

39 Idem, ibid., p. 13.

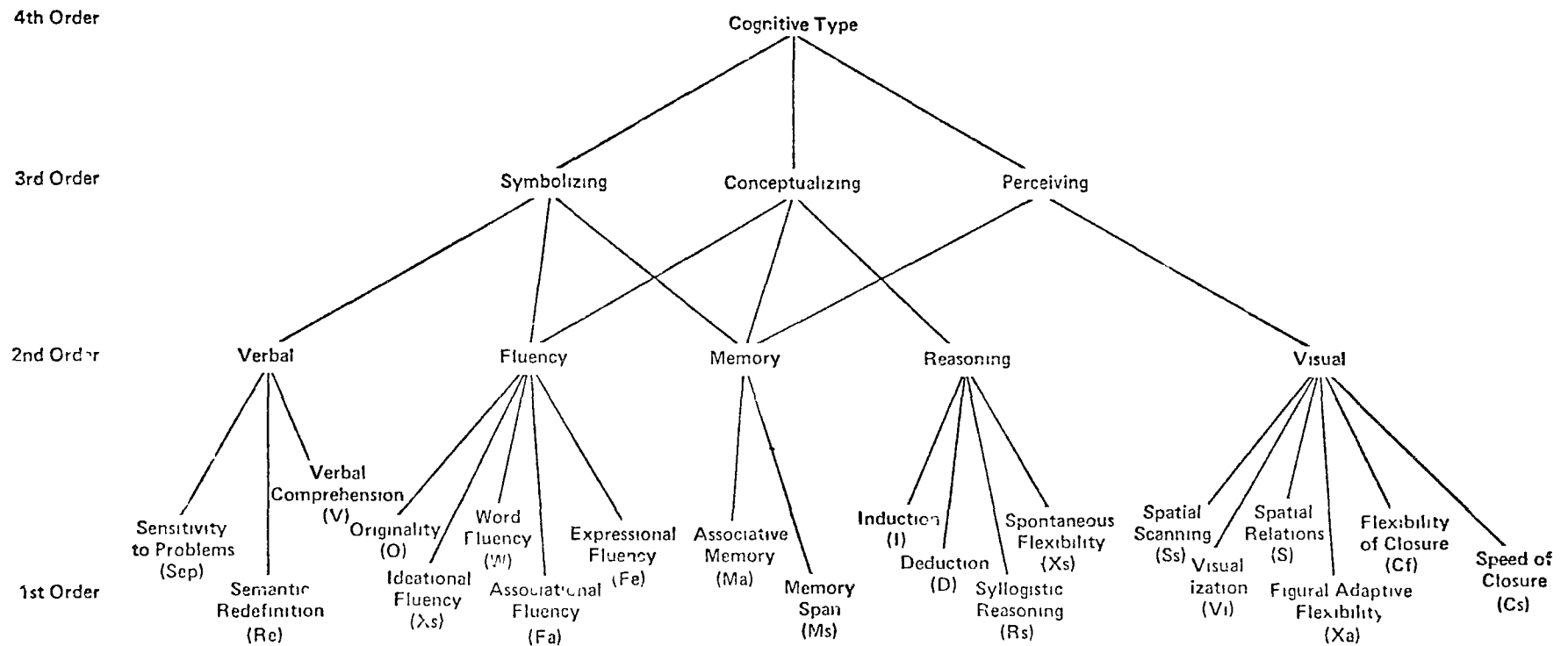


Figure 1.- The Hierarchical Structure of the Cognitive System, in J. R. Royce and G. Kearsley, "A Multi-Dimensional System-Dynamics Model of Cognitive Processing", Unpublished manuscript, 1977, p. 7.

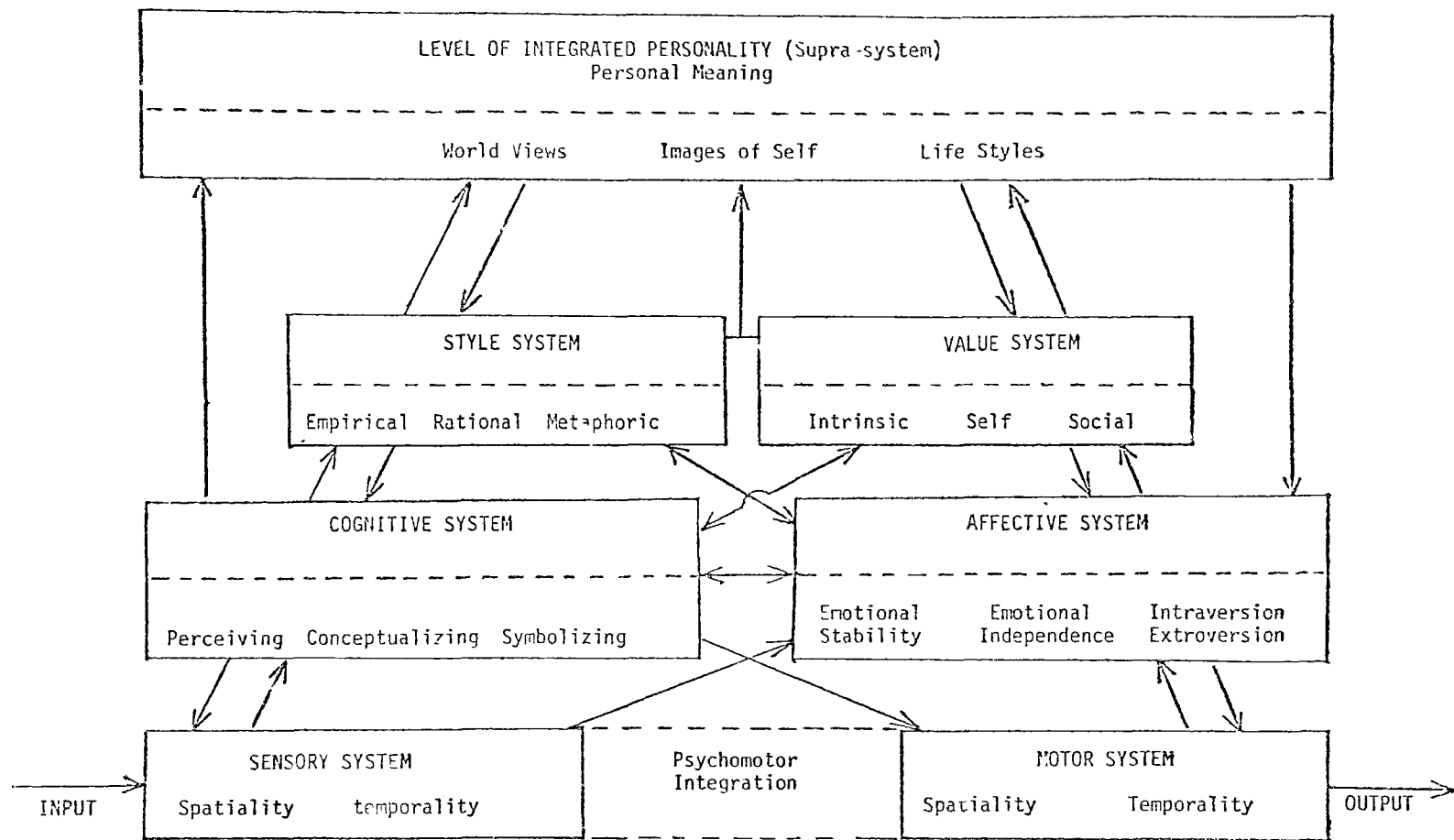


Figure 2.- Integrated Personality and Subsystem Interactions, in A. Powell and J. R. Royce, "A Brief Overview of Multi-Factor-Systems Theory of Individuality, Op. Cit., p. 10.

Thus, the Multi-Factor Theory of Individuality is a conceptual framework consisting of factorially identified traits organized in a system-dynamic supra-structure that provides for interaction within and among the six sub-systems along with a hierarchically organized structure.

Of particular interest to this study is the style system. This system, considered to be near the apex of the supra-system,⁴⁰ is then as Royce suggests an integrative information system.⁴¹

a) Psycho-Epistemic Styles

Royce has defined style as "a characteristic mode or way of manifesting cognitive and/or affective phenomena".⁴² This system along with its sub-systems of cognitive, affective and cognitive-affective styles are considered to be higher-order dimensions and serve as a higher order integrative system. It is to be noted as Royce and Wardell⁴³ suggested that the style system is more inclusive than what is generally

40 See Figure 2.

41 D. Wardell and J. R. Royce, "Toward a Multi-Factor Theory of Styles and Their Relationships to Cognition and Affect", Unpublished manuscript, Center for Advances Study in Theoretical Psychology, University of Alberta, 1977, p. 6.

42 J. R. Royce, "The Conceptual Framework for a Multi-Factor Theory of Individuality", Op. Cit., p. 330.

43 D. Wardell and J. R. Royce, Op. Cit., p. 10-12.

considered in the literature on cognitive styles. Such conceptual, instrument-bound styles usually include affective dimensions, as in the case of Kagan's analytical vs relational categorizing.⁴⁴

These styles, according to Royce are relatively stable. They bring into play specific cognitive and/or affective traits depending upon the particular situation and the particular individuality profile of an individual. By being labelled higher-order personality integrators, styles are then considered by Royce as "determinants of combinations of traits that are activated when alternative possibilities exist".⁴⁵ Within the hierarchical structure of the style system, the theory has identified three higher-order constructs which are at the apex of the system. These three are called the rational, empirical and metaphoric styles.⁴⁶ These three styles reflect the different ways in which an individual processes information using the cognitive, affective, and cognitive-affective styles of the style system. In terms of psychological epistemology, Royce defined the three psycho-epistemic styles as follows:⁴⁷

44 Idem, ibid., p. 11.

45 Idem, ibid., p. 3.

46 Idem, ibid., p. 4.

47 J. R. Royce, L. Mos, and G. P. Kearsley, Manual for the Psycho-Epistemological Profile (Form V), Center for Advanced Study in Theoretical Psychology, University of Alberta, 1975, p. 3.

Metaphorism. The person whose view of reality is largely determined by his commitment to metaphoric experience would test the validity of his view in terms of the universality of his insight or awareness. The cognitive processes underlying this commitment are of a symbolizing nature, including both conscious and unconscious aspects.

Rationalism. The person whose view of reality is largely determined by his commitment to rationality would test the validity of his view of reality by its logical consistency. The major underlying cognitive processes involve clear thinking, and the rational analysis and synthesis of ideas.

Empiricism. The person whose view of reality is largely determined by his commitment to external experience would test his view of reality in terms of the reliability and validity of observations. The major underlying cognitive processes involve active perception and the seeking out of sensory perceptions.

Subsumed under these three epistemic styles are various cognitive, affective and cognitive-affective styles linked along with various subsumed cognitive and affective traits. The hypothesized hierarchy is still, according to Royce, in its infancy.⁴⁸ The total number of traits, along with their interactions, are still subject to extensive empirical investigation although Royce posited that the basic hierarchical structure appears to be quite solid.⁴⁹

48 J. R. Royce and G. Kearsley, "A Multi-Dimensional System-Dynamic Model of Cognitive Processing", Unpublished manuscript, Center for Advanced Study in Theoretical Psychology, University of Alberta, 1976, p. 21-22.

49 D. Wardell and J. R. Royce, Op. Cit., p. 31.

At present, Royce postulates in Figure 3 the probable conceptual linkages between epistemic styles, cognitive abilities and affective traits. As illustrated in Figure 3, the rational, empirical and metaphoric epistemic styles are near the apex of the structure and as such are considered as having a potentially powerful influence on personality. Within the style system are subsumed both the cognitive and affective styles. It is through these two classes of styles that the linkages are made possible to the various cognitive and affective traits. Epistemic styles then can be considered of major importance in the processing of information. Using Figure 3 as a guide, it can be shown how epistemic styles are determinants of cognitive and/or affective styles along with their respective combinations of traits. When an individual is faced with a problematic situation, epistemic styles, along with the various subsumed styles and traits are activated and the information processing route will vary in terms of the situation and the individual.⁵⁰

The style system permits a more holistic conceptual understanding of how an individual faced with a particular task, processes information. In terms of individuality, the psycho-theoretic model suggests that individuals use different information processing routes depending upon their particular

50 D. Wardell and J. R. Royce, Op. Cit., p. 3.

hereditary-environmental characteristics.

The processing routes are extremely numerous when one considers the possible combination of styles and traits along with the "weighting" of each. For the purpose of this study and for the sake of clarity, further analysis of epistemic styles will concentrate on what could be considered as the three "pure" epistemic styles.⁵¹

The Rational Epistemic Style. An individual possessing this "pure" epistemic style would in terms of the subsumed cognitive style tend to be more abstract rather than concrete,⁵² more analytical than relational,⁵³ be of the "levelling extreme rather than the "sharpening"⁵⁴ and would show more ability to discriminate on complex cognitive tasks.⁵⁵ In terms of the subsumed affective styles, the individual with a rational epistemic style would be more flexible rather than constricted,⁵⁶ be more emotionally independent,⁵⁷ high on

51 D. Wardell and J. R. Royce, Op. Cit., p. 28.

52 Idem, ibid., p. 10.

53 Idem, ibid., p. 9.

54 Idem, ibid., p. 12.

55 Idem, ibid., p. 6.

56 Idem, ibid., p. 13.

57 J. R. Royce and J. R. McDermott, "A Multidimensional System Dynamics Model of Affect", in Motivation and Emotion, Vol. 1, No. 3, 1977, p. 205.

autonomy and cortertia which would indicate an individual to be "realistic, tough-minded and detached or aloof".⁵⁸ Included within the conceptualizing abilities of the rational epistemic style are such cognitive factors as reasoning and verbal ability. According to Royce, the deductive and syllogistic reasoning factors are the most critical.⁵⁹ As for affective traits, the rational epistemic style is hypothesized to include such dimensions as lack of sociability, little concern for social conventions and some lack of tidiness and dislike for routine.⁶⁰

The Empirical Epistemic Style. In terms of the subsumed cognitive styles, the empirical epistemic style relies more on perceptual abilities than the conceptual abilities of the rational epistemic style. The empirical style is characterized as being high on compartmentalization⁶¹ and of preferring more concrete rather than abstract manipulation.⁶² The individual with an empirical epistemic style is more concerned with detail⁶³ and the sequential presentation of

58 Idem, ibid., p. 206.

59 J. R. Royce and G. Kearsley, Op. Cit., p. 9.

60 D. Wardell, J. R. Royce, Op. Cit., p. 23.

61 Idem, ibid., p. 12.

62 Idem, ibid.

63 Idem, ibid., p. 22.

stimuli (sharpening).⁶⁴ In contrast to the rational style, the empirical style activates the relational rather than the analytical cognitive style.⁶⁵ Low tolerance for the unconventional,⁶⁶ high stress on realistic experience⁶⁷ along with a reflective rather than impulsive orientation are two of the affective styles subsumed within the empirical epistemic style.

There are numerous traits that have been factorially identified within the cognitive and affective styles of the empirical epistemic style. According to Royce some empirical evidence exists to suggest that extensive scanning and inductive reasoning may be related to the empirical epistemic style although Figure 3 does not at present hypothesize such a link.⁶⁸ Extensive scanners according to Royce are more interested in "doing, not theorizing".⁶⁹ He further noted that extensive scanners are "preoccupied with veridicality, exactness, and the adequacy of their response, and perhaps control over impulses".⁷⁰ The empirical epistemic style

64 Idem, ibid., p. 12.

65 Idem, ibid., p. 9.

66 Idem, ibid., p. 13.

67 Idem, ibid., p. 16.

68 Idem, ibid., p. 22.

69 Idem, ibid., p. 24.

70 Idem, ibid.

appears to be also characterized by a more outward orientation,⁷¹ a more sociable and self-confident behaviour that could be described as low inhibition.⁷²

The Metaphoric Epistemic Style. Low compartmentalization and high conceptual integration are characteristics of the symbolizing abilities of the cognitive style profile of the metaphoric epistemic style. This highly developed symbolizing ability described by Royce as a "creative and synthesizing ability",⁷³ is linked to ideational fluency,⁷⁴ originality and expressional fluency.⁷⁵ The affective domain of the metaphoric epistemic style is associated with excitability, emotional instability and high anxiety.⁷⁶ The affective style is more physiognomic than literal.⁷⁷ Relating the cognitive and affective traits of metaphorism, Horn indicated that there were correlations between the cognitive fluency measures and such affective measures as "impulsive, expansive, talkative, friendly, independent-minded,

71 Idem, ibid., p. 24.

72 Idem, ibid., p. 25.

73 Idem, ibid., p. 22.

74 Idem, ibid.

75 Idem, ibid., p. 27.

76 Idem, ibid., p. 26.

77 Idem, ibid., p. 18.

unruly, playful, unconventional, emotional, volatile".⁷⁸ He also suggested that these ratings correlated in general with creativity measures.

The preceding description of the three epistemic styles along with their corresponding lower-order traits presents a hypothetico-theoretic structure of individuality. Although the structure has as yet to be submitted to extensive empirical investigation, factorial analysis of the empirical literature on traits along with a systems-dynamic heterarchical⁷⁹ arrangement of the six systems is considered sufficiently advanced for the purposes of this exploratory theoretical study.

The implication of this hierarchically-arranged goal-seeking system⁸⁰ of individuality is that epistemic styles are, according to Royce, potentially more personality integrative than the other systems and sub-systems. When confronted with a particular learning task, an individual utilizes an information processing route that may be

78 J. L. Horn, "Personality and Ability", in R. B. Cattell (ed.), Handbook of Modern Personality Theory, Washington, D.C., Hemisphere Publishing Co., 1977, p. 139-165, as quoted in D. Wardell and J. R. Royce, Op. Cit., p. 27.

79 J. R. Royce and A. R. Buss, "The Role of General Systems and Information Theory in Multi-Factor Individuality Theory", in Canadian Psychological Review, Vol. 17, No. 1, 1976, p. 16.

80 D. Wardell and J. R. Royce, Op. Cit., p. 30.

predominantly rational, empirical or metaphorical. The difference between the three styles is the fact that each activates a particular route characterized by the specific subsystem and its accompanying cluster of traits. Since it is possible for a person to have a "mixed" epistemic style,⁸¹ this study will focus on what Royce has described as encapsulated epistemic styles.⁸²

More specifically these encapsulated epistemic styles are closely linked to the ever-increasing phenomenon of academic specialization. Royce defined encapsulation as "looking at life partially but issuing statements concerning the wholeness of living; as claiming to have the whole truth when one has only part of it".⁸³ The problem of specialism, particularly in psychology, can be viewed as problems of epistemic encapsulation, and partialness. In various attempts to come to grips with the whole of man from a psychological point of view, psychologists may have failed because of their exclusive reliance on one particular information processing route (e.g. epistemic style). Not only are there bio-physical conditions

81 D. Wardell and J. R. Royce, Op. Cit., p. 45.

82 J. R. Royce, The Encapsulated Man, New York, D. van Nostrand, Princeton, N.J., 1964, xi-206 p.

83 Idem, ibid., p. 30.

which lead to encapsulation⁸⁴ but also there is language encapsulation.⁸⁵

These three main types of epistemic encapsulation as developed and elaborated by Royce are not new. Sorokin⁸⁶ elaborated at the cultural level something quite similar with his description of the three systems of truth, namely: idealistic, ideational and sensate. In addition, in the field of neurological psychology, Pribam⁸⁷ studied and posited the neural basis of induction, deduction and abduction as the primary basis for knowing. The question that Royce addressed was the nature of the knowing process.

[...] how come the earth was once flat, but now we "know" it is round? And why did we drop Ptolemy for Copernicus, Newton for Einstein [...] And why are the truths and insights of one discipline of knowledge in conflict, or at least not in harmony, with the awareness of neighboring disciplines?⁸⁸

84 J. R. Royce, "Epistemic Styles, Individuality and World-View", Op. Cit., p. 34-39.

85 J. B. Carroll, A Study of Language, Cambridge, Harvard University Press, 1955, p. 1-53.

86 P. A. Sorokin, The Crisis of Our Age, New York, E. P. Dutton, 1941, 338 p.

87 K. H. Pribam, "Neurological Notes on Knowing", in J. R. Royce and W. W. Rozeboom (eds.), The Psychology of Knowing, New York, Gordon & Breach, 1972, p. 449-462.

88 J. R. Royce, "Cognition and Knowledge: Psychological Epistemology", in Handbook of Perception, Vol. I, edited by E. C. Carterette and M. P. Friedman, New York, Academic Press, 1974, p. 149.

These encapsulated epistemic styles are then conceptually useful in explaining why empirically-oriented laboratory scientists, using mainly perceptual abilities and the within-system and sub-system traits, emphasize mainly facts. Mathematicians using a basically conceptual information processing route, bet on logical consistency. Likewise, poets proceeding through the symbolizing information processing route and its accompanying sub-systems create through the use of metaphors. These differing information processing routes can help explain:

[...] that knowing in the arts, for example, is not the same as knowing in the sciences. How might they differ? They might differ both psychologically and philosophically. On the philosophic side there may be different truth criteria. Does it make sense, for example, to demand empirical repeatability in evaluating truth claims in literature? And psychologically one might expect differential involvement of the cognitive processes. Symbolizing, for example, may be more crucial, or be of a different order, in the creation of artistic products, than in the creation of mathematical or logical-deductive systems.⁸⁹

The almost total reliance on one particular epistemic style at the expense of the other two can account at least partially for differences in weltanschauung. For Royce, these three ways of knowing represent a legitimate approach to reality. In Figure 4, Royce attempted, through the aid of a diagram, to show the possible relationship between man the knower, and the nature of reality via the epistemic styles.

89 Idem, ibid., p. 151.

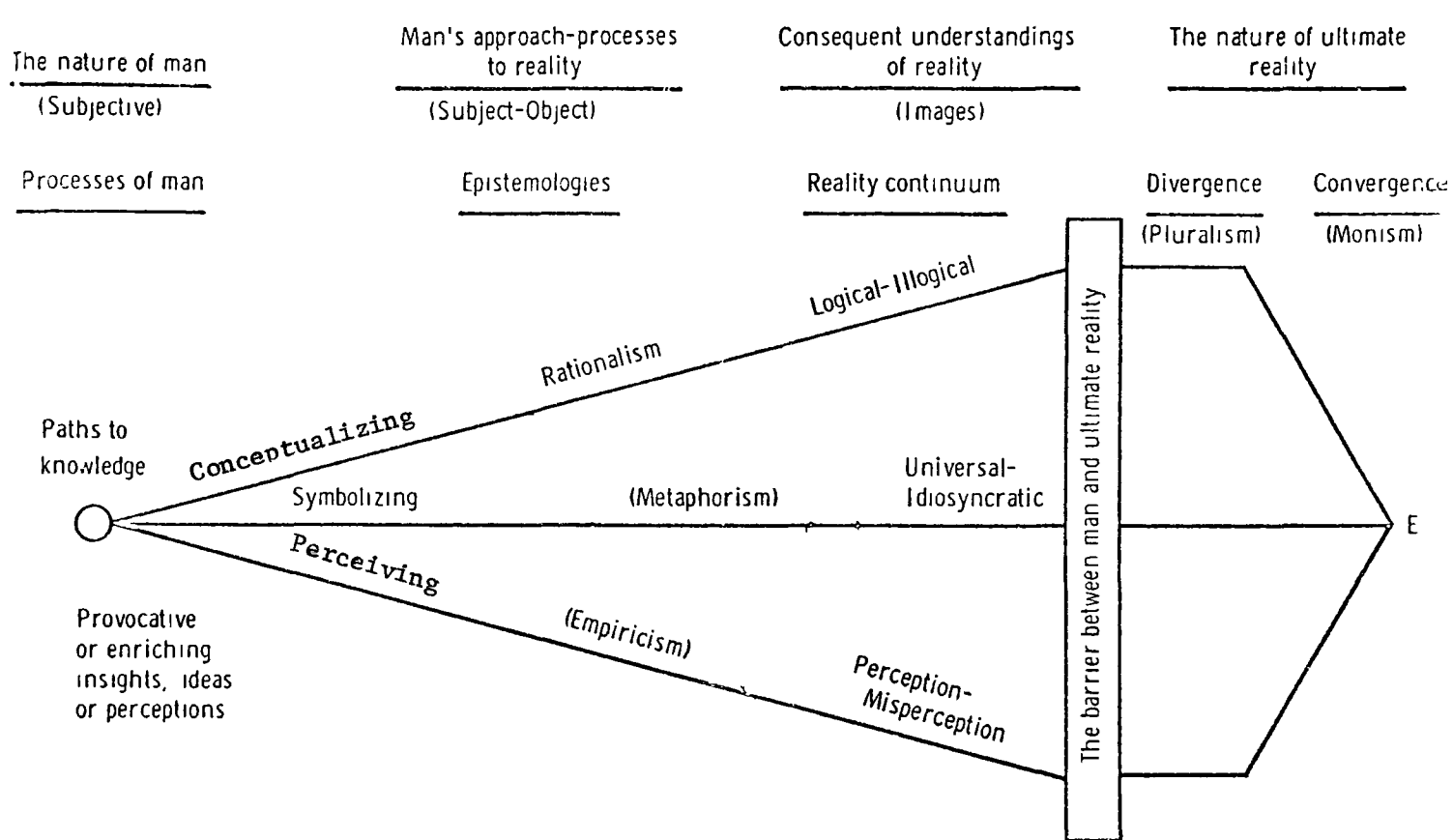


Figure 4. The Basic Paths to Knowledge.

J. R. Royce, "Epistemic Styles, Individuality, and World-View", p. 37.

The three psycho-epistemologies developed by Royce have some theoretical affinity to the structure of knowledge in the various domains and disciplines. The scientist for example may conceptualize, symbolize, and perceive as a scientist, but his professional epistemological commitment will encourage him to maximize the rational and empirical epistemic styles along with the specific activated systems and sub-systems. Consequently, the metaphoric epistemic style is minimized as a valid epistemological way of knowing. Conversely, the artist, who also evokes conceptual, perceptual and symbolizing abilities, may maximize the latter at the expense of the other two. In terms of valid truth criteria when faced with decision-making, the predominantly rational individual will select logical consistency as a truth criterion and will therefore reject as false something which is illogical. The empirical epistemic style says knowledge is dependent upon accurate perception and the metaphoric epistemic style says that knowledge is dependent upon the degree to which symbolizing abilities lead to universal rather than idiosyncratic awareness.⁹⁰

It must be made clear at this point that Royce is not suggesting that all individuals function with a "pure" epistemic style. Rather, he suggests that "one does not think independently of sensory inputs and the process of symbol formation, nor do we perceive independently of

90 J. R. Royce, The Encapsulated Man, p. 13 & 14.

conceptualizing".⁹¹

The theoretical analysis to this point can now be used as a framework to attempt to explain variability in achievement in instruction and more specifically in programmed instruction.

The theoretical evidence reported in this chapter has suggested that epistemic styles might offer a possible explanation to the persistent problem of variability in achievement in instruction and more specifically in programmed instruction. Two particular models were noted and Royce's Multi-Factor Theory of Individuality was selected and examined.

The following chapter will attempt to establish the possible relationship of Royce's psycho-epistemic styles and variability in achievement in programmed instruction. The chapter will conclude with a statement of the problem and the formulation of a research hypothesis.

⁹¹ J. R. Royce, "Epistemic Styles, Individuality and World-View", Op. Cit., p. 13.

CHAPTER III

STATEMENT OF THE RESEARCH PROBLEM AND HYPOTHESIS

This chapter has three objectives. The first is to present evidence of a possible relationship between epistemic styles and the broad range of achievement scores in programmed instruction. The second objective of this chapter is to delineate the problem and to indicate its limits and the third objective is to formulate the research hypothesis. The chapter consists of three sections corresponding to the three objectives.

1. Epistemic Styles and Programmed Instruction.

Programmed instruction, developed in the laboratory by behavioural psychologists and in particular by B. F. Skinner, rests on the assumption that man is a reacting organism, dominated solely by the environment. Although the characteristics of programmed instruction are usually described in the literature as being derived from behavioural learning theory, Skinner is quick to point out that theories have no place in a science of behaviour.¹ He suggested that as far as he is concerned, knowledge obtained

¹ B. F. Skinner, Science and Human Behavior, New York, MacMillan, 1953, p. 5-10.

about reality through objective and systematic observation and description must remain purely descriptive and atheoretical. Consequently Skinner's main interest in education lies in the development of a technology rather than a theory of education. In this sense then, programmed instruction was the result not of behavioural learning theory but of laws discovered by observation. Such laws included the Law of Exercise, the Law of Effect, and the Law of Reinforcement. This concern for generalizations appears to be the reason why Skinner's methodological behaviourism has no terms to describe individual differences, and refuses to discuss motivation, affective feedback and boredom.² For Skinner anything "under the skin"³ simply must be ignored by a science of human behaviour.⁴

Epistemologically, Skinner's methodological or descriptive behaviourism from which programmed instruction was developed is primarily empirically oriented. He described his own approach to scientific investigation as follows:

2 D. J. Satterly and M. A. Brimer, "Cognitive Styles and School Learning", in British Journal of Educational Psychology, Vol. 41, No. 3, 1971, p. 294.

3 B. F. Skinner, Op. Cit., p. 257.

4 Idem, Beyond Freedom and Dignity, New York, A. A. Knopf, 1972, p. 193-215.

I never faced a problem which was more than the eternal problem of finding order. I never attacked a problem by constructing a Hypothesis. I never deduced theorems or submitted them to Experimental Check. So far as I can see, I had no preconceived Mode of Behavior - certainly not a physiological or mentalistic one, and I believe not a conceptual one [...]. Of course, I was working on a basic assumption - there was order in behavior if I could only discover it - but such an assumption is not to be confused with the hypothesis of a deductive theory. It is also true that I exercised a certain selection of facts, not because of relevance to theory but because one fact was more orderly than another. If I engaged in experimental design at all, it was simply to complete or extend some evidence of order already observed.⁵

Skinner's view of science makes it clear that his methodological behaviourism is founded on functional analysis (cause-effect) and on the verifiability principle which asserts that for any factual statement to be meaningful it must be empirically verifiable.⁶ Although Royce's Psycho-Epistemological Styles is basically a cognitive model of the knowing process and as such seemingly incompatible with Skinner's view that thinking is behavior,⁷ Royce's empirical epistemic mode of knowing seems to describe accurately

5 Idem, "A Case History in Scientific Method", in S. S. Koch (ed.), Psychology: A Study of Science, New York, McGraw-Hill, Vol. 1, 1959, p. 369.

6 Idem, "Behaviorism at Fifty", in T. W. Wann (ed.), Behaviorism and Phenomenology, Chicago, University of Chicago Press, 1964, p. 79, 106.

7 Idem, Verbal Behavior, New York, Appleton-Century-Crofts, 1957, p. 452.

methodological behaviourism. For Royce, a person is considered to have a predominantly empirical epistemic style when his view of reality is "largely determined by his commitment to external experience and would test his view of reality in terms of the reliability and validity of observation".⁸ The information processing route of the predominantly empirical epistemic style is activated and channeled through the perceptual rather than the conceptual or symbolizing abilities domain. The cognitive style is more concrete than abstract. The concern for detail and sequentiality using inductive reasoning as well as a preoccupation for the iterativity of acquired knowledge characterizes quite adequately the epistemological assumptions of methodological behaviourism.

Because of programmed instruction's structured, sequential and overt-responding nature, authors such as Silberman,⁹ Summers,¹⁰ and Glaser¹¹ have described programmed

8 J. R. Royce et al., Manual: Psycho-Epistemological Profile, Edmonton, Center for Advances Study in Theoretical Psychology, University of Alberta, 1975, p. 3.

9 R. E. Silberman, "Behavior Science and a Technology of Education", in Educational Technology, Vol. 6, No. 7, 1966, p. 8.

10 E. G. Summers, "Programmed Instruction and the Teaching of Reading", in Educational Technology, Vol. 4, No. 10, 1965, p. 1-13.

11 R. Glaser, "Psychology and Educational Technology", in Educational Technology, Vol. 6, No. 9, 1966, p. 6-12.

instruction as a basically inductive teaching strategy. The principles of stimulus-response, confirmation of results, and reinforcement, taken directly from methodological behaviourism have been interpreted by many programmers to indicate that terminal behaviour is achieved by using an inductive, specific to general learning sequence. B. F. Skinner partially disagreed with that interpretation. He suggested that far too long programmed instruction has suffered guilt by association.¹² He suggested that if the inherent structure of a subject matter dictated that the presentation of programmed materials be from the general to the specific, as could be the case of teaching the Pythagorean Theorem, then he had no objection.¹³ Although Evans¹⁴ pointed out that between thirty five to forty per cent of earlier programmes were in the field of logic and mathematics, Koran stated that very few programmes existed that were deductive in mode of presentation.¹⁵ Those programmes that are deductive-analytical

12 B. F. Skinner, The Technology of Teaching, New York, Appleton-Century Crofts, 1968, p. 115.

13 Idem, ibid., p. 222.

14 J. L. Evans, "Programming in Mathematics and Logic", in R. Glaser, Teaching Machines and Programmed Learning, II, Data and Directions, Washington, Dept. of Audio-visual Instruction, N.E.A., 1965, p. 372.

15 M. L. Koran, "Differential Response to Inductive and Deductive Sequences of Programmed Instruction", in Journal of Educational Psychology, Vol. 62, No. 4, 1971, p. 300-307.

in sequence are referred to as generally of the mathetics-type developed by Gilbert in 1962.¹⁶ The paucity of deductive-type programmes is probably what led most proponents of programmed instruction to define it as an inductive teaching strategy. The important thing for Skinner in programmed instruction, is that the sequence, be it inductive or deductive, be structured and sequential in terms of levels of difficulty and demand overt responding on the part of the student. The sequence can be constructed according to the complexity of the materials, the difficulty of the terminal behaviour, or a natural order inherent in the subject matter. In Skinner's methodological behaviourism, deduction is utilized to contribute to the development of classification systems.¹⁷ It was in this sense that he suggested that "rules of logical and mathematical thinking, laws of thought, forms of syllogisms, and so on, have a related use".¹⁸

The metaphoric epistemological modality of knowing is acknowledged by Skinner, but he refuses at present to deal significantly with it. He suggested that the metaphoric community as opposed to the rational and empirical communities

16 T. F. Gilbert, "Mathetics: The Technology of Teaching", in Journal of Mathetics, Vol. 1, Jan. 1962, p. 7-73.

17 B. F. Skinner, Verbal Behavior, p. 427.

18 Idem, ibid., p. 422.

is by its nature pre-scientific.¹⁹ The metaphoric community as represented by music, literature and the arts, talks about things or events before the empirical and rational communities become involved. Skinner argued that metaphoric behaviour is usually discouraged or punished by the rational and empirical communities. For him, scientific verbal behaviour is most effective when "it is free of multiple sources of strength, humor, wit, style, the devices of poetry, and fragmentary recombinations and distortions of form...".²⁰

For the foregoing reason, Skinner has no room in his methodological behaviourism and the behavioural laws derived from it for metaphorical knowing. He has gone so far as to specify that the role of science is "to replace the metaphor with an abstract response".²¹ Therefore, the symbolizing abilities of the analogical, intuitive mode of thinking,²² and with its characteristic sub-systems have according to Skinner, no place in behavioural laws or in the classificatory system of human behaviour. Skinner and Royce share the same concept of metaphorism, seeing it as an analogical rather than a

19 Idem, ibid., p. 98.

20 Idem, ibid., p. 420.

21 Idem, ibid., p. 428.

22 Idem, ibid., p. 92.

deductive or inductive process,²³ although they disagree as to the interpretation. For Royce it is primarily a cognitive process with some affective links;²⁴ for Skinner it is behaviour that is of no consequence, and therefore, not included in his methodological behaviourism.²⁵

When Royce's epistemic styles concept is applied to methodological behaviourism it becomes evident that the empirical epistemic style is maximized with the acceptance of the rational style and that the metaphoric epistemic style is minimized and in some cases ignored completely. The sequential structured overt responding format of programmed instruction suggests that there is no room for that person who, according to Skinner and Royce, processes information via the symbolizing route.

Royce claims that each person possesses a particular hierarchical epistemological profile because the three epistemic styles are combined in an individualized psycho-bio-social way. Using his instrument, the Psycho-Epistemological Profile,²⁶ he observed the existence of these profiles. He

23 J. R. Royce, "Epistemic Styles, Individuality and World-View", p. 13.

24 Idem, ibid.

25 B. F. Skinner, Verbal Behavior, p. 434-435.

26 To be discussed in Chapter Four.

also noted the various forms of epistemological encapsulation in three specific professions: chemistry-biology, music-drama and mathematics-physics.²⁷ The normative data published validating the psycho-epistemic instrument indicated a roughly equal division among the three modes of knowing in a sample of 1,342 subjects. It would appear feasible then, to suggest that at least one third of a randomly selected population may have metaphorism as its predominant epistemic style.²⁸ This epistemic style activates such cognitive styles as low compartementalization and high conceptual integration. Subsumed under these two styles are such traits as ideational fluency, originality and expressional fluency along with such affective characteristics as excitability, high anxiety and unconventionality. It becomes clearer then that this metaphoric style activates an information processing route that appears to be incompatible with the inductive and/or deductive reasoning route along with the "signific", overt responding mode and extended sequentiality of the learning task in programmed instruction.²⁹

27 J. R. Royce et al., Manual: Psycho-Epistemological Profile, Edmonton, University of Alberta Press, 1975, p. 21.

28 Idem, ibid., p. 13.

29 B. F. Skinner, Verbal Behavior, p. 420.

Skinner does not deny the existence of metaphoric knowing, he simply rules it out of scientific consideration³⁰ and as a consequence programmed instruction is void of metaphoric information processing characteristics. This may possibly help explain why authors such as Garruto,³¹ Tanner³² and Hoban³³ noted that because of the inductive or sometimes deductive sequence in programmed instruction, the intuitive, creative, divergent-thinking person feels uncomfortable when exposed to the strategy.

The closely guided control of the thought processes of the individual as he proceeds step by step through the learning material subtly shifts the cognitive initiative from the individual to the program. Such a process appears to be incompatible with independent-minded, verbal, unconventional, emotional and physiognomic individuals. Crutchfield and Covington³⁴ did actually suggest the potential detrimental

30 Idem, Beyond Freedom and Dignity, p. 189-191 and 197.

31 J. C. Garruto, "Is Programmed Instruction Favourable to the Development of Creative Insights?", in School and Society, Vol. 91, No. 2227, 1963, p. 223.

32 D. Tanner, "The Machine Teacher and the Human Learner", in A. de Grazia, D. Sohn (eds.), Programs, Teachers, and Machines, Toronto, Bantam Books, 1962, p. 303.

33 C. F. Hoban, "Man, Ritual, The Establishment and Instructional Technology", in Educational Technology, Vol. 8, No. 20, 1968, p. 5.

34 R. S. Crutchfield and M. V. Covington, "Programmed Instruction and Creativity", Theory into Practice, Vol. 5, No. 4, Oct. 1966, p. 179-183.

effects of programmed instruction on individuals who are predominantly metaphoric. They further suggested that the highly structured and overtly controlled character of the strategy makes it less able to accommodate "the distinctive and idiosyncratic ways in which an individual thinks".³⁵

The negative effects of programmed instruction on some individuals may possibly be linked to those who respond that such learning activities are unwanted and boring. Noble and Gray seemed to suggest this although unaware of Royce's work. They wrote the following: "the more children enjoyed English literature the more they grew to dislike programmed instruction".³⁶ Since the study of English literature is more closely related to a metaphoric epistemic style³⁷ and programmed instruction to an empirical and/or rational epistemic style, differences in attitudes might be possibly explained by Royce's model. In a somewhat similar conclusion the Aýcas and Pascal study concluded, "that students studying different subjects differed considerably from one another".³⁸

35 Idem, ibid., p. 180.

36 B. G. Noble and K. Gray, "The Impact of Programmed Instruction: A Longitudinal Attitudinal Study", in Programmed Learning and Educational Technology, Vol. 5, No. 4, 1968, p. 280.

37 J. R. Royce et al., Op. Cit., p. 36.

38 M. Aýcas, C. E. Pascal, "Convergent, Divergent and Esthetic Ability and Bias in College Students: Their Relation to Personality and Preference for Major Subject and Instructional Method", in Improving Human Performance, Vol. 3, No. 1, 1974, p. 36.

Since Mathematics and Art for example are two different subjects possessing a predominantly rational and metaphoric epistemic style respectively, students specializing in those two areas would possess the compatible epistemic style of each and as a consequence would be epistemologically different from one another.

In another study, Roth invited his students to react to the Holland and Skinner programme: The Analysis of Behavior. The following student quotations³⁹ from the Roth study will serve to illustrate the lack of consensus regarding attitude towards the strategy.

It is a detriment to creativity, critical thinking, and problem-solving.

There was no motivation for thinking, reflection, meaning, or non-conformity.

It is difficult to conceive that critical, creative, and independent thinking would result from this type of instruction.

I myself enjoyed learning through this method [...] I enjoyed it very much.

With this program, I had successive goals which were reached in a pleasant, painless, and effective manner.

The Naumann study⁴⁰ done with subjects from Harvard, Oberlin

39 R. H. Roth, "Student Reactions to Programmed Learning", in A. de Grazia, D. Sohn (eds.), Op. Cit., p. 281-287.

40 T. F. Naumann, "A Laboratory Experience in Programmed Learning for Students in Educational Psychology", in Journal of Programmed Instruction, Vol. 1, No. 1, 1962, p. 9-18.

and Central Washington State College with the same programme reinforced the findings of the Roth study. As both authors stated, roughly 45% of those subjects tested experienced boredom and negativism from the instructional strategy. Since no investigation was made as to reasons which might explain the attitudes of those subjects, Royce most likely would have concluded that there was a mismatch between the teaching strategy and the epistemic styles of the students.

Royce suggested that cultural characteristics of certain persons and even countries produce specific epistemic profiles. He posited that certain cultural groups possess epistemic profiles in contradistinction to others. He illustrated this point by empirical evidence which indicated that in general the French are more "metaphorical" than "empirical."⁴¹ This fact would tend to give more credence to Hartley's evaluation of programmed instruction in European and African countries. He concluded that "Skinner's techniques have not been shown to be universally valid".⁴²

More specifically, the theoretical analysis to this point suggests that there may well be a relationship between Royce's psycho-epistemic styles and variability in achievement

41 J. R. Royce et al., Op. Cit., p. 51.

42 J. Hartley, "Programmed Instruction 1954-1974: A Review", in Programmed Learning and Educational Technology, Vol. 11, No. 6, 1974, p. 286.

in programmed instruction. Theoretically, a predominantly metaphoric epistemic style appears to be incompatible with the predominantly empirical and sometimes rational epistemic nature of programmed instruction and its underlying methodological behaviourism. The next section will attempt to delineate the problem and to formulate a research question.

2. The Problem.

The theoretical exploration has arrived at the point where uncertainty is best resolved by some reference to empirical investigation. Although this study is primarily a theoretical exploration, some empirical evidence would strengthen the possible explanation of variability in achievement in terms of psycho-epistemic styles. The problem to be explained is whether variability in achievement in programmed instruction is related in some way to what Royce has described as epistemic styles.

The preceding section suggested that a person possessing a predominantly metaphoric epistemic style might not react favourably when exposed to programmed instruction materials. The possible incompatibility between a person's epistemological profile in which metaphorism is rated as predominant and the empirical/rational epistemology underlying programmed instruction might possibly help explain the wide range of scores on a post-test in spite of highly set pre-established performance

criteria (90/90). On the other hand, that person possessing an epistemological profile in which metaphorism is rated as lowest might attain more readily the pre-established performance criterion.

Within a particular population, the existence of a significant group of predominantly metaphoric epistemic styles might possibly account for the broad range in achievement in programmed instruction. Stated more precisely, do subjects possessing an epistemological profile in which metaphoric style is rated as lowest achieve significantly higher scores on programmed instruction post-tests than do subjects whose epistemological profile indicate a predominant metaphoric style?

The problem is one which the current theoretical and empirical literature in programmed instruction does not consider or for that matter specifically acknowledge. A possible explanation to the problem seems to be suggested by the preceding theoretical analysis. Two observations resulting from that analysis will be reinforced.

The first observation supporting the likelihood of a relationship between epistemic style and achievement in programmed instruction is the continued reference by authors

such as Powell,⁴³ Winn,⁴⁴ Downey,⁴⁵ Marler,⁴⁶ von Bertalanffy,⁴⁷ van Kaam,⁴⁸ Suchett-Kaye,⁴⁹ Wirsing⁵⁰ and Pai,⁵¹ that epistemological encapsulation of theories and models prevents researchers from explaining some contradictory findings in their studies. The experimentally oriented studies in psychology and education seem to maximize the rational and empirical modes of knowing and to minimize the metaphoric mode.⁵² This then,

43 W. R. Powell, "The Nature of Individual Differences", in R. A. Weisgerber, Perspectives in Individualized Learning, Itasca, Ill., Peacock Publishers, 1971, p. 104.

44 W. Winn, "An Open-System Model of Learning", in A. V. Communication Review, Vol. 23, No. 1, 1975, p. 33.

45 L. Downey, The Secondary Phase of Education, Toronto, Blaisdell, 1965, p. 65.

46 C. D. Marler, Philosophy and Schooling, Boston, Allyn & Bacon, 1975, p. 19-24.

47 L. von Bertalanffy, General System Theory, New York, George Brazillier, 1968, p. 186-192.

48 A. van Kaam, Existential Foundations of Psychology, New York, Image Books, 1969, p. 15-23.

49 C. Suchett-Kaye, "Personality Factors and Self-Instruction: A Survey", in Programmed Learning and Educational Technology, Vol. 9, No. 4, 1972, p. 206.

50 M. E. Wirsing, Teaching and Philosophy: A Synthesis, Boston, Houghton Mifflin, 1972, p. 42-65.

51 Young Pai, Teaching, Learning and the Mind, Boston, Houghton Mifflin, 1973, p. 1-10.

52 J. R. Royce, "Epistemic Styles, Individuality and World-View", p. 13.

might possibly explain the widespread inattention or lack of concern about such metaphoric phenomena as intuition, creativity, analogical thinking, and motivation in programmed instruction research. On the other hand, humanistic psychology and education seem to maximize the metaphoric mode⁵³ and consequently seem to be less influenced by experimental findings. Generally, humanistic psychology and education express concern about the overt and structured nature of programmed instruction.⁵⁴

The second observation to be made concerns the broad range of scores in achievement in programmed instruction. Because of the overt responding, structured, sequential, inductive and/or deductive knowing process underlying programmed instruction, the variability in achievement scores on post-tests can possibly be examined in terms of epistemic style matching. It appears feasible to suggest on the one hand that subjects possessing a predominantly metaphoric epistemic style should not succeed as well on a post-test because of a mismatch between their predominant epistemic style and the predominantly empirical or rational nature of

53 Idem, "Psychology is Multi: Methodological, Variate, Epistemic World-View, Systemic, Paradigmatic, Theoretic, and Disciplinary", unpublished address to the Nebraska Symposium on Conceptual Foundations of Theory and Method in Psychology, University of Nebraska, Feb. 27-28, 1975, p. 38-39.

54 A. H. Maslow, The Farther Reaches of Human Nature, New York, Viking Press, 1971, p. 168-179.

the programming sequence. On the other hand, those subjects possessing an epistemological profile in which the metaphoric style is rated the lowest should be expected to show higher scores on a post-test because of the compatibility of their epistemic information processing route and the one inherent in programmed instruction.

3. The Hypothesis.

A thorough search of the relevant literature has not disclosed any attempt to differentiate subjects in terms of Royce's epistemological styles when exploring the effectiveness of teaching strategies. Furthermore, the advocates of programmed instruction do not appear to admit the existence of a metaphoric epistemic style or if they do, they dismiss it as irrelevant. It does seem logical then, from the preceding theoretical analysis to hypothesize that epistemic styles might help to explain the variability in achievement scores with respect to programmed instruction. It is therefore hypothesized that:

achievement in programmed instruction as measured by post-test scores is significantly higher for that group whose metaphoric epistemic style is rated the lowest than for that group whose metaphoric epistemic style is rated the highest.

CHAPTER IV

RESEARCH METHODOLOGY AND EXPERIMENTAL DESIGN

This chapter presents the empirical aspect of the present study which evolved from the research hypothesis outlined in the previous chapter. The two research instruments and the treatment are discussed. This discussion is followed with a description of the sample and extreme groups, the procedure used in the collection of the data and the statistical techniques used in the analysis of the data.

1. The Measuring Instruments.

Two instruments were used: a) The Psycho-Epistemological Profile (PEP) as developed by Royce and b) the post-test of Human Factors in Manpower Counselling: A Self-Instruction Manual. Each of these instruments will be discussed.

a) The Psycho-Epistemological Profile (PEP)

This instrument was developed by Royce et al.¹ as a comprehensive measure of the three epistemic styles. An epistemic style is conceptualized as a major personality

¹ J. R. Royce et al., Manual: Psycho-Epistemological Profile, Edmonton, Center for Advanced Study in Theoretical Psychology, University of Alberta, 1975, 63 p.

integrator which determines an individual's particular "world-view".² Each epistemic style, according to Royce activates a particular information processing route of psychological processes and involves a different criterion to truth. These are indicated in Figure 5. While it is desirable to invoke all the available ways of knowing in order to gain the most comprehensive world-view, individuals tend to be partial to one of the three epistemic styles. The underlying concept behind the PEP is that each individual has a hierarchical commitment with respect to the three epistemologies. The dominant epistemic style will activate in an individual that system and set of subsystems reflected in his epistemological commitment.

The development of PEP began in 1961 and to date there have been six revisions. The instrument used in this study is the latest known as Form VI. This form is a 90 item test, (30 items measuring each dimension) randomly ordered in which the subject is to indicate agreement of a five-point scale.³

2 J. R. Royce, The Conceptual Framework for a Multi-Factor Theory of Individuality, USC, The Center for Advanced Study in Theoretical Psychology, Edmonton, University of Alberta, Paper presented at the third Bank Conference on Theoretical Psychology, Sept. 25-Oct. 2, 1971, at Banff, Alberta, p. 25-26.

3 See Appendix 1.

Epistemic Style	Sub-hierarchy of Cognitive Processes	Truth Criterion
Rationalism	Conceptualizing	Logical-illogical
Empiricism	Perceiving	Perception-misperception
Metaphorism	Symbolizing	Universal-idiosyncratic

Figure 5. The Cognitive Processes and Truth Criteria of Epistemic Styles.

J. R. Royce et al., Manual: Psycho-Epistemological Profile, Edmonton, University of Alberta, Center for Advanced Study in Theoretical Psychology, 1975, p. 1.

To study the validity of the PEP, Royce examined the scores of groups whose characteristics were known. Smith et al.,⁴ confirmed that empiricism was the more dominant epistemic characteristic among those professional persons engaged in chemistry and biology, that metaphorism was more dominant among professional persons engaged in the performing arts and that rationalism was more dominant among those engaged in mathematics and theoretical physics. Additional evidence for the validity is cited by Royce. He selected names from the Journal of Symbolic Logic, Vol. 28, 1963, for the names of mathematics and philosophy subjects; for the group designated as geophysicists he selected them from various petroleum corporations; and for the group of experimental psychologists, they were drawn from the Directory of the American Psychological Association (1968), that had a membership in Division 3. Names for the speech drama group were drawn from a listing of persons engaged in teaching drama and speech in an academic setting. The means and standard deviations on the three dimensions for the various groups are presented below in Table I. As Royce expected, the Speech-Drama group, the Mathematics-Philosophy group, the geophysics group and the experimental psychology group had as their

4 W. A. Smith et al., "Development of an Inventory to Measure Ways of Knowing", in Psychological Reports, Vol. 21, 1967, p. 529-535.

Table I

Means and Standard Deviations of the PEP Dimensions
for Various Professions.

Epistemic Style Professional Groups	Metaphorical		Rational		Empirical	
	Mean	SD	Mean	SD	Mean	SD
Speech-Drama N = 160	116.9*	16.7	98.9	13.1	98.2	13.4
Mathematics-Philosophy N = 127	94.2	20.7	100.6*	8.7	89.3	15.0
Geophysics N = 114	94.8	8.3	100.5*	26.5	95.0	20.1
Experimental Psychology N = 34	97.2	15.9	97.8	11.8	102.7*	12.0
Combined Groups of Geophysics and Experi- mental Psychology N = 148	95.3	10.5	99.9*	23.9	96.8	18.8

* highest mean score

J. R. Royce et al., Op. Cit., p. 22.

highest scores the epistemic style that Royce envisaged. The two above mentioned studies were replicated by Kearsley.⁵ Using twelve different disciplines ranging from Fine Arts to Zoology, and grouped under Humanities, Analytical Sciences and Life Sciences, he found that the Humanities were metaphorical, the Analytical Sciences were rational and the Life Sciences, empirical. The means obtained for each were significantly different from the other scores at $p < .05$.

In comparing the PEP with other tests, it was found that most of these studies contributed to the construct validity of the test. A study reported by Mos⁶ comparing the PEP with the Allport-Vernon-Lindzey Study of Values, the Myers-Briggs Type Indicator, and the Edwards Social Desirability Scale indicated some significant correlations. Of particular interest are the correlations on the PEP dimensions and the values on the Allport-Vernon-Lindzey Study of Values.

5 J. P. Kearsley, A Simulated Model of Psycho-Epistemology, manuscript submitted for publication (Center for Theoretical Psychology, paper -189A-75), 1975, as found in J. R. Royce et al., Op. Cit., p. 24.

6 L. Mos et al., "A Factor Analysis of Some Measure of Cognitive Style", in Multivariate Behavioural Research, Vol. 9, 1974, p. 47-58.

There is a moderately high positive correlation between rationalism and theoretical values, between metaphorism and the aesthetic, social and religious values, and between empiricism and theoretic, economic and political values.⁷

Furthermore, there is a moderately high negative correlation between rationalism and aesthetic values, between metaphorism and economic and political values, and between empiricism and aesthetic, social and religious values.

Taken as a whole, these above mentioned studies along with those of Zelhart and Wargo,⁸ and Coan⁹ provide considerable support for the theoretical assumptions underlying the construct of epistemic styles and the three dimensions as measured by PEP.

In regard to the reliability of the PEP, test retest reliability studies conducted by Royce on two populations of university students showed the results given in Table II. The first was after a three month interval and the second after a nine month interval.

The author acknowledged that the sample sizes were small. Since reliability is partially a function of sample size, Royce suggested that the correlations would be in the

7 J. R. Royce et al., Op. Cit., p. 27.

8 P. F. Zelhart and D. C. Wargo, "Psychotherapist Epistemologies and Client Outcomes", paper presented to the Rocky Mountains Psychological Association Annual Meeting, Denver, Colorado, May 1971, as found in J. R. Royce, Op. Cit., p. 38-41.

9 R. Coan, "Towards a Psychological Interpretation of Psychology", in Journal of the History of the Behavioral Sciences, Vol. 9, 1973, p. 313-327.

Table II
Test-retest Correlation Coefficients of PEP.

	N - 19 Three month interval	N - 43 Nine month interval
Rationalism	.61	.68
Metaphorism	.78	.66
Empiricism	.67	.87

J. R. Royce, Op. Cit., p. 44.

range of .80 to .90 as N increased.

In looking at correlations among the dimensions of the PEP, Royce and his associates established the following inter-correlations among the dimensions for a junior college population of 1,342 subjects. Moderately high positive correlations indicated considerable dependence among the three epistemological dimensions. Yet their relative degree of independence supported the interpretation that these were three meaningful and isolatable dimensions.¹⁰

It would appear that results from the use of the PEP have proven it to be reliable and valid measure of an individual's epistemic styles.

b) Human Factors in Manpower Counselling: A Self-Instruction Manual, post-test

This instrument was developed by the Instructional Development Section of the Canadian Manpower and Immigration Department as a post-test to the programmed text.¹¹ Since only the last two chapters of the manual were used as treatment, the post-test instrument used in this study was modified to contain only twenty multiple-choice type questions pertaining to the content of these two chapters. Although

10 J. R. Royce, et al., Op. Cit., p. 45.

11 See Appendix 2.

statistical data were not furnished to the author regarding the effectiveness of the programmed text nor to the validity and reliability of the post-test instrument, the quality and high standards set by the Manpower and Immigration Department of the Federal Government is a matter of public record to those involved with the Instructional Development Sections of the various provincial and federal ministries in Canada and the United States.

The writer of this study examined the reliability of the post-test in a test-retest study on a group of 45 elementary teacher education students from Queen's University. Using a one week interval between the first and last testing session, a correlation of .81 was obtained. Although the sample size was rather small, the correlation obtained was considered acceptable for the purposes of this study.

2. The Treatment.

The self-instruction programme used in this study was entitled Human Factors in Manpower Counselling: A Self-Instruction Manual. It was designed and written by the Programmed Learning Section of the Staff Training Division of the Manpower Planning and Development Branch of the Federal Department of Manpower and Immigration of the Canadian Government. First published in 1968, and revised in 1972, the programme has two basic purposes. First, it serves as a prelude

to a manual on Employment Service Testing and utilizes the terminology found in that manual. Second, it acquaints the five thousand or so manpower counsellors with the thinking and underlying assumptions of a behavioural approach to the study of human behaviour relating primarily to the world of work. The programme is divided into three chapters, each with its specific objective.

Chapter I Kinds of Employment Skills and Behaviours

Objective: Successful completion of this self-instruction manual will enable the reader to: assess the goodness of match between an employee client's qualifications and the requirements of specific jobs, according to a designated list of employment skills and behaviours.

Chapter II Basic Factors in Human Behaviour

Objective: Systematically analyze samples of human behaviour in terms of prescribed motivation and reinforcement theory.

Chapter III Methods for Influencing Human Behaviour

Objective: Employ at an elementary level the various techniques of behaviour modification.

Since the construction of a programmed text is a problem of many facets, and that educational and psychological researchers disagree as to what constitutes the proper frame length, pacing, reinforcements, prompting as shown in previous analysis on programmed instruction, this particular programme appears to meet all of the criteria of a programme including the iterative validation process. It was developed through

the use of an activity analysis, behavioural objectives, criterion tests of terminal and sub-terminal behaviour and feedback.

Although there are two well-known programmed instruction sequence models that are currently used, the linear-type developed by Skinner and the branching-type developed by Crowder, this particular type of programmed instruction manual is less known in the United States but well-known and used in Canada. Developed by Friesen, who was responsible for the development of the Programmed Learning Section of the Department of Manpower and Immigration along with the writer of this study, in 1967, it was called integrative programming.¹² The basic difference between integrative and linear or branching programmes resides in the fact that integrative programming successfully combines both the linear and branching techniques. Two criteria are used to select one or the other techniques in terms of a specific frame or set of frames. Firstly, the subject matter itself dictates the particular technique to be employed. The subject matter is not forced within the structure of a linear or branching technique. Secondly, some particular curricular entities within a total programme may demand discrimination on the part of the learner which is better served by branching,

¹² P. A. Friesen, Designing Instruction, Ottawa, F.K.A. Publications, 1971, p. 114-116.

while other sections demanding memory or recall are better served by the linear method. In this particular programmed manual, Chapter One is of the integrative type, Chapter Two is of the branching type and Chapter Three is of the linear type. The subjects used for the experimental part of this study were exposed only to Chapter Two and Three. Two reasons justified the selection. More than three hours of exposure to programmed instruction was considered to be detrimental to this study's volunteer population and as a consequence the attrition rate could be expected to be quite high. Secondly, the subject matter content of Chapter One did not appear to be relevant nor did the tested sample meet the entering behaviour criterion. Consequently, only the last two chapters of this programmed text were used in the experimental part of this study.

3. The Sample.

The samples in this study were not randomly selected; but were obtained by a two-staged sampling scheme. The total number of persons tested was one hundred and ten students enrolled in the Secondary Teacher Education Programme of Queen's University. However, several cases were excluded from the final analysis. Among these were students who, on the basis of their scores on PEP did not meet the required "extreme group" criterion as well as those students who

abandoned the task before being given the treatment.

The final sample for which data were analyzed therefore totalled 63 secondary teacher education students. Both males and females were included in the sample and the ages of individuals ranged from twenty-one to forty seven with 84.7% of the students being between the ages of 22 to 25.

4. Establishment of Extreme Groups.

In order to test the hypothesis of the present study it was necessary to identify each epistemic style profile where metaphoric style was rated as highest and each epistemic profile where metaphoric style was rated as lowest. Although there exists a wide range of possible profiles, the theoretical analysis of this study suggested that variability in achievement might be possibly explained in terms of predominance of either the empirical/rational style or the metaphoric style. It is for this reason then that extreme grouping was utilized.

The following two step procedure was utilized with the total sample of one hundred and ten subjects. First, subjects were divided into two categories; namely, one category for those subjects possessing an epistemic styles profile that indicated the metaphoric style as the highest score obtained on the three scales and the other category for those subjects possessing an epistemic styles profile that

indicated the metaphoric style as the lowest score obtained on the three scales. Second, the following criterion was applied. For a metaphoric style to be considered as the highest, it had to exceed the other two scores by five points or more.¹³ Similarly, for a metaphoric style to be considered as the lowest, it had to be inferior to the other two scores by five points or more. The results indicated that thirty two subjects fell within the high group and thirty one subjects fell within the low group. Hence the comparison groups of the present study consisted of thirty two subjects possessing a high metaphoric style profile and of thirty one subjects possessing a low metaphoric style profile. The PEP scores for these two groups as well as the pre and post-test scores are to be found in Appendix 3 and 4.

5. Method of Data Collection.

Subsequent to the approval of the associate dean of education of Queen's University, various professors in the programme were contacted in April of 1977 as to the possibility of volunteering the use of their students in this study. Data were collected by the author from a total of five classes. On each testing occasion, students were told that the questionnaires and the treatment to be administered formed part

¹³ Communication with the Center for Advanced Study in Theoretical Psychology.

of a research study being done at the graduate level on the possible relationship between achievement in a specific teaching strategy and ways of thinking. The students were also told that their participation in the study and the results that were to be obtained would be made known to them and explained. After these brief introductory remarks, the instructions for PEP and the post-test given as a threshold knowledge test, were read aloud by the author. Students were asked to re-read the instructions before beginning the task. Test booklets were collected immediately after each student completed the task. The average time to complete both instruments was 40 minutes.

The administration of the treatment Human Factors in Manpower: A Self-Instruction Manual was given to each class one week following the administration of the PEP and the threshold knowledge test. Students were instructed to read carefully the instructions found at the beginning of the programmed text and then to begin study from Chapter Two. No other instructions were given. Time to complete the programme varied from 95 minutes to 170 minutes with 80% of the students completing the programmed text in 140 minutes. No significant difference in time to complete the programme was observed between the high and low metaphoric groups. Because of the relatively small sample and the ease of scoring, both instruments were scored by hand.

6. Statistical Techniques Used in the Analysis of the Data.

Data were analyzed using the analysis of covariance techniques described by Keith.¹⁴ The main effect relevant to the hypothesis was tested at .01 level of significance.

Two considerations led to the selection of the statistical techniques used in the analysis of the data. 1) Since this study is meant to be primarily theoretical, the addition of some empirical evidence might help reinforce the possible relationship between variability in achievement and epistemic styles. Therefore the use of a more statistically complete design¹⁵ was not considered justified for the purposes of this study. 2) The utilization of extreme-groups led to the conclusion that ANCOVA satisfied the minimal criteria of a good design.¹⁶

The results of the analysis of the data are reported in the next chapter.

14 V. Keith, Design and Analysis in Experimentation, Ottawa, University of Ottawa, 1972, p. 177-187.

15 L. J. Cronbach and R. E. Snow, Aptitudes and Instructional Methods, p. 40-55.

16 Idem, ibid., p. 61.

CHAPTER V

PRESENTATION AND DISCUSSION OF RESULTS

The results of the analysis of the data are reported in this chapter. Accordingly, the chapter has three sections corresponding to its three objectives. In the first section, the research problem and hypothesis are recapitulated. The second section presents the results of testing the hypothesis of this study. Finally, the third section discusses the results obtained in testing the hypothesis.

1. Recapitulation of the Research Problem and Hypothesis.

The present study was based on the following research question: Does the particular epistemic styles profile of a student in some way influence his achievement in programmed instruction? More specifically the question asked: Do students possessing an epistemic styles profile in which the metaphoric style is rated as lowest achieve significantly higher scores on programmed instruction post-tests than do students whose epistemic styles profile indicate a predominant metaphoric style?

From this question, the research hypothesis forming the nucleus of the study was stated as follows: Achievement in programmed instruction as measured by post-test scores is significantly higher for that group whose metaphoric

epistemic style is rated the lowest than for that group whose metaphoric epistemic style is rated the highest. In accordance with the above hypothesis the independent variable is high and low metaphoric style and the dependent variable is achievement scores as measured by the post-test.

2. Results of the Analysis of Covariance.

The performance of the low and high metaphoric groups is shown in Tables III and IV. In Table III, the adjusted and unadjusted dependent variable means are presented for both groups. The results indicate that the adjusted dependent variable mean, is greater for the low metaphoric group. This finding suggests that the directionality of the prediction is confirmed.

The assumptions underlying analysis of covariance used in this study were met. Homogeneity of regression was found to be non-significant ($F = .056$). As for homogeneity of variance using Hartley's test,² the $F_{\max}$ was non-significant ($.01 F_{\max} 1.11$).

The analysis of covariance was computed to test the hypothesis that the low metaphoric group would achieve significantly higher scores on an adjusted post-test than the high

² H. O. Hartley, "The Maximum F-Ratio as a Short-Cut Test for Heterogeneity of Variance", in Biometrika, Vol. 37, 1950, p. 308-312.

Table III

Adjusted and Unadjusted Means for the Low and High Metaphoric Groups

Group	N	Post-Test Adjustment	Unadjusted	Pre-Test Achievement
Low metaphoric	31	23.84	23.9	17.7
High metaphoric	32	20.03	19.9	17.5

Table IV

Analysis of Covariance of the Adjusted Post-Test Scores for the High and Low Metaphoric Groups.

Source of Variation	Degree of Freedom	Sum of Squares	Mean Square	F
Between	1	227.741	227.741	33.61*
Within	60	406.597	6.777	
Total	61	634.339		

* F required for significance at 0.01 level = 7.08

metaphoric group. Table IV reveals a significant positive difference in favour of the low metaphoric group. It would appear from Tables III and IV that the hypothesis that the low metaphoric group would achieve significantly higher scores on a post-test than the high metaphoric group, was confirmed.

Using Pearson's coefficient of correlation ($r = .7345$), the coefficient of determination was computed to be $r^2 = .5329$. It would appear then that fifty three percent of the variance in the post-test is explained by the pre-test. This seems to give further justification for using analysis of covariance.

In summary, the hypothesis that achievement in programmed instruction as measured by post-test scores is significantly higher for that group whose metaphoric epistemic style is rated the lowest than for that group whose metaphoric epistemic style is rated the highest, was confirmed.

3. Discussion of the Results.

The results of the empirical part of this investigation clearly support the hypothesis being tested. The predicted differences in achievement as measured by the post-test scores for the low and high metaphoric groups were found at levels that satisfy the criteria for statistical significance.

The discussion of the results which follow includes statements regarding some considerations based on the findings of the study.

The empirical studies in programmed instruction reviewed in the first chapter of this study indicated that programmed instruction did not in general fare any better than conventional methods. The broad range in achievement scores in conventional teaching strategies was also noted in programmed instruction. This study reinforces that observation. An analysis of the results in Appendices 3 and 4 indicates that the post-test scores for the high and low metaphoric group range from a minimum of twelve to a maximum of thirty. Although the programmed text was not intended specifically for teacher education students, the text was not incompatible with the subjects used in this sample. Most manpower counsellors, for whom the text was written, possess academic qualifications similar to teacher education students.

The studies of such authors as Tanner,³ Thelen,⁴ Lumsdaine and Glaser,⁵ Sutter and Reid,⁶

3 D. Tanner, "The Machine Teacher and the Human Learner", in A. De Grazia and D. A. Sohn, Programs, Teachers, and Machines, Toronto, Bantam Books, 1962, p. 303.

4 H. A. Thelen, "The Triumph of 'Achievement' Over Inquiry in Education", in Elementary School Journal, Vol. 60, 1960, p. 190-197.

5 R. Lumsdaine and A. Glaser (eds.), Teaching Machines and Programmed Learning, Washington, Dept. of A. V. Communication, N.E.A., Vol. 1, 1960, p. 46.

6 E. G. Sutter and J. B. Reid, "Learner Variables and Interpersonal Conditions in Computer-Assisted Instruction", in Journal of Educational Psychology, Vol. 60, No. 3, 1969, p. 153-157.

Summers⁷ and Hoban,⁸ as found in the review of the literature of this study, had suggested a possible link between epistemological commitments on the part of learners and success in programmed instruction. The results of this study appear to empirically reinforce their suggestion. More specifically, this study by providing some supportive empirical data of the theoretical relationship of epistemic styles to success in programmed instruction has partly answered Vernon's⁹ assertion that such empirical data was badly needed. Furthermore, the data generated from this study reinforce the theoretical speculations of such authors as Bruner,¹⁰ Morris and Pai,¹¹ Pai¹² and Wirsing,¹³ that there may be a direct

7 E. G. Summers, "Programmed Instruction and the Teaching of Reading", in Educational Technology, Vol. 4, No. 10, 1965, p. 1-13.

8 C. F. Hoban, "Man, Ritual, The Establishment and Instructional Technology", in Educational Technology, Vol. 8, No. 20, 1968, p. 5-11.

9 M. D. Vernon, The Psychology of Perception, Baltimore, Penguin, 1962, p. 302.

10 Jerome Bruner, On Knowing: Essays for the Left Hand, Cambridge, Harvard University Press, 1962, p. 123-125.

11 Van Cleve Morris, Young Pai, Philosophy and the American School, Boston, Houghton Mifflin, 1976, p. 102-265.

12 Young Pai, Teaching, Learning and the Mind, Boston, Houghton Mifflin, 1973, 226 p.

13 Marie Wirsing, Teaching and Philosophy: A Synthesis, Boston, Houghton Mifflin, 1972, 226 p.

relationship between epistemological commitments on the part of learners and teaching and learning effectiveness.

As this study has indicated, the low metaphoric group appears to have profited the most from programmed instruction. This group, defined as having scored higher on the empirical and rational scales than on the metaphoric scales performed significantly better on the post-test than did the high metaphoric group. Since the high metaphoric group is composed of persons possessing higher scores on the metaphoric scale than on the rational and empirical scales, the hypothesized incompatibility between the overt-responding, structured, individualized nature of the strategy, described in Chapter Three as being basically empirical and in some cases rational, was confirmed empirically.

However, three considerations seem to be justified at this point. First, since the sample was not randomly chosen but rather selected on a volunteer basis, the willingness of the volunteers to participate may reflect some particular characteristics not shared by those who did not volunteer. Therefore, it may be possible that those who volunteered and made up the sample may have differed from the target population. In addition, the establishment of extreme groups from the volunteered sample further reduced the size of the sample. The exclusion of subjects from an already non-randomized sample reinforces the fact that some caution

should be exercised in extrapolating possible conclusions. Finally, the establishment of extreme groups narrows the representativity of the sample to the population. Those possessing a predominant epistemic style defined as having a scale score of at least five points higher than each of the other two scales, represent according to Royce no more than 40% of a particular sample.¹⁴ Therefore, generalizability of results from sample to population must be done with caution, although this 40% may account for the variability in achievement.

The second consideration concerns the possible relationship that might exist between attitude towards programmed instruction and epistemic styles. Although the use of an attitude instrument was not judged to be relevant to this study, the writer did observe more negative attitude towards the strategy from the high metaphoric group than from the low metaphoric group. It seems feasible to suggest that if there is no epistemic style matching between a teaching strategy and the learner, the incompatibility could be manifested by the learner through a negative attitude towards the strategy. This would tend to reinforce one of the conclusions of the Noble and Gray study¹⁵ that students who enjoyed English

14 Communication with the author.

15 B. G. Noble and K. Gray, "The Impact of Programmed Instruction: A Longitudinal Attitudinal Study", in Programmed Learning and Educational Technology, Vol. 5, No. 4, 1968, p. 280.

literature more than other subjects tended to dislike programmed instruction. Further research in the area of attitudes towards programmed instruction, epistemic styles and achievement would seem justified.

The third consideration suggests that programmed instruction may not be a teaching strategy that is effective for everyone. The claim made by such authors as Homme,¹⁶ Pocztar,¹⁷ and Fry¹⁸ that programmed instruction could teach anything to anyone to a degree unmatched by other conventional methods does not appear to have been substantiated in this study. Rather, Hartley's conclusion that "Skinner's techniques have not been shown to be universally valid"¹⁹ appears to have been confirmed in the light of the results of this particular study. More specifically, the existence of persons possessing a predominantly metaphoric epistemic style profile casts some doubts as to the holistic nature of the

16 L. E. Homme, "The Rationale of Teaching by Skinner's Machines", in A. A. Lumsdaine and R. Glaser (eds.), Op. Cit., p. 133.

17 J. Pocztar, The Theory and Practice of Programmed Instruction, Paris, UNESCO, 1972, p. 134.

18 E. B. Fry, Teaching Machines and Programmed Instruction: An Introduction, New York, McGraw-Hill, 1963, p. 199-206.

19 J. Hartley, "Programmed Instruction 1954-1974: A Review", in Programmed Learning and Educational Technology, Vol. 11, No. 6, 1974, p. 286.

epistemological assumptions underlying Skinner's methodological behaviourism. This study seems to indicate that a certain segment of the population, namely those who are predominantly metaphoric, have no place in Skinner's model and as such have contributed significantly when exposed to programmed instruction, to the broad range of scores. A question emerges then from this study: What percentage of those subjects who participated in the research studies reviewed in Chapter I of this study possessed a predominantly metaphoric epistemic style and to what degree did they contribute to the contradictory findings? An answer to the question seems highly impossible. The question is considered important in that it reveals the necessity of taking into consideration in future research the possible influence of epistemic styles on achievement.

A summary of this research study along with a statement of conclusions follow in the next chapter.

SUMMARY AND CONCLUSIONS

The purpose of this study was to investigate and establish the theoretical relationship between epistemic styles and variability in achievement. Subsumed within the purpose was the empirical evidence gathered to support the theoretical relationship by examining more closely epistemic styles and variability in achievement in programmed instruction as measured by post-test scores.

The first part of the study was an examination of variability in achievement in general, and in particular variability in achievement in programmed instruction. The review of the literature in programmed instruction indicated that contrary to the claims made by the proponents of the instructional strategy, few studies demonstrated programmed instruction's superiority in reducing variability in achievement. In fact, most studies concerning variability in achievement were of a contradictory nature and uneven achievement outcomes seemed to be the rule rather than the exception.

The second part of this study examined reasons offered by some authors to explain such variability in achievement. The use of Royce's Multi-Factor Theory of Individuality was justified as a possible contributing explanation of the broad range in achievement scores found in most programmed instruction studies.

The problem discussed in the third part of the study poses the following question: Does the group characterized as having a low metaphoric style achieve better results on a programmed instruction post-test than does the group characterized as having a high metaphoric style?

From this question it was hypothesized that: Achievement in programmed instruction as measured by post-test scores is significantly higher for that group whose metaphoric epistemic style is rated the lowest than for that group whose metaphoric epistemic style is rated the highest.

The fourth part of this study described the techniques used to test the hypothesis. Two research instruments were employed. The Psycho-Epistemological Profile devised by Royce et al., was used to determine the low and high metaphoric groups and the Human Factors in Manpower Counselling post-test was used to determine achievement in programmed instruction. The treatment used in this study was the Human Factors in Manpower Counselling programmed text developed by the Programmed Learning Section of the Federal Department of Manpower and Immigration.

The research sample, after the establishment of the extreme groups, consisted of sixty three secondary teacher education students enrolled at Queen's University in Kingston, Ontario, during the 1976-1977 academic year. An analysis of

covariance was used to test the results. The level of α was set at .99. The results favoured the hypothesis at levels that satisfied the criteria for statistical significance.

In the fifth part, it was concluded that achievement in programmed instruction as measured by post-test scores is significantly higher for that group whose metaphoric epistemic style is rated the lowest than for that group whose metaphoric epistemic style is rated the highest.

The contribution of this study is both theoretical and practical. The theoretical contribution lies in the link established between psycho-epistemic styles and variability in achievement in programmed instruction. Although caution is to be recommended, five conjectures can be put forth.

First, psycho-epistemic styles may be what Cronbach and Snow suggested;¹ one of those as yet undetected variables that could be responsible for variability in achievement. Some authors in philosophy and psychology of education had speculated on a possible relationship between epistemological commitment on the part of learners and learning effectiveness, but the originality of this study appears to be the specific link established between Royce's psycho-epistemic styles and variability in achievement. Despite the univariate

¹ Lee J. Cronbach and Richard E. Snow, Aptitudes and Instructional Methods, New York, Irvington Publishers, 1977, p. 6.

experimental design, the empirical evidence gathered served to reinforce the theoretical analysis presented in this study and to encourage a more multivariate investigation in the area of trait-treatment interaction.

Second, this study has contributed to the strength of the theoretical framework of the Multi-Factor Theory of Individuality. Psycho-epistemic-styles are hypothesized to be the activators of the various information processing routes taken by individuals. The theoretical analysis of the epistemic style underlying programmed instruction has provided some confirmation and justification of Royce's hypothesized information processing routes in his hierarchical systems view of individuality. This secondary contribution should encourage a more exhaustive and detailed analysis of which of the cognitive and affective styles along with their respective traits are of importance when an individual is faced with a specific teaching strategy.

Third, the findings of this study have also indicated that a possible explanation to the preference of learners for specific instructional strategies might in some way be linked in part to epistemological compatibility between the learner and the instructional strategy. In the case of this study, those students who possessed a predominantly metaphoric epistemic style were not compatibly matched to the empirical/rational epistemic style of programmed instruction and as a

consequence did not fare as well on post-test scores.

Fourth, psycho-epistemic styles raise an interesting question regarding epistemological assumptions in educational and psychological theories. The psychological principles that led to the development of programmed instruction are based on Skinner's methodological behaviourism. Since, as this study suggested, the metaphoric epistemic style is neglected and ignored by Skinner, it appears logical to assume that those learners possessing that epistemic style in predominance were disadvantaged in programmed instruction. An empirical investigation of various teaching methods resting on predominantly metaphorical and/or rational epistemologies would appear to be needed.

Fifth, as noted in Chapter II, the Educational Sciences Model developed by Hill was not selected because of its apparent theoretical weakness. A research study investigating the possible relationships between PEP and the Cognitive Style Mapping instrument of the Educational Sciences may help provide theoretical strength for the Hill model and further support for the Multi-Factor Theory of Individuality.

In summation, a practical conclusion that can be drawn from the present research is that Royce's psycho-epistemic styles can be a valuable instrument in education. The practical applications in theoretical as well as classroom realities appear numerous. More specifically, teacher

education students could be made aware, in a concrete manner, of the possible epistemological mismatch between teaching strategies, curricular contents, and learning styles of individuals. Further, PEP can provide them with insight regarding their area of specialization and their epistemological commitments used in educational decision-making.

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APPENDIX 1
THE PSYCHO-EPISTEMOLOGICAL PROFILE
FORM VI

University of Alberta

Edmonton

P.E.P.

Experimental Form VI

Directions

For each of the following statements, you are to indicate your personal agreement or disagreement on the scale provided on the answer sheet. 'CD' means complete disagreement with the statement, 'MD' means moderate disagreement, 'N' means neutral, 'MA' means moderate agreement, and 'CA' means complete agreement.

Here is a sample question:

The Roman Empire fell because of moral degeneration of its rulers.

CD MD N MA CA

--- --- --- ~~---~~ ---

In this example, the person agrees with the statement, but not entirely, so they have blacked out the space under 'MA' -- moderate agreement.

Your personal preference alone is required. There are no right or wrong responses. It is necessary, however, that you answer all of the questions. Be sure to clearly mark the appropriate space for each question. Use a pencil and erase any extra marks. Trust your first impression. There is no time limit.

1. A good teacher is primarily one who has a sparkling entertaining delivery.
2. The thing most responsible for a child's fear of the dark is thinking of all sorts of things that could be "out there".
3. Most people who read a lot, know a lot because they come to know of the nature and function of the world around them.
4. Higher education should place a greater emphasis on fine arts and literature.
5. I would like to be a philosopher.
6. A subject I would like to study is biology.
7. In choosing a job I would look for one which offered opportunity for experimentation and observation.
8. The Bible is still a best seller today because it provides meaningful accounts of several important eras in religious history.
9. Our understanding of the meaning of life has been furthered most by art and literature.
10. More people are in church today than ever before because they want to see and hear for themselves what ministers have to say.
11. It is of primary importance for parents to be consistent in their ideas and plans regarding their children.
12. I would choose the following topic for an essay: The Artist in an Age of Science.
13. I feel most at home in a culture in which people can freely discuss their philosophy of life.
14. Responsibility among men requires an honest appraisal of situations where irresponsibility has transpired.
15. A good driver is observant.
16. When people are arguing a question from two different points of view, I would say that the argument should be resolved by actual observation of the debated situation.

17. I would like to visit a library.
18. If I were visiting India, I would be primarily interested in understanding the basis for their way of life.
19. Human morality is molded primarily by an individual's conscious analysis of right and wrong.
20. A good indicator of decay in a nation is a decline of interest in the arts.
21. My intellect has been developed most by learning methods of observation and experimentation.
22. The prime function of a university is to teach principles of research and discovery.
23. A good driver is even tempered.
24. If I am in a contest, I try to win by following a pre-determined plan.
25. I would like to have been Shakespeare.
26. Our understanding of the meaning of life has been furthered most by mathematics.
27. I like to think of myself as a considerate person.
28. I would very much like to have written Darwin's "The Origin of Species".
29. When visiting a new area, I first try to see as much as I possibly can.
30. My intellect has been developed most by gaining insightful self knowledge.
31. I would be very disturbed if accused of being insensitive to the needs of others.
32. The kind of reading which interests me most is that which creates new insights.
33. The greatest evil inherent in a totalitarian regime is alienation of human relationships.
34. Most atheists are disturbed by the absence of factual proof of the existence of God.

35. In choosing a job I would look for one which offered the opportunity to use imagination.
36. In my leisure I would most often like to enjoy some form of art, music, or literature.
37. The kind of reading which interests me most is that which stimulates critical thought.
38. I prefer to associate with people who are spontaneous.
39. In my leisure I would like to play chess or bridge.
40. Most people who read a lot, know a lot because they develop an awareness and sensitivity through their reading.
41. When visiting a new area, I first pause to try to get a "feel" for the place.
42. Many T.V. programs lack sensitivity.
43. I like to think of myself as observant.
44. Happiness is largely due to sensitivity.
45. I would be very disturbed if accused of being inaccurate or biased in my observations.
46. A good teacher is primarily one who helps his students develop their powers of reasoning.
47. I would like to be a novelist.
48. The greatest evil inherent in a totalitarian regime are restrictions of thought and criticism.
49. More people are in church today than ever before because theologians are beginning to meet the minds of the educated people.
50. The most valuable person on a scientific research team is one who is gifted at critical analysis.
51. Many T.V. programs lack organization and coherence.
52. I like country living because it gives you a chance to see nature first hand.

53. Upon election to Parliament I would endorse steps to encourage an interest in the arts.
54. It is important for parents to be familiar with theories of child psychology.
55. The prime function of a university is to train the minds of the capable.
56. I would like to have written Hamlet.
57. Higher education should place a greater emphasis on mathematics and logic.
58. The kind of reading which interests me most is that which is essentially true to life.
59. A subject I would like to study is art.
60. I feel most at home in a culture in which realism and objectivity are highly valued.
61. The prime function of a university is to develop a sensitivity to life.
62. When playing bridge or similar games I try to think my strategy through before playing.
63. If I were visiting India, I would be primarily interested in noting the actual evidence of cultural change.
64. When buying new clothes I look for the best possible buy.
65. I would like to visit an art gallery.
66. When a child is seriously ill, a good mother will remain calm and reasonable.
67. I prefer to associate with people who stay in close contact with the facts of life.
68. Many T.V. programs are based on inadequate background research.
69. Higher education should place greater emphasis on natural science.
70. I like to think of myself as logical.

71. When people are arguing a question from two different points of view, I would say that each should endeavor to assess honestly his own attitude and bias before arguing further.
72. When reading an historical novel, I am most interested in the factual accuracy found in the novel.
73. The greatest evil inherent in a totalitarian regime is distortion of the facts.
74. A good driver is considerate.
75. Our understanding of the meaning of life has been furthered most by biology.
76. I would like to have been Galileo.
77. My children must possess the characteristics of sensitivity.
78. I would like to be a Geologist.
79. A good indicator of decay in a nation is an increase in the sale of movie magazines over news publications.
80. I would be very disturbed if accused of being illogical in my beliefs.
81. Most great scientific discoveries come about by thinking about a phenomena in a new way.
82. I feel most at home in a culture in which the expression of creative talent is encouraged.
83. In choosing a job I would look for one which offered a specific intellectual challenge.
84. When visiting a new area, I first plan a course of action to guide my visit.
85. A good teacher is primarily one who is able to discover what works in class and is able to use it.
86. Most great scientific discoveries come about by careful observation of the phenomena in question.
87. Most people who read a lot, know a lot because they acquire an intellectual proficiency through the sifting of ideas.

- 88. I would like to visit a botanical garden or zoo.
- 89. When reading a historical novel, I am most interested in the subtleties of the personalities described.
- 90. When playing bridge or similar games I play the game by following spontaneous cues.

APPENDIX 1

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P.E.P. ANSWER SHEET

NAME		Last		First		Middle		FACULTY OR SCHOOL											
AGE	YEAR OR GRADE	☐ Male ☐ Female		DATE			I. D. NUMBER												
Years				Day	Month	Year	0	1	2	3	4	5	6	7	8	9			
Indicate response by placing a mark between the guidelines as shown in the example. Use HB pencil. Don't make marks longer than guidelines. CD MD <u>Example</u> N MA CA																			
CD	MD	N	MA	CA	CD	MD	N	MA	CA	CD	MD	N	MA	CA	CD	MD	N	MA	CA
26					51					76									
27					52					77									
28					53					78									
29					54					79									
30					55					80									
31					56					81									
32					57					82									
33					58					83									
34					59					84									
35					60					85									
36					61					86									
37					62					87									
38					63					88									
39					64					89									
40					65					90									
41					66														
42					67														
43					68														
44					69														
45					70														
46					71														
47					72														
48					73														
49					74														
50					75														

CAUTION - AVOID PLACING ANY MARKS AMONG THE BLACK TIMING LINES

APPENDIX 2

HUMAN FACTORS IN MANPOWER COUNSELLING POST-TEST

Circle which one(s) of a set of answers is(are) TRUE.

- (1) The factors influencing trainability are:
 - (a) previous learning
 - (b) inborn capacities
 - (c) motivation
- (2) Educational level, special aptitudes and skills, tests and identification of motivators provide us with information about a client's:
 - (a) motivations for further training
 - (b) employability
 - (c) trainability
- (3) You are unsure about a client's professed desire to enroll in an occupational training course. To obtain further information, you would:
 - (a) have him take employment tests
 - (b) subject him to motivation tests
 - (c) examine his academic history and job performance.
- (4) If an individual lacks motivation, this means that he:
 - (a) has not received positive reinforcement
 - (b) has few goals
 - (c) needs negative sanctions
- (5) A client who fails to show up for an appointment may have been influenced in his failure to appear by an:
 - (a) activity motive
 - (b) avoidance motive
 - (c) acquisition motive
- (6) A behaviour not successful in satisfying a motive will be:
 - (a) learned
 - (b) negatively reinforced
 - (c) extinguished
- (7) A behaviour pattern will be learned only if it:
 - (a) avoids aversive stimuli
 - (b) is reinforced
 - (c) is compatible

- (8) A clue about the positive reinforcers in a man's life can be obtained by identifying:
 - (a) high frequency behaviours
 - (b) those things which, when removed or blocked, cause frustration
 - (c) how well he has learned in the past
- (9) By asking the client to choose between alternatives, you can identify:
 - (a) his most valued goals
 - (b) his preferred reinforcers
 - (c) his conflicts
- (10) The behaviours and attitudes of a client tend to reflect the attitudes and behaviours of:
 - (a) his ideal self
 - (b) the individual's primary groups
 - (c) his actual self
- (11) Role refers to:
 - (a) a person's status or position within a group
 - (b) how the group expects a person in the position to behave
 - (c) how the group sees a person in the position behave
- (12) Our behaviour is also controlled by aversive situations. Typical reactions to aversive situations are:
 - (a) avoidance and emotional behaviour
 - (b) frustration and anger
 - (c) indecision and conflict
- (13) The anxiety caused by highly novel situations can be reduced by:
 - (a) adaptation
 - (b) learning
 - (c) positive reinforcement
- (14) Behaviour which is incompatible with employment:
 - (a) has been learned
 - (b) has been reinforced
 - (c) is not motivated

- (15) To produce behaviour change we must use:
 - (a) reinforcement
 - (b) immediate reinforcement
 - (c) appropriate reinforcers
- (16) Performance goals should be:
 - (a) attainable
 - (b) set with the client
 - (c) practiced with correction
- (17) Behaviour change can sometimes be effected quickly by:
 - (a) imitation
 - (b) gradualism
 - (c) instruction
- (18) Undesirable behaviour can be stopped by using:
 - (a) negative sanctions
 - (b) positive reinforcement for alternative behaviour
 - (c) withdrawing its reinforcers
- (19) Joint setting of performance goals can lead to:
 - (a) practice with correction
 - (b) increased motivation
 - (c) self-reinforcement
- (20) A conflict can be resolved by:
 - (a) increasing positive factors
 - (b) decreasing negative factors
 - (c) good sound advice

You have now completed all post-test questions.

APPENDIX 3

SUBJECT DESCRIPTION AND RAW SCORES FOR THE HIGH METAPHORIC GROUP

SUBJECT DESCRIPTION AND RAW SCORES FOR THE HIGH METAPHORIC GROUP

<u>Subject</u>	<u>Age</u>	<u>Sex</u>	<u>Metaphoric</u>	<u>Empirical</u>	<u>Rational</u>	<u>Pre</u>	<u>Post</u>
1	23	F	126	115	107	26	28
2	23	F	119	95	96	16	20
3	47	M	124	85	98	25	26
4	23	M	106	94	98	21	24
5	23	F	117	75	94	11	14
6	24	M	125	106	108	12	15
7	23	M	112	85	87	14	20
8	24	M	115	93	92	15	17
9	24	M	127	106	112	19	15
10	24	F	106	94	91	19	23
11	23	F	122	117	104	10	16
12	25	M	116	109	106	21	23
13	23	M	102	84	89	16	22
14	23	M	103	91	96	15	14
15	24	F	123	110	116	13	15
16	26	M	99	88	79	13	15
17	23	F	123	96	114	21	23
18	22	F	130	91	100	15	18
19	22	F	98	93	91	13	13
20	23	M	97	87	84	13	18
21	22	M	110	81	100	29	26
22	23	F	114	105	109	18	21
23	27	F	123	94	108	22	23
24	22	M	103	85	83	20	22
25	22	F	128	111	120	18	25
26	23	F	104	96	88	15	16
27	22	F	107	97	102	19	23
28	26	F	138	103	115	24	24
29	26	M	117	105	106	18	22
30	25	M	114	92	98	19	24
31	23	F	132	113	123	18	21
32	23	F	119	95	99	13	12

APPENDIX 4

SUBJECT DESCRIPTION AND RAW SCORES FOR THE LOW METAPHORIC GROUP

SUBJECT DESCRIPTION AND RAW SCORES FOR THE LOW METAPHORIC GROUP

<u>Subject</u>	<u>Age</u>	<u>Sex</u>	<u>Metaphoric</u>	<u>Empirical</u>	<u>Rational</u>	<u>Pre</u>	<u>Post</u>
1	22	F	79	88	89	12	19
2	23	M	97	108	107	13	26
3	24	M	72	83	78	23	29
4	25	M	110	122	119	19	25
5	22	M	98	108	112	24	26
6	22	F	106	116	111	17	19
7	22	M	80	97	85	17	23
8	20	M	103	110	124	13	22
9	21	F	99	105	110	20	27
10	23	M	90	104	95	15	19
11	23	F	96	102	112	20	30
12	23	F	94	99	110	22	30
13	26	M	102	108	115	14	25
14	26	M	73	97	87	13	17
15	25	M	100	110	106	23	29
16	22	F	87	95	105	14	18
17	23	M	81	86	91	21	28
18	24	M	81	105	99	23	26
19	25	M	92	98	100	18	24
20	23	F	96	103	105	21	24
21	24	M	100	106	118	15	26
22	23	F	91	97	99	16	25
23	23	F	100	105	115	12	17
24	24	F	86	96	94	13	21
25	24	F	102	109	113	23	27
26	23	M	92	108	120	21	29
27	26	M	90	100	105	14	22
28	23	F	75	110	105	24	30
29	22	F	89	95	100	14	18
30	22	F	78	95	101	17	20
31	23	F	89	102	97	20	21

APPENDIX 5

ABSTRACT OF

A Study of Differences in Achievement Resulting from
Programmed Instruction as a Function of
Royce's Psycho-Epistemological Styles

ABSTRACT OF

A Study of Differences in Achievement Resulting from
Programmed Instruction as a Function of
Royce's Psycho-Epistemological Styles¹

The purpose of this study is to obtain information regarding the possible link between epistemic styles and variability in achievement in programmed instruction. The study is divided into two major parts. The first part, based on a review of the literature examines variability in achievement in general and in particular variability in achievement in programmed instruction. In the search for a possible explanation of variability, the area of philosophical and psychological epistemology is explored. Royce's Multi-Factor Theory of Individuality especially the psycho-epistemic styles section is chosen and explained. The first part ends with the formulation of the problem and the statement of the hypothesis that:

Achievement in programmed instruction as measured by post-test scores is significantly higher for that group whose metaphoric epistemic style is rated the lowest than for that group whose metaphoric epistemic style is rated the highest.

The second part of the study is based on the empirical investigation of the above hypothesis. The measuring instruments include the Psycho-Epistemological Profile and

¹ Richard Rancourt, doctoral thesis presented to the School of Graduate Studies of the University of Ottawa, Ottawa, Ontario, 1978, xii-146 p.

the Human Factors in Manpower Counselling post-test. The treatment consists of learning from the Human Factors in Manpower Counselling programmed text. The sample includes 63 secondary teacher education students enrolled at Queen's University during the 1976-1977 academic year. The data is analyzed using analysis of covariance ($p < .01$). The results are interpreted as favouring the hypothesis.

It is concluded that differences in achievement resulting from programmed instruction may be described as a function of psycho-epistemic mismatch between the learner and the instructional strategy. In addition, it was noted that Royce's Multi-Factor Theory of Individuality, especially the section on psycho-epistemic styles provides evidence that it may be useful as a tool in explaining and possibly predicting differences in achievement resulting from programmed instruction.

Theoretical and practical implications are noted and directions for further research are presented.