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AN EXPERIMENTAL STUDY TO COMPARE LINEAR AND BRANCHING FORMATS OF PROGRAMED INSTRUCTION FOR LEARNING MUSIC FUNDAMENTALS

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AN EXPERIMENTAL STUDY TO COMPARE LINEAR AND BRANCHING FORMATS OF PROGRAMED INSTRUCTION FOR LEARNING MUSIC FUNDAMENTALS

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CHAPTER I

INTRODUCTION

Purpose of the Study

The purpose of the study was to compare linear and branching formats of programed instruction as they pertain to the learning of music fundamentals at the collegiate level. Specifically, the investigation sought to determine the effect of branching and linear program formats on achievement, retention, time required to learn content matter, and general attitude toward programed instructional material.

Need for the Study

In recent years experimental studies dealing with the effectiveness of programed instruction have been conducted at virtually all levels of learning. Research and experience have shown programed material to be a viable means of instruction in education, industry, and the armed forces.

Studies by Kanable,[1] Wardian,[2] and Arcarese,[3] among others, give evidence that programed instruction can be an effective means of teaching

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[1]Betty May Kanable, "An Experimental Study Comparing Programed Instruction With Classroom Teaching of Sight Singing" (unpublished doctoral dissertation, Northwestern University, 1964), Dissertation Abstracts, XXVI (1964).

[2]Jeanne Foster Wardian, "An Experiment Concerning the Effectiveness of Programmed Learning for Use in Teaching the Fundamentals of Music" (unpublished doctoral dissertation, Washington State University, 1973), Dissertation Abstracts, XXIV (1973).

[3]Lawrence C. Arcarese, *et al.*, "Independent Learning of Music Fundamentals," National Society for Programmed Instruction, Journal, VI (July, 1967), pp. 9-12.

the cognitive and skills aspects of music. An examination of publisher's catalogues reveals programed courses of study in written theory, sight singing, dictation, form and analysis, music appreciation, and performance.

While considerable research has been directed toward the development of programed material and the evaluation of its effectiveness, studies comparing the general utility of linear and branching formats have not been sufficient to establish constructs from which broad development and utilization procedures can be referenced. To the knowledge of this writer, only one such comparative study deals specifically with music, the results of which are difficult to generalize to the discipline at large.[1] In view of these considerations a study concerned with the variables of achievement, retention, time required to learn content matter, and general attitude toward programed instruction as correlatives of linear and branching formats was deemed timely and appropriate.

Rationale

During the past two decades American education has undergone extensive modification. In response to changing social, cultural, and technological realities, this period was marked by an infusion of Federal and foundation funding directed toward the development and evaluation of more effective instructional and curricular approaches. Traditional standards and definitions of terminal educational outcomes were challenged in the pursuit of higher and more varied levels of educational excellence. In this regard, Bruner states that:

> . . . It is clear that there is in American education today a new emphasis upon the pursuit of excellence. There seem to

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[1]This study, by James C. Carlsen, is discussed in more detail in Chapter II.

> be several things implied by the pursuit of excellence that have relevance not only to what we teach, but how we teach and how we arouse the interest of our students. . . .[1]

Concepts such as team-teaching, modular scheduling, individualized instruction, new math and science, the open classroom, and acountability are indicative of recent effort directed toward the improvement of instruction and overall curriculum reform.

In music, the Contemporary Music Project (CMP) and the Manhattanville Music Curriculum Program (MMCP) have influenced educational materials, planning, and practice at every level.[2] In keeping with developments in other disciplines, music instruction is now characterized by goals and objectives referenced to concept development, creativity, and a general synthesis of musical competency and demonstrable musical behavior in the areas of performance, composition, and perception.[3] Benson comments on the role of the teacher in the pursuit of such objectives in a summary report of a pilot curriculum project sponsored by the Contemporary Music Project:

> In eight semesters and two summer sessions of teaching this course, . . . it has never been taught the same way twice. The students have been different. . . . It is even possible that last year's teacher, this year is "different." . . . The teacher becomes a focusing agent rather than a focal point. He is a catalyst.[4]

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[1]Jerome S. Bruner, The Process of Education (New York: Vintage Books, 1960), p. 70.

[2]Adrienne Fried Block, "Sources and Resources; and Now We Begin--A Survey of Recent Theory Texts," College Music Symposium Journal of the College Music Society, XIII (Fall, 1973), pp. 99-100.

[3]Ronald B. Thomas, Manhattanville Music Curriculum Program: A Structure for Music Education (Bardonia, New York: Media, Inc.), pp. 15-21.

[4]Warren Benson, Creative Projects in Musicianship (Washington: Contemporary Music Project/Music Educators National Conference, 1967), p. 45.

Although CMP and MMCP philosophies are based on Gestalt psychology, being concerned with the elemental parts of music as they relate to the whole, each recognizes the value of programed instruction in achieving stated goals. Willoughby maintains:

> . . . it must be made clear that comprehensive musicianship does not reject programed learning, drill, technological hardware, or any system that might relate more to behaviorist than to Gestalt psychology. It regards these items as means to the end of developing a more complete musicality; therefore, they should serve and enhance the musical experiences of composition, performance, and analysis.[1]

During a personal interview with the writer, Ronald Thomas stated that:

> . . . MMCP, which is based on Gestalt psychology, is compatible with programed instruction and other behaviorist methodologies so long as such means are flexibly employed to strengthen operational competencies. Skills and skill training techniques must never become fundamental goals.[2]

Whether viewed traditionally, or within the context of contemporary trends in music education and curriculum, programed instruction can serve as an effective means of teaching fundamental or supplemental material, thus allowing the teacher more flexibility and the freedom to pursue broader purposes. This contention is supported by Bruner who views programed instruction as a means of releasing teachers from direct responsibility of teaching fundamental concepts, skills, and factual material.[3]

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[1] David Willoughby, Comprehensive Musicianship and Undergraduate Music Curricula (Washington: Contemporary Music Project/Music Educators National Conference, 1971), p. 15.

[2] Statement by Ronald B. Thomas, personal interview, July 27, 1973.

[3] Bruner, p. 84.

In the continuing pursuit of educational excellence, the present study represents an attempt to contribute a modicum of knowledge relative to the effectiveness of the two formats normally employed in the construction of programed materials.

Hypotheses

It was hypothesized that an experimental study comparing linear and branching formats for the learning of music fundamentals would result in higher achievement rates, higher retention rates, less time required for completing assigned materials, and a more positive attitude toward programed instruction for students utilizing a branching format.

To facilitate the drawing of conclusions, the following null hypotheses were formulated.

N H_1 : There will be no difference in the achievement rate of students as a result of the program format utilized.

N H_2 : There will be no difference in the retention rate of students as a result of the program format utilized.

N H_3 : There will be no difference in the time needed by students to complete material as a result of the program format utilized.

N H_4 : There will be no difference in students' attitude toward instruction as a result of the program format utilized.

N H_5 : No significant relationship will exist for any combination of the dependent variables--achievement, retention, time, and attitude--as a result of the program format utilized.

Definition of Terms

Definitions provided in this section relate to the specific usage of terms peculiar to the present study.

Programed instruction. A general term implying a method of presenting instructional material that permits efficient independent study without the continuous intercession of a live instructor. To be truly classified as programed instruction, the program must (1) present information and require frequent responses by the student, (2) provide immediate feedback to the student concerning accuracy of the response, and (3) allow the student to work independently and to adjust the rate of progress to individual needs and capabilities.

Frame. The question or material presented to elicit one response from the student.

Step. The amount of material presented in one frame. On occasion reference is made to step size; small step, large step, etc.

Linear program. Linear programed instructional material is structured and characterized by short sequential steps, repetition, controlled error rate, and the use of known material to elicit correct responses. Completion of the programed study unit requires every student to read and respond to each frame in identical sequence. The one variable is the amount of time required to read and respond to each frame. New material in introduced gradually and repetition is considered an integral part of the process in order to reinforce previously learned material and as a means of precluding incorrect responses.[1]

Branching program. The intrinsic or branching program is viewed as a means of preparing programed materials that will accomodate a wide range of educational purposes. The answer to a multiple choice question is used to direct the student to new material. Students who give

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[1]W. Lee Garner, Programed Instruction (New York: Center for Applied Research in Education, Inc., 1966), p. 10.

different answers will automatically be directed to different material.[1] When an incorrect response is selected, the program branches to another path, explains the reason for the error, and sends the student back to the frame missed or through further remedial or practice material. Both the correct and incorrect responses function similarly in guiding the student through the program. Incorrect responses can be used to discover areas of weakness and misunderstanding. Since the weakness is corrected before the student continues, the step size can be larger and the main line or prime path of the program may proceed more rapidly than with the linear format.

Pretest. An instrument, developed by the writer, to aid in assessing a student's level of proficiency in music fundamentals at the beginning of the experimental period.

Achievement. A student's level of attainment in music fundamentals as a result of the linear or branching programed instructional material studied.

Posttest. The pretest instrument used at the experiment's culmination to aid in assessing a student's level of attainment in music fundamentals.

Retention. A student's ability to retain or remember music fundamentals subject matter as a result of the linear or branching programed instructional material studied.

Retention test. A parallel form of the pretest-posttest to aid in assessing a student's level of proficiency in music fundamentals at a specified time after the culmination of the experiment.

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[1]Alfred de Grazia and David A. Sohn, ed., Programs, Teachers, and Machines (New York: Metron, Inc., 1964), pp. 80-84.

Attitude. A student's relative positive or negative attitude toward programed instruction as a result of the linear or branching programed instruction material studied.

Attitude assessment instrument. An instrument, developed by the writer, to aid in assessing a student's attitude toward programed learning.

Time. The number of hours required for a student to work the assigned programed text materials utilized in the experimental portion of the present study.

Stratified random assignment. A procedure for randomly assigning students to branching or linear subgroups according to scholastic ability. The process provided for an equal distribution of students from high, middle, and low scholastic levels within each of the subgroups of the two extant groups used in the study.

Limitations of the Study

The present study, conducted during the 1972-1973 academic year, involved two extant groups of students from the University of Oklahoma, Norman, Oklahoma: freshman music majors enrolled in Music Theory 0601, Music Fundamentals; and junior and senior elementary education majors enrolled in Music Education 1742, Materials and Methods for Classroom Teachers.

Each of the subject-groups were randomly divided by a stratified procedure based on scholastic ability into two subgroups. The subgroups then were assigned to follow either the linear or branching format of self-instructional study of music fundamentals. Although both groups were engaged in limited class discussion of music fundamentals, the assigned programed materials were completed outside of class.

The conclusions drawn from the study are limited to the generalizations allowed by the experimental procedures, the criterion measures employed, and the programed instructional material utilized.

Summary

In the preceding sections the writer discussed certain aspects relative to current educational trends and attempted to show how programed instruction can be employed as a useful teaching method in meeting present needs in music education.

The sources cited reveal that through the reassessment of educational goals and objectives, innovations in both curriculum and instructional methods are taking place. It has been shown that programed instruction can be a vital and effective means in helping to achieve such objectives.

In addition, the hypotheses, purpose, and need of the investigation have been stated, and terms peculiar to the investigation defined.

CHAPTER II

REVIEW OF RELATED LITERATURE

The study was concerned with the effects of branching and linear treatments in programed learning of music fundamentals as they pertain to achievement, retention, completion time required for the programed material, and attitude toward programed learning.

This chapter reports on the history and development of programed instruction and presents a review of related literature regarding the defined problem.

Historical Background, Development, and Rationale of Programed Instruction

In 1924, at Ohio State University, Pressey invented a small machine intended originally to automatically administer and score multiple choice examinations. Pressey realized, however, the potential of this machine in helping teachers perform certain functions in drill and recitation if the machine could be arranged to provide the student with immediate information concerning the correctness of each response.[1]

In May of 1927, an article by Pressey was published in School and Society describing a second machine that was capable of performing all the functions of the first plus the capability of omitting items

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[1]A. A. Lumsdaine and Robert Glasser, eds., Teaching Machines and Programmed Learning: A Source Book (Washington: National Education Association of the United States, 1960), p. 32.

from further presentation once a student could give the correct response.[1]

Pressey was one of the first to recognize the importance of immediate feed back as reinforcement to a correct response. Although other instructional machines had previously been built, Pressey's were among the first to incorporate established principles of learning. Pressey advocated the multiple-choice linear program, the underlying rationale of which was based on two factors of learning theory established at that time: (1) the law of frequency; the student may get a wrong answer, but in each frame he ultimately gives the correct response and by chance will give more correct than incorrect responses, and (2) the law of recency; no matter how many wrong answers a student may try in response to a question, the correct answer is always the last one and thus more likely to be remembered.[2]

The machines of Skinner, another significant innovationist in linear programing, differed from those developed by Pressey.[3] Rather than mechanically manipulating a machine to indicate a correct multiple choice answer, an overt response was required. This response was written on an exposed frame of paper tape located in the face of the machine. When the student raised a lever to see the correct answer, his written response was advanced under a clear plastic window. He could still see his response but could not change it. Skinner reasoned

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[1]Lumsdaine and Glasser, p. 42, citing Sidney L. Pressey, A Machine for Automatic Teaching of Drill Material.

[2]David Cram, Explaining "Teaching Machines" and Programming (Palo Alto, California: Fearon Publishers, Inc., 1961), p. 8.

[3]Lumsdaine and Glasser, p. 11.

that recall is more efficient in the learning process than recognition, and that responding overtly tends to contribute to learning.[1]

The utilization of the principles involved in machine teaching as pioneered by Pressey and Skinner have come to be known by the more inclusive term, "programed instruction." This term describes not only the mechanical apparatus used but also the material covered, the manner of presentation, as well as the complete underlying rationale. While the terms programed instruction and machine teaching are still used synonymously, the former seems to be in more general usage.

Although programs can be devised in numerous ways, two basic formats of programing have evolved: the linear and the intrinsic or branching. The objective of the two formats is the same: to produce materials that permit efficient, independent study by a student without the continuous intercession of a live instructor.[2] While differing in the manner in which the objective is pursued, both formats have three characteristics in common: (1) they present information and require frequent responses by the student; (2) they provide immediate feedback to the student concerning the accuracy of response; and (3) they allow the student to work individually and to adjust the rate of progress to his own needs and capabilities.[3]

The differences in the two methods of programing seem, on cursory

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[1]Cram, p. 18.

[2]Alfred de Grazia and David A. Sohn, eds., Programs, Teachers, and Machines (New York: Metron, Inc., 1964), pp. 77-78, citing Norman A. Crowder, On the Differences Between Linear and Intrinsic Programming.

[3]Cram, p. 8.

examination, to pertain only to the mechanics of construction; but closer study reveals that their foundations rest on fundamentally differing educational philosophies. Those individuals advocating the linear theory believe that a change of behavior, defined as learning, can best be achieved by inducing and then rewarding the desired behavior. The student is first presented with a small segment of the new material requiring a response. He then compares his response to the correct response. If they correspond, he feels rewarded and the material is thus learned.

These beliefs are founded on Skinner's theory of operant conditioning. An understanding of operant conditioning, then, is a requisite to a full understanding of the theories underlying linear programing. The principle of conditioning implies that one stimulus or response is connected to another stimulus or response in such a manner that bringing the first into operation elicits the second. A response that is elicited by a new "conditioned" stimulus is considered a conditioned-response. Reinforcement (reward) is described as a ". . . special kind or aspect of conditioning within which the tendency for a stimulus to evoke a response on subsequent occasions is increased by reduction of a need or a drive stimulus."[1]

Skinner's operant conditioning is "a procedure in which the response is freely available, the rate of occurence depending upon feedback from the environment. It is correlated with reinforcement and contingent upon the response."[2] Of particular interest is the variability

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[1]Morris L. Bigge and Maurice P. Hunt, Psychological Foundations of Education (New York: Harper and Row, Publishers, 1962), p. 292.

[2]Malcolm D. Arnoult, Fundamentals of Scientific Method in Psychology (Dubuque, Iowa: William C. Brown Co., Publishers, 1972), p. 201.

of the schedule of reinforcement: how is the performance of a response that is freely available influenced by the schedule determining when reward is available for making that response?[1] Skinner proffers that one cannot predict or control a response that has already occured: only that similar responses can be predicted to occur in the future.[2] The unit of concern then is not the response, but a class of responses. The term "operant" is used to describe this class. This implies that ". . . behavior operates upon the environment to generate consequences."[3]

Proponents of linear programing consider the conditioned response to be an integral part of the learning process. If the student makes an error, he is considered to have practiced an incorrect response, so properly constructed linear programs are refined to the point where very few errors occur. An error on the part of the student is considered to be a fault in the program which is usually changed or revised.[4] The material is presented in very short steps and uses known material to help the student give correct responses to unknown material. With the linear method, all students read every frame in identical sequence. The one variable is the rate of speed with which they progress.

According to Crowder, the developer of the intrinsic or branching theory, a student's choice of answer to a multiple choice question is used to direct him to new material. Students who give different

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[1]Frank A. Logan, Fundamentals of Learning and Motivation (Dubuque, Iowa: Wm. C. Brown Company Publishers, 1970), p. 83.

[2]B. F. Skinner, Science and Human Behavior (New York: The Macmillan Company, 1953), pp. 64-65.

[3]Skinner, p. 65.

[4]W. Lee Garmer, Programmed Instruction (New York: Center for Applied Research in Education, Inc., 1966), p. 10.

answers will automatically be directed to different material.[1] The proponents of the branching concept do not consider this technique as representative of any particular theory of learning. Rather it is viewed as a means of preparing programed materials that will accommodate a wide range of educational purposes.[2]

In the intrinsic format, when an incorrect response is selected, the program branches to another path, explains the reason for the error, and then either instructs the student to return to the frame missed or provides directions for further remedial or practice material. The student does not necessarily have to be sent back to the frame missed, but may proceed along any of a number of paths depending upon the response and manner in which the program is designed. The paths may contain many kinds of material. One path may be of a remedial nature while another might provide examples for practice and drill. Still another may have enrichment material to keep the superior learner interested.

Incorrect responses in a branching program are considered as a design component, and thus not believed to be a hindrance to learning. Both the correct and incorrect responses function similarly in guiding the student through the program. As such, the overt response is considered a measurer rather than a determiner of learning.[3] Incorrect responses can be used to discover areas of weakness and misunderstanding. Since the weakness is corrected before the student continues, the step size can be larger and the main line or prime path of the program may proceed more

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[1]de Grazia and Sohn, pp. 81-82.

[2]de Grazia and Sohn, p. 80.

[3]Cram, pp. 39-40.

rapidly than in the linear method.

The potential of programed instruction is being greatly expanded through research and development in utilizing the electronic digital computer. Modern electronic computers are currently being utilized in a variety of roles with computer-assisted instruction (CAI). Through the computer's high speed information storage and retrieval system, vast amounts of material can be introduced into programs far surpassing the capacity for material in even the most complex and expensive non-computerized teaching machines. In addition, through the development of other highly sophisticated equipment designed to work in conjunction with the computer, elaborate and innovative programs are being written and their efficiency studied.[1]

The following discussion, although not exhaustive, does indicate that CAI is assuming an important role in music instruction. Experimentation utilizing the Plato IV system developed at the University of Illinois, for example, concerns CAI programs in music history, music theory, music performance, music education, and music research and evaluation.[2]

In an experiment at Stanford University, the IBM 1620 computer and a device developed by IBM called the Automatic Pitch Discriminator

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[1]A listing of the principle areas of development for instructional use of the computer is provided by W. B. Holland and M. L. Hawkins, "Technology of Computer Uses in Instruction," The Emerging Technology: Instructional Uses of the Computer in Higher Education, Roger E. Levien (New York: McGraw-Hill Book Company, 1972), pp. 328-329.

[2]G. David Peters and others, Research and Development in Computer-Assisted Instruction in Music at the University of Illinois, Brochure prepared by the University of Illinois (Urbana-Champaign, Illinois: n.d.).

for Training in Tone Production were utilized in the teaching of sight-singing.[1]

The Pennsylvania State University has conducted CAI experiments utilizing the IBM 1500 instructional system in certain areas of instrumental music performance. The program concentrated on the areas of phrasing, articulation, and rhythm for intermediate clarinetists of secondary school level. A dual program was also developed incorporating aural training and playing.[2]

Allvin discusses the potential of CAI and how it can enhance music education through the computer's unique capabilities in three areas: individualized instruction, aural-visual instruction, and error analysis. Allvin also examines the effects of CAI on music curriculum and instructional material.[3]

It can be seen from the previous discussion that the potential of programed learning is being greatly expanded through the use of computer-assisted instruction. This interest indicates that as more sophisticated equipment and programs are developed, and as costs are lowered, CAI will assume an important and strategic role in education.

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[1]Wolfgang E. Kuhn and Raynold L. Allvin, "Computer-Assisted Teaching: A New Approach to Research in Music," Journal of Research in Music Education, XV (Winter, 1967), pp. 305-315.

[2]Ned C. Deihl, "Computer-Assisted Instruction and Instrumental Music: Implications for Teaching and Research," Journal of Research in Music Education, XIX (Fall, 1971), pp. 299-306.

[3]Raynold L. Allvin, "Computer-Assisted Music Instruction: a Look At the Potential," Journal of Research in Music Education, XIX (Summer, 1971), pp. 131-143.

Related Research

In 1962 Beane conducted an experimental study comparing the linear and branching techniques of programed instruction in teaching plane geometry.[1] Sixty-five students from two classes in high school geometry were divided into four experimental groups. A third class given conventional instruction served as a control group. Assignment to all experimental groups was accomplished by a stratified random procedure based on the Henman-Nelson test of mental ability. Two of the experimental groups used linear or branching programs exclusively, and two groups switched program type midway through the experiment.

Results of Beane's investigation revealed no significant difference in posttest achievement, delayed achievement, or retention scores. An attitude questionnaire to ascertain students' attitude toward programed instruction was administered at the mid-point of the experiment. The same measure was given at the experiment's conclusion, and again seven weeks later. All four experimental groups showed a preference for programed instruction on the first two questionnaires, but were neutral the last time the questionnaire was administered. Beane concluded that no significant differences existed in attitude toward programed instruction. There was, however, a preference among the mixed-treatment groups for the linear approach. As a result of the study Beane postulated that the greater difficulty of the branching program was possibly responsible for the mixed-treatment groups' preference for the linear approach.

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[1]Donald G. Beane, A Comparison of Linear and Branching Techniques of Programmed Instruction in Plane Geometry, Technical Report No. 1 (Urbana, Illinois: University of Illinois, 1962), ERIC no. ED020677.

It can be noted that the experimental group using the linear program exclusively spent significantly more time working programed materials than did their counterparts using the branching program. The control group had a higher mean achievement score than either of the experimental groups, but the difference was not sufficient to be considered statistically significant. The author suggested that this difference might have been due to the greater amount of time spent by the control group because of homework assignments. In each treatment group the high ability students exceeded the low ability students in achievement, and although the students expressed a preference for the linear approach, branching was considered the more efficient program timewise.

During the fall of 1961, Carlsen conducted an experiment to investigate the effects of linear, branching, and traditional teacher-classroom techniques for teaching melodic dictation.[1] Subjects for the experiment were students in two sections of first year ear training at the collegiate level. The first group was designated the control group and was taught melodic dictation by a teacher in a classroom situation. The second group, designated the experimental group, was divided into two subgroups. One subgroup was designated the linear subgroup and the other, the branching subgroup. Both subsections of the experimental group learned melodic dictation without a teacher by means of programed materials.

The programs were printed in book form and the melodies, played on a piano, were recorded on tape. Each student was provided his own

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[1] James C. Carlsen, "Programmed Learning in Melodic Dictation," Journal of Research in Music Education, XXI (Summer, 1964), pp. 139-148.

book and worked independently. The linear subgroup used every frame of the material. The branching subgroup used only selected frames within each concept unless an error was made, in which case the student would branch to a frame or frames that otherwise would have been omitted.

Two original criterion tests were developed. All students were given the first test as a pretest prior to the experiment and again as a posttest after ten 50-minute sessions. After the posttest, the experimental group continued with the program and was given the second test after reaching criterion level. The pretest scores served as control scores and the posttest scores served as criterion scores for analysis of covariance. Scores of the second test for both branching and linear subgroups also were compared by analysis of covariance to examine the effectiveness of branching and linear programing techniques. Scores from the first test served as the co-variant. In testing the relationship between melodic dictation and scholastic aptitude, scores from verbal and mathematical aptitude were compared with melodic dictation scores.

The conclusions reported by Carlsen included the following: (1) the techniques of programing (linear versus branching) are equally effective for the teaching of melodic dictation; (2) melodic dictation can be more effectively taught by programed instruction than by the traditional teacher-classroom approach; (3) the results indicated that fast learners, based on the number of sessions required to reach criterion level, make superior scores on melodic dictation taught by programed instruction. Therefore, learning rate does seem to have a bearing on achievement in melodic dictation; (4) no significant difference was found between scores of verbal aptitude and melodic dictation;

(5) there was no significant interaction between the teaching method (programed instruction versus teacher-classroom method) and scholastic aptitude scores.

Larkin and Leith experimented with the effects of linear and branching methods of programed instruction as they pertain to both learning and retention of a topic in elementary science.[1] A linear program written previously by Larkin entitled Introduction to Electricity was used for the experiment. The branching version was prepared from the linear program in order to preserve the same vocabulary and phraseology. A sampling of nine-year-old children was stratified within sexes into three ability levels and randomly assigned to linear and branching groups.

The program was divided into three sections and administered on consecutive mornings. A test consisting of fifteen multiple choice questions and an equal number requiring a constructed overt response was given immediately after the program as a posttest, and again in twelve weeks as a retention test.

Results of the experiment indicated:

1. Students of the linear group showed significantly higher results than those of the branching group on both posttest scores and retention test scores.

2. Students of lower ability level showed significantly higher achievement with the linear method than with branching. There was no significant difference among the higher ability level students as a result of treatment.

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[1]T. C. Larkin and G. O. M. Leith, "The Effects of Linear and Branching Methods of Programmed Instruction on Learning and Retention of a Topic in Elementary Science," Programmed Learning, Vol. 1, (May, 1964), pp. 12-16.

3. Students in the branching group spent much less time working the program than those in the linear group.

4. There was no significant difference as a result of treatment on either the contructed response or the multiple choice subtests. The lower ability linear students did, however, score higher on both subtests than did the lower ability branching students.

Larkin and Leith mention that the superior performance of the linear group could be due to the superiority of the method of response (constructed response versus multiple choice), or by the cueing of responses in the linear program. Another explanation concerned the size of frame; the linear program contained many short frames whereas the branching program utilized a greater number of words before requiring a response. Although none of the students were poor readers, the authors recognize that the size of frame is important in deciding program-type with a given class of students. They submit, however, that the study did not contribute to the resolution of the problem.

Coulson and Silberman[1] have studied the effect of several independent variables on programed learning: (1) student response mode (multiple choice versus constructed response); (2) size-of-item step; and (3) item sequence control (predetermined or linear sequence, versus branching).

From the combinations of these three independent variables the experimenters derived the following eight teaching procedures:

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[1]J. E. Coulson and H. F. Silberman, "Results of an Initial Experiment in Automated Teaching," in Teaching Machines and Programmed Learning, a Source Book, A. A. Lumsdaine and Robert Glasser (Washington: National Education Association, 1960), pp. 452-468.

1. Multiple choice, small steps, no branching
2. Constructed response, small steps, no branching
3. Multiple choice, large steps, no branching
4. Constructed response, large steps, no branching
5. Multiple choice, small steps, branching
6. Constructed response, small steps, branching
7. Multiple choice, large steps, branching
8. Constructed response, large steps, branching[1]

The authors constructed eight experimental teaching procedures from a portion of a course in elementary pyschology used at Harvard University and assigned ten junior-college students to each procedure (n=80). A control group (n=104), consisting of students from the same psychology classes as the experimental groups, but having no exposure to the teaching machines nor any instruction in the concepts studied by those in the experimental portion of the study, was utilized for purposes of comparison. The experimental portion of the study required one week. A psychology pretest was administered to both the experimental and control groups prior to the experiment. Immediately after the experiment a written criterion test was administered to the experimental and control groups. This criterion test was administered to the experimental groups approximately three weeks later as a measure of retention. The criterion test was divided into constructed response and multiple choice subtests.

Some of the major results of the experiment were:

1. No significant difference was observed between the experimental and control groups as a result of pretest scores.

2. Based on scores of the first administration of the criterion test (posttest), the experimental group yielded significantly higher results than did the control group, in the total test as well as the

[1]Coulson and Silberman, p. 456.

constructed response and multiple choice subtests.[1]

3. Based on results of the second administration of the criterion test (retention test), no significant difference was observed between the eight experimental procedures.[2]

4. Students of the experimental groups employing the multiple choice mode required significantly less time to work the program than did those employing the constructed response mode.

5. There was no significant difference in results between modes on the first criterion test (posttest) of students in the experimental groups.

6. The first criterion test (posttest) revealed no significant difference between the experimental groups on the multiple choice subtest or the total (total of both subtests) criterion test.

7. Small-item-steps required more time, but yielded higher results, than did the large-item-steps on the constructed response portion of the first criterion test (posttest).

8. The branching approach required significantly less time to complete than did the linear.

9. No significant difference in achievement scores was observed between branching and linear sequencing on the first total criterion test (posttest).

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[1]The authors emphasize these findings do not indicate the experimental subjects exceeded the control subjects, as the control group was not being taught the same concepts as the experimental group; only that the experimental subjects experienced significant learning of the concepts taught and retained them for a three-week period.

[2]Retest scores were not available for the control group.

In an experimental study conducted by Noble, an attempt was made to determine the inter-relationships between individual differences and mathematical performance when using branching programed instruction in different environments.[1] Six independent samples (minimum n=50) were used ranging from grammer school through high school. Each sample used different levels of programed material from an existing set of mathematics programs. Some of the sample groups studied with the programed material exclusively, while others integrated programed material with conventional classroom study. A portion of the sample groups utilized students from different ability levels in mathematics.

Age, sex, intelligence, personality traits (anxious or non-anxious), reading ability, and speed of progress were assessed for each child. Attitude toward programed instruction was measured by use of inclined-to-X, inclined-to-Y paired-statement attitude scales. Speed and error measures were calculated from records of progress completed after each period of programed instruction. Both pre- and posttests were administered to the students, and gain scores computed by subtracting pretest scores from posttest scores.

From scores of all the variables, Noble calculated six correlation matrices (one for each of the six independent samples used in the study) and submitted each matrix to principal component analysis which acts to isolate the general or principle components in the correlation matrix. Although sixty variables were included in the matrices, only

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[1]Grant Noble, "A Study of the Relationship Between Ability, Performance, Attitudes, Inclinations and Speed of Progress Using Intrinsic Programmed Instruction," Programmed Learning and Educational Technology, Vol. 1, No. 2 (April, 1969), pp. 109-119.

those correlations with specific variables of interest were shown in the report. Because the author expected to find considerable interaction between individual differences, multivariate analysis was used to establish these relationships.

Results from the experiment included:

1. The maturation component was isolated in each of the six independent samples used in the experiment. The older, more intelligent students progressed faster through the program, scored highly on both pretests and posttests, yet displayed unfavorable attitudes towards programed instruction. The author suggests these results indicate that programed instruction was of greatest benefit to students who also would have benefited from conventional study.

2. The primary determinants of achievement and speed of progress seemed to have been age and intelligence rather than personality factors.

3. Where programed instruction was the sole means of teaching, greater gains were made by anxious children.

4. Where programed instruction was integrated with conventional instruction, the greater gains were made by the more intelligent children.

5. In only three of the six independent samples did attitude scores correlate with maturation beyond criterion level (+.30 to -.30). Of these three correlations, two were negative and one positive. The author suggests these results indicate that older, more intelligent students tend to have unfavorable attitudes toward programed instruction.

6. Attitude scores were found to be inter-related with sex. Girls displayed more favorable attitudes toward programed instruction than did boys.

7. In all six independent samples, attitude and personality traits correlated beyond criterion level. Favorable attitudes were associated with anxious personality traits in four of the six samples, and in the remaining two with non-anxious personalities. Noble suggests this indicates that attitude toward programed instruction was not determined by individual differences *per se*, but at least in part by the social structure of the situations in which programed instruction was used. The author specifically suggests that attitude was in part determined by the degree of supervision and interest displayed by the teachers to the way in which programed instruction was used.

Valverde and Morgan performed an experimental study at the Medical Service School at Sheppard Air Force Base, Texas, to investigate the effect of redundancy on the learning from self-instructional materials.[1] Redundancy was defined by the authors as the use of more words, instructional frames, or support material than are necessary to teach desired behaviors.

Eighty-eight students were assigned to each of five experimental groups. The students were incoming airmen selected for the medical services career. Study material for the five groups was taken from the programed medical terminology text in the Medical Helper Course, AQR90010. One group studied from the standard programed medical terminology text. Study material for the other four groups was taken from the medical terminology text, but by the elimination of repeated material was arranged in descending order of redundancy.

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[1]Horace H. Valverde and Ross L. Morgan, "Influence on Student Achievement of Redundancy in Self-Instructional Materials," *Programmed Learning and Educational Technology*, Vol. 7, No. 2 (July, 1970), pp. 194-199.

The authors provide the following description of material for the five instructional modes used in the experiment.

MMS-1. A linear programed text consisting of 274 instructional frames. This was the regular programed text used in the Medical Helper Course.

MMS-2. An experimental programed text similar to MMS-1, but the number of frames was reduced to 160.

MMS-3. An experimental programed text similar to MMS-1 and MMS-2, except the number of frames was reduced to 83. With the exception of five introductory frames, each criterion item was the subject of only one frame.

MMS-4. An experimental terse narrative text, using a typographically cued response (underlining important words).

MMS-5. Experimental material was presented on four-by-six cards, and included all of the regular course medical terminology information.

Valverde and Morgan concluded that eliminating the usual redundancy in a linear program of instruction significantly increased achievement of the students. Groups one and two did not significantly differ in achievement, nor did groups three, four, and five. Groups three, four, and five, however, showed significantly higher achievement scores compared to groups one and two.

In an investigation by Murdoch, students' attitudes toward programed and conventional texts were compared.[1] The study included 548 subjects from an introductory course in psychology, enrolled in one

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[1]Peter H. J. Murdoch, "Attitude and Learning in Performance on Programmed and Conventional Materials," Programmed Learning and Educational Technology, Vol. 7, No. 2 (July, 1970), pp. 200-204.

of four lecture sections and one of 24 laboratory and discussion sections. Of the 24 laboratory sections, 12 were randomly assigned to use a programed text and 12 to use a conventional text.

The administration of the attitude questionnaire immediately preceded that of the final examination, and contained 17 questions, eight of which were considered by the author to be relevant to the present discussion. Responses to each attitude question were scored on a 21-point scale, higher scores indicating less favorable attitudes toward programed instruction.

Based on the results of the study, Murdoch generalized that students prefer programed to conventional materials in college-level courses. When compared with conventional texts, programed texts might be expected to yield (1) more favorable attitudes to the course and texts, and (2) better performance on examinations.

Summary

The preceding sections of the current chapter were concerned with the historical background, development, and rationale of programed material as an instructional mode, and a review of literature related to the primary objectives of the inquiry.

The discussion of the historical background and development revealed that programed instruction has become a significant and important method of learning. A review of related literature disclosed that educators are concerned with the effect of programed instruction as related to achievement, retention, completion time required for programed material, and attitude toward programed learning. Two of the reviewed studies, while not concerning comparisons of linear and branching concepts, do indicate an interest on the part of the investigators regarding attitude toward programed instruction.[1,2]

Interest also was apparent concerning the effectiveness of methods of programing as well as the effects of scholastic ability in relation to these variables.

Only one of the reviewed studies was concerned with music. A search of the ERIC files, instigated through the GIPSY information storage and retrieval system at the University of Oklahoma, revealed no further studies in music involved with these particular aspects of programed instruction. The writer believes that the interest shown through other disciplines regarding these areas and the lack of such research in music is indicative of the need of the present study.

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[1]Murdoch, pp. 200-204.

[2]Noble, pp. 109-119.

CHAPTER III

MEASURES AND PROCEDURES

The investigation was concerned with the differential effect of branching and linear programed instruction formats in the study of music fundamentals. Specifically, the study examined achievement, retention, time required to learn programed material, and attitude toward programed self-instruction of two distinct student groups. This chapter provides a description of the procedures and instruments utilized.

Description of the Study

The study was conducted during the fall semester of the 1972-1973 academic year utilizing two extant groups of students from the University of Oklahoma, Norman, Oklahoma. The first group was comprised of freshman music majors enrolled in the first term of the regular course sequence of study in music theory in the School of Music. The second group consisted of College of Education students enrolled in the music education course sequence designed for the prospective elementary teacher.

Students comprising the music major group were selected on the basis of scores earned on a music fundamentals examination administered to all freshmen entering the University of Oklahoma School of Music during the 1972 fall term. The administration of the examination is a normal procedure employed by the School of Music theory faculty to identify those students demonstrating a deficiency in the music fundamentals area. Of the 75 students whose performance was below that considered minimal for satisfactory matriculation in the theory sequence, 10 were disqualified on the basis of changes in their major field of study. Of the remaining number, 45 were randomly selected for inclusion in the study.

Students comprising the prospective elementary teacher group were included in the study on the basis of their enrollment in a two-semester music education course sequence designed for the prospective elementary teacher. This group, totaling 55 students, was divided, through normal enrollment-scheduling procedure, into four extant academic sections.

Students from each group described were randomly divided into subgroups by a stratified procedure based on scholastic ability. The stratification of students in each group was considered a design component of the study for purposes of assuring an equal number of students from high, middle, and low scholastic levels within the respective subgroups.

Music Major Group. Forty-five students comprising the music major group were divided into two equivalent subgroups by means of a stratification procedure employing ACT scores. The subgroups then were arbitrarily assigned to follow either the branching or linear format of self-instructional study of music fundamentals.

Prospective Elementary Teacher Group. Fifty-five students comprising the prospective elementary teacher group were divided into two equivalent subgroups by means of a stratification procedure employing grade point averages. The subgroups then were arbitrarily assigned to follow either the branching or linear format of self-instructional study of music fundamentals.

Experimental Procedures

The scores of the music fundamentals examination administered to the incoming freshman music majors served as pretest scores for those who were subsequently placed in the two subgroups comprising the music major group of this study. The prospective elementary teacher group was administered the pretest at the beginning of the third week of the first semester. A facsimile of the pretest is included as Appendix A.

Each student was furnished a time-log-sheet and instructed to keep an exact accounting of time utilized working the programed text. A copy of the time-log-sheet is furnished as Appendix B.

At the end of each experimental period, the posttest was administered to the respective groups. At the time of the posttest, the students also completed the attitude assessment instrument to ascertain their attitude toward programed instruction. Facsimilies of the posttest and attitude assessment instrument are shown in Appendices A and C respectively.

Both the music major group and the prospective elementary teacher group were administered the retention test at the end of the 1972 fall semester as a portion of the final examination for the respective music courses in which they were enrolled. Appendix D is a facsimile of the retention test.

The music major group met five days per week and was requested to complete the programed material within a four week period. The prospective elementary teacher group met three days per week; because music fundamentals represented only a portion of the required subject matter for the course ten weeks were allowed for completion of the programed material.

By nature of course content and curriculum organization of the regular course sequence of study for both the music major and prospective elementary teacher groups, the students were engaged in class work involving music fundamentals. A relatively small amount of the prospective elementary teacher group class time was devoted to discussion of music fundamentals, but neither group utilized class time for the completion of the programed assignments, nor did the class discussions follow the format of the assigned programed texts. In an effort to control the class discussion variable the music fundamentals material discussed in class was coordinated so that subgroup teachers within each group discussed the same material. The writer worked closely with the other teachers to assure this standardization of class instruction in an attempt to provide equal treatment between subgroups.[1] Both groups made aural application of the music fundamentals material during class, such as interval singing and dictation, but the programed texts included only written fundamentals.

The experimental design of the study approximates design six as described by Campbell and Stanley.[2] The design, as adapted for use in the present study, is illustrated in Table 1.

Statistical Procedures

Several statistical procedures were considered as a means of analyzing data of the present investigation. Discriminant function analysis was selected as the analytical procedure to best serve this purpose because it allows for testing the significance of a single dependent variable, and also provides a means for determining significant relationships between combinations of the dependent variables. Considering the complex nature of multivariate analysis a discussion of discriminant function analysis is included in the present chapter to provide a clearer understanding of the results of the inquiry.

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[1]The music major and prospective elementary teacher groups utilized two instructors each. The writer taught the linear subgroup of the music major group.

[2]Donald T. Campbell and Julian C. Stanley, Experimental and Quasi-Experimental Designs for Research (Chicago: Rand McNally and Company, 1970), pp. 25-31.

Table 1. Experimental Design

Groups	Treatment Subgroups	n	Treatment and Observations
Music Major Group	Linear	21	R X O_1 O_2
	Branching	24	R X O_1 O_2
Prospective Elementary Teacher Group	Linear	27	R X O_1 O_2
	Branching	28	R X O_1 O_2

Discriminant function analysis reduces multiple measurements to a single weighted composite. By assigning appropriate weighting coefficients, several scores can be transformed to a single score having maximum potential for distinguishing between members of two groups.[1] Through this procedure a multivariate problem is reduced to a simple univariate problem, enabling individuals to be assigned to each of the two groups based on the value of a single score. This composite score enables the researcher to utilize probability tables for the unit-normal distribution for determining probabilities of misclassification and to determine the likelihood with which an individual case belongs to a particular group.[2]

The discriminant function equation enables the investigator to

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[1]John E. Overall and C. James Klett, Applied Multivariate Analysis (New York: McGraw-Hill Book Company, 1972), p. 243.

[2]If scores on the original measures follow a normal distribution, the new weighted composite scores will also be normally distributed. Maurice M. Tatsuoka, Discriminant Analysis: The Study of Group Differences (Champaign, Illinois: The Institute for Personality and Ability Testing, 1970), p. 11.

determine the appropriate weights for the several variables. Once the optimal values for the weighting coefficients have been determined, the difference in the mean scores of the two groups is maximized relative to the variation within groups.[1] In following this procedure the researcher computes a discriminant criterion which becomes a function of the combining weights. The discriminant criterion is the ratio of the sums-of-squares-between and the sums-of-squares-within.[2] Tatsuoka describes this procedure thusly:

> . . . The problem is to express the two kinds of sums-of-squares, SS_b SS_w . . . for any linear combination as functions of the unknown weights. . . . The discriminant criterion . . . being the ratio of these two SS's, then also becomes a function of these combining weights.[3]

Once these weighting coefficients have been established, producing maximum separation between the two groups, the means or centroids of the groups are projected to a new single axis, and a point on the new axis mid-way between the intersecting lines from the two centroids becomes the cutting point for assigning individuals to one of the two groups. If a student's composite score is larger than that figure representing the cutting point, he is assigned to one group; if smaller than the cutting point score, he is assigned to the other.[4]

Figure 1 is a geometric representation showing the linear combi-

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[1]Overall and Klett, p. 244.

[2]The discriminant criterion ratio is expressed in the following manner: Tatsuoka, Discriminant Analysis, p. 23.

$$\text{discriminant criterion} = \frac{SS_b}{SS_w}$$

[3]Tatsuoka, Discriminant Analysis, p. 25.

[4]James E. Wert and others, Statistical Methods in Educational and Psychological Research (New York: Appleton-Century-Crofts, Inc., 1954), p. 369.

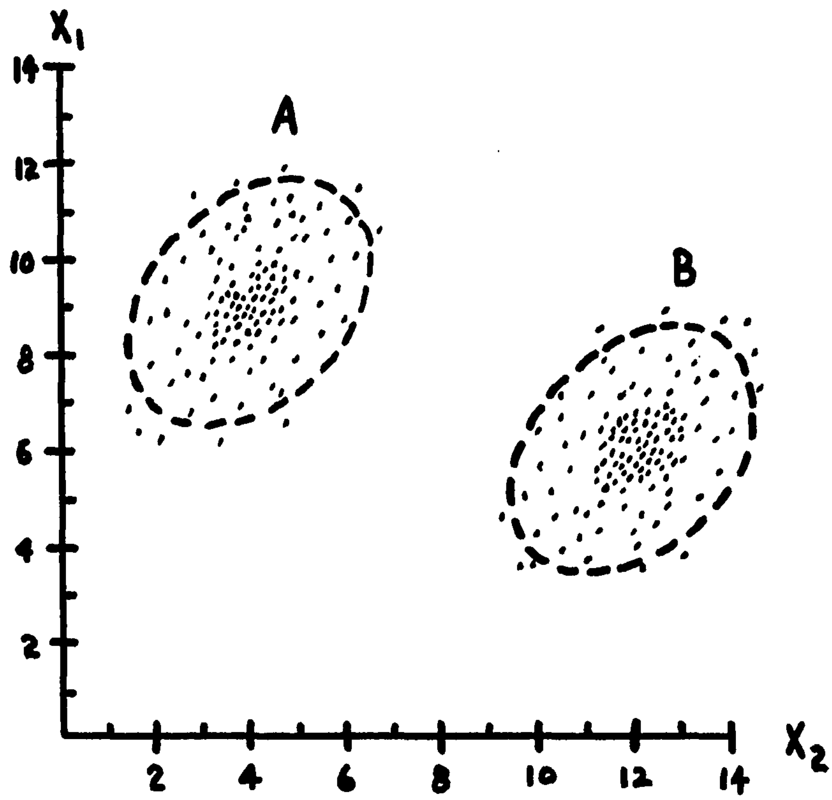

Figure 1. Scattergrams for two groups representing the distribution of scores of two variables X_1 and X_2

nation of two variables, X_1 and X_2. Scattergrams for groups A and B have been plotted showing the linear combination scores for each subject. This is accomplished by plotting subjects scores on X_1 and X_2 respectively, and drawing lines from these points perpendicular to the X_1 and X_2 axes. The points of intersection of these lines represent linear combination scores for the variables X_1 and X_2.

Figure 2 is a schematic representation of the scattergrams shown in Figure 1, locating the centroids for groups A and B and projecting these centroids to a new single axis (Y). This is accomplished by drawing perpendicular lines from axis Y to each of the centroids. A point on the Y axis (Q) midway between the intersecting lines from the two centroids becomes the cutting point for assigning subjects to one of the two groups. Scores for individual subjects can be projected to the Y axis in the same manner as that of the centroids, giving each individual's new "Y" score. It can be seen that if the Y axis is rotated, changing the angle of Y in relation to the X_1 X_2 combination, the centroids and individual scores on axis Y will be changed accordingly. The purpose of the discriminant function equation (of which the discriminant criterion is a function) is to establish an angle for the Y axis that gives maximum separation between the intersecting lines from the two centroids. This is equivalent to saying that the discriminant function equation establishes an angle for the Y axis in such a manner that there is maximum separation between the group A and group B means on axis Y.

Overall and Klett mention that in evaluating probabilities for misclassification for members within a group, such probabilities are not uniform for all possible scores; those individuals whose scores lie near the cutting point are more likely to be placed in the wrong group than

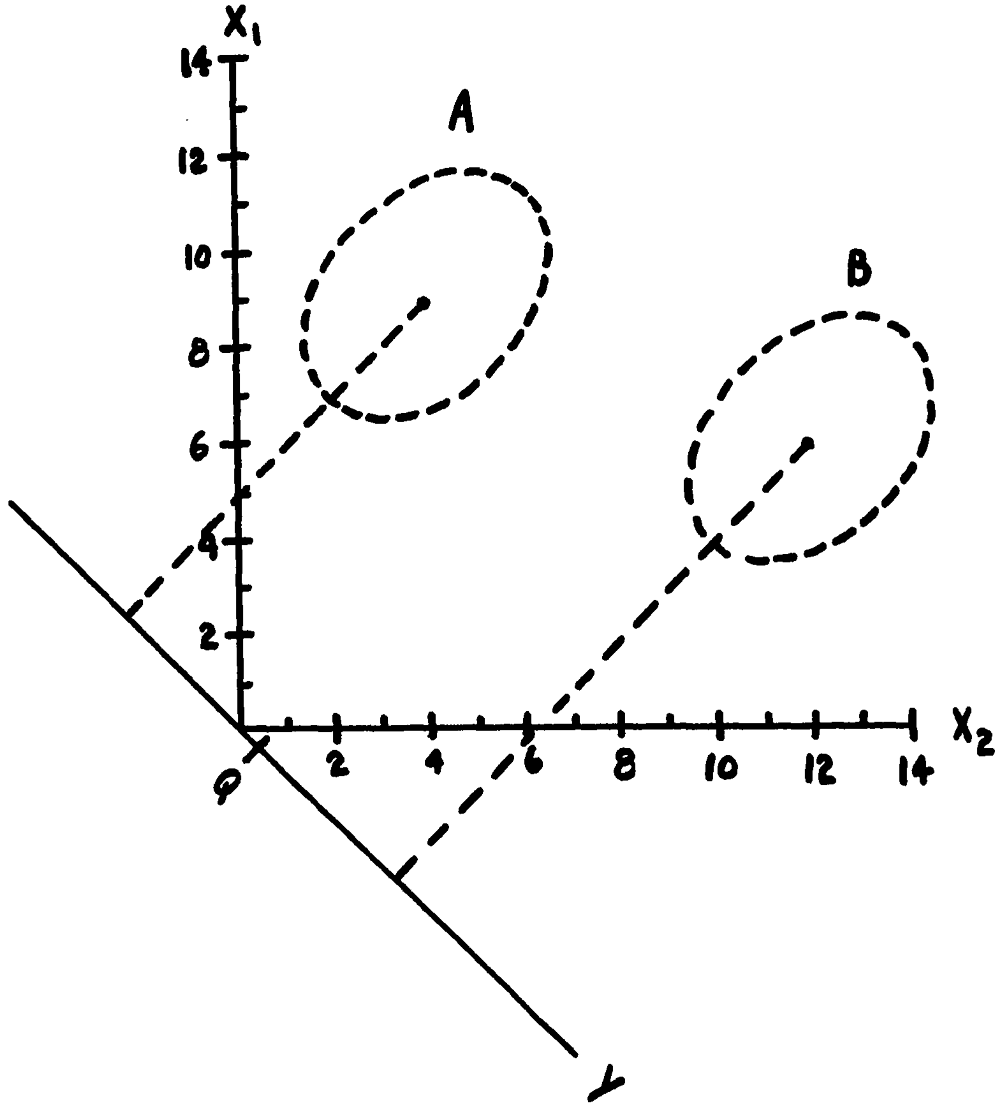

Figure 2. Schematic representation of the scattergrams in Figure 1 with centroids of each group projected to a new single axis (Y)

individuals whose scores are more distant from the cutting point.[1]

After the discriminant function equation has been computed it may be tested for significance by one of several methods. If only two variables are envolved, a t-test may be used; if more than two variables are used ANOVA or Chi-Square statistics are appropriate.[2]

In reaching an understanding of this aspect of discriminant function analysis it is essential to understand the difference between the F-Ratio provided by the computer program and the number of correctly classified cases. The F-Ratio is a test of the discriminant function equation to establish if a significant difference exists between the means of the groups. The number of correctly classified cases is merely a check to determine the number of persons whose scores are on the same side of the cutting point as the intersecting line drawn from the centroid of the group to which they actually belong.

As a hypothetical example of this, assume there are two groups whose mean scores and standard deviations are identical for a particular linear combination. Further assume that each group contains the same number of cases and the scores between members of the groups are identical. It is theoretically possible that the discriminant function program will assign every member of both groups to the group which they actually belong. This will result in one-hundred percent correct classification. However, when an F-Test for significance is computed for the discriminant function equation, the resulting F-Ratio will be zero, indicating that

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[1]Overall and Klett, p. 253.

[2]Maurice M. Tatsuoka, Multivariate Analysis: Techniques for Educational and Psychological Research (New York: John Wiley and Sons, 1971), p. 188.

there is no variance between the two groups.

Description of Treatments

The experiment involved two treatments, branching and linear programed texts in music fundamentals, applied to the two described student groups. The development of programed materials was beyond the scope of the present study, consequently the writer's concern was in selecting linear and branching programed texts whose content was essentially the same. The programed text used by the branching subgroups was Gary M. Martin's Basic Concepts in Music.[1] The linear subgroups used Paul Harder's Basic Materials in Music Theory.[2]

The described treatment is consistent with the need for the study developed in Chapter I, which illustrates the growing interest and concern on the part of music educators for investigating materials and procedures that enable students to more effectively participate in a comprehensive study of music. The aforementioned section reveals considerable interest among music educators in experimentation concerning the effectiveness of programing technique and the utilization of programed instructional materials.

Instruments

Three evaluative instruments were used in the experiment. The writer was unable to locate existing instruments dealing specifically with the music fundamentals material included in the two programed texts or for

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[1] Gary M. Martin, Basic Concepts in Music (Belmont, California: Wadsworth Publishing Company, Inc., 1966).

[2] Paul O. Harder, Basic Materials in Music Theory: A Programed Course (Boston: Allyn and Bacon, Inc., 1970).

assessing attitude toward programed material. An appropriate pretest-posttest, retention test, and an instrument for assessing attitude toward programed instruction were constructed.

Pretest-posttest. Subject matter incorporated in the pretest-posttest instrument was criterion referenced to the programed texts utilized in the present study. Only facts and concepts included in both texts were included in the test. Appendix E shows a detailed comparison of the material included in the two texts.

The format of the test included seven general concept areas in music fundamentals: Part I, Music Symbols; Part II, Note Identification; Part III, Meter and Measure-Completion; Part IV, Scales; Part V, Intervals; Part VI, Triads; and Part VII, Key Identification.

The criterion for determining the length of the pretest-posttest dictated that a student could complete the test in one fifty-minute class period. The instrument was revised on four occasions before it was considered adequate for the study.

The fourth draft was administered to forty volunteer members from two local church choirs, and to eight University of Oklahoma graduate music students enrolled in the 1972 summer term. Based on a total score of 126 points, the church choir pilot-study yielded a mean score of 65.3 and a standard deviation of 33.73. The pilot-study of the graduate music students yielded a mean score of 121.63 and a standard deviation of 4.85. Split-half reliability coefficients based on the Pearson Product-Moment Coefficient of Correlation, and corrected by the Spearman-Brown Prophecy Formula, were computed using scores from the pilot tests given to the church choirs and graduate music students. Results from the pilot-studies yielded corrected reliability coefficients of .98 and .90 respectively.

The smaller standard deviation, as well as the lower reliability coefficient of the graduate music student group as compared to the church choir group, is consistant with Whybrew:

> The variability of the group tested also is significant in estimating the reliability of a test or in evaluating its reliability coefficient. In general, a smaller reliability coefficient is to be expected when a relatively homogenous group is tested than when a group of more widely varying abilities is investigated. . . . The reliability coefficient of a musical achievement test . . . will be smaller if derived from administration of the test to college music majors than to an unselected group of college students. . . .[1]

The eight graduate students who were administered the test included doctoral and masters students in music. The forty church choir members ranged from those with virtually no formal music training to several with degrees in music.

Employing the recorded performance of the two pilot-study groups, the criterion measure was studied for purposes of determining item difficulty and discrimination according to a procedure outlined by Tate.[2]

Suggestions concerning the wording of items in the pretest-posttest instrument were solicited from both pilot-study groups. On the basis of the results from the item analysis and the pilot-studies, the final version of the criterion measure was constructed.[3]

The pretest-posttest instrument was utilized solely for purposes of bilateral comparative evaluation. Validation of the instrument is

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[1]William E. Whybrew, Measurement and Evaluation in Music (Dubuque, Iowa: Wm. C. Brown Company Publishers, 1962), p. 60.

[2]Merle W. Tate, Statistics in Education and Psychology: a First Course (New York: The Macmillan Company, 1965), pp. 204-209.

[3]Careful consideration was given to the results of the item analysis, however some items considered by the writer to be important to the test were retained regardless of their difficulty or discrimination indices.

viewed on the basis of formal validity and makes no attempt to generalize beyond the comparative analysis of the resultant data of the present study. The criteria relating to the assumption of formal validy for a rating instrument so employed are described by Tate.[1]

Retention test. The retention test was intended as an equivalent form of the pretest-posttest. Due to the time factor in administering the test, the overall length was reduced. The format of the pretest-posttest was maintained in the retention test which was approximately one-half the length of the former instrument.

Although a portion of the material used in the pretest-posttest was included in the retention test instrument, some items were changed for the sake of consistency and thoroughness. The resultant changes were minor and consisted primarily of modifications within a particular concept area to assure that the concept had been adequately considered.

Based on a total of sixty-four points, the combined scores of the music major and prospective elementary teacher groups yielded a mean score of 47.85 and a standard deviation of 13.78. The corrected reliability coefficient of the combined group was .94 (n=100).

Assumptions of validity, as well as the limits of generalizations of the analysis of data concerned with the retention test instrument utilized in the present study, are based on the same criteria as those described for the pretest-posttest instrument.[2]

Attitude assessment instrument. The attitude assessment instrument underwent three revisions before the writer felt it would suffi-

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[1]Tate, p. 183.

[2]Tate, p. 183.

ciently fulfill the needs of ascertaining students' attitude toward programed instruction. An attempt was made to measure attitude in five concept areas: students' enjoyment of programed instruction, students' response to immediate reinforcement, students' response to self-chosen speed, students' response to presentation of material, and students' response to the lack of teacher assistance. One other area examined but not used in scoring was the students' reaction to the possibility of seeing an answer before forming his own.

The selection of the proper scale to use in measuring students' attitude was of importance in constructing the instrument. In discussing the selection of scales, Miller states:

> Regardless of the method used in construction, what the researcher seeks is the scale that best fits his problem, has the highest reliability and validity, is precise, and is relatively easy to apply.[1]

The first draft considered used a five point Likart scale indicating the corresponding opinions: strongly disagree, disagree, undecided, agree, strongly agree. It was concluded, however, that it would be advantageous to force an agree or disagree response; therefore, the following scale was adopted. Students were asked to indicate their opinion to each statement based on the following responses.

+1 = I agree a little	-1 = I disagree a little
+2 = I agree on the whole	-2 = I disagree on the whole
+3 = I agree very much	-3 = I disagree very much

In scoring, a constant of plus four was added to each response in order to eliminate dealing with negative numbers. This gave, for each response, a positive range from one through seven. The final version of

[1]Delbert C. Miller, Handbook of Research Design and Social Measures (2nd ed., New York: David McKay, Inc., 1970), pp. 95-96.

the instrument contained sixteen statements, fifteen of which were used for scoring purposes, resulting in an attitude response continium from fifteen through one hundred five.

Of the fifteen statements used for scoring purposes, nine were stated in a manner favorable to programed instruction; the remaining six were couched in terms unfavorable to programed instruction. The latter were scored in reverse; therefore, a favorable attitude toward programed instruction resulted in a high score, while an unfavorable attitude yielded a correspondingly low score.

The third draft was administered to five graduate music students at the University of Oklahoma in an effort to assure clarity. The students were asked to give their opinions and suggestions which were considered in constructing the final draft.

Based on a continum ranging from fifteen to one hundred five, the combined scores of the music major and prospective elementary teacher groups yielded a mean score of 75.36 and a standard deviation of 17.73. The corrected reliability coefficient of the combined groups was .94.

The attitude assessment instrument was utilized solely for purposes of bilateral comparative evaluation. Validation of the instrument is viewed on the basis of formal validity and makes no attempt to generalize beyond the comparative analysis of the resultant data of the present study. The criteria relating to the assumption of formal validity for a rating instrument so employed are described by Tate.[1]

[1]Tate, p. 183.

CHAPTER IV

PRESENTATION AND ANALYSIS OF DATA

The investigation was concerned with the differential effect of branching and linear programed instruction formats in the study of music fundamentals. Specifically, the study examined achievement, retention, time required to learn programed material, and attitude toward programed self-instruction of two distinct student groups. The present chapter presents the data, their analyses, and statistical procedures and findings.

Two extant groups from the University of Oklahoma, Norman, Oklahoma were included in the study. The first group was comprised of freshman music majors enrolled in the first term of the regular course sequence of study in music theory in the School of Music. Junior and senior students comprised the second group and were included in the study on the basis of their enrollment in a two semester music education course sequence designed for the prospective elementary teacher.

Preliminary Analysis

When t-tests for independent means were computed for the variables pretest scores and scholastic ability, no significant differences existed between subgroups of either of the two extant groups used in the study. The assumption that subgroups within each of the groups were homogeneous within the limits of the two variables was thus validated.

Statistical Procedures

The study employed the University of Oklahoma Computing Center Library BMD07M Stepwise Discriminant Analysis computer program for data analysis.[1] The BMD07M program provides a within-groups correlation matrix for the four dependent variables; in addition the program provides an F-Ratio and a probability statement for each single variable and for each combination of variables. The probability statement gives each individual's likelihood of being included in either the linear or branching subgroup.

For the experimental portion of the present study students were members of linear or branching treatment subgroups engaged in the study of music fundamentals. The computer program utilizes students' scores from the measurement instruments discussed in Chapter III and establishes appropriate weighting coefficients for each of the single dependent variables as well as for combinations of variables exhibiting significant relationships. As each single variable is entered in the program in stepwise manner and its weighting coefficients established, new composite scores are generated as described in the previous chapter. These composite scores are projected to a new axis, and the intersecting lines from the means of the original scores to this new axis form the means for the composite scores. At a point midway between these composite means a cutting point is established for assigning students to either linear or branching subgroups. The computer program then provides a two-by-two matrix showing the number of students correctly and incorrectly classified into the respective subgroups.

For purposes of interpreting the analysis of data in establishing the statistical findings and for the subsequent drawing of conclusions it

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[1]This program, updated in 1974, was written by Paul Sampson, a member of the staff of Health Sciences Computing Facility, University of Southern California, Los Angeles.

is helpful to ascertain the total number of correctly classified students for each variable. This is best expressed as a percentage of correctly classified students.

The computer generates an F-Ratio to aid in establishing the level of significance for the discriminant function equation of each single variable as well as for the combinations of variables exhibiting significant relationships. The program first selects the single variable with the highest F-Ratio and continues in stepwise manner, selecting variables in order of the highest F-Ratio. As each variable is entered in stepwise manner, the classification power changes and the program reevaluates and accounts for variance. If the F-Ratio becomes too low, the variable is deleted from the program. The program is designed to treat all variables in a continuous manner, providing F-Ratios and numbers of correctly classified students for each single variable. The program continues until all variables have been entered, or until an F-Ratio is generated that is lower than the program's tolerance level for inclusion. Once each variable is accounted for the program determines the combination or combinations of variables which exhibit significant relationships and provides pertinent data for each.

Primary Analysis of Data

The dependent variables achievement, retention, time, and attitude form the basis for the null hypotheses stated in Chapter I. The null hypotheses, which reflect the major purpose of the investigation, furnish the rationale for the analyses to follow. Due to the diverse nature of the two extant groups used in the study, they will be considered separately.

Music major group. The analysis revealed that the mean scores for the dependent variable achievement (based on posttest scores) were 110.29 for the linear subgroup and 117.48 for the branching subgroup; the respective standard deviations were 17.75 and 9.43. The dependent variable retention yielded mean scores of 57.75 for the linear subgroup and 56.29 for the branching subgroup; the standard deviations were 7.91 and 7.93 respectively. The linear subgroup produced a mean score of 12.71 for the dependent variable time, as compared to a mean score of 4.79 for the branching subgroup. The standard deviations produced by the linear and branching subgroups for the variable time were 8.09 and 2.71 respectively. Mean scores for the variable attitude were 76.79 for the linear subgroup and 76.43 for the branching subgroup; the respective standard deviations were 15.20 and 15.39. Table 2 provides a summary of these data.

Table 2. Size of Sample, and Mean and Standard Deviation of Each Variable for the Music Major Group

	Linear Subgroup (n=24)		Branching Subgroup (n=21)	
Variable	Mean	S.D.	Mean	S.D.
Achievement	110.29	17.75	117.48	9.43
Retention	57.75	7.91	56.29	7.93
Time	12.71	8.09	4.79	2.71
Attitude	76.79	15.20	76.43	15.39

The analysis indicates that the within-groups correlation coefficient for the dependent variables achievement and retention was 0.75. Achievement and attitude yielded a correlation coefficient of 0.25, while the correlation coefficient of retention and attitude was 0.17. Attitude and time produced a correlation coefficient of 0.16. No greater correlation was obtained. Table 3 provides a within-groups correlation matrix giving all correlation coefficients for the dependent variables achievement, retention, time, and attitude.

Table 3. Within-Groups Correlation Matrix for the Music Major Group

	Achievement	Retention	Time	Attitude
Achievement	1.00			
Retention	0.75	1.00		
Time	0.10	-0.10	1.00	
Attitude	0.25	0.17	0.16	1.00

As illustrated in Table 4, only one single variable produced an F-Ratio that equaled or exceeded the critical value of F at the .05 level. The time variable correctly classified seventy-six percent of the students, and yielded an F-Ratio of 18.30 which exceeded the critical value of F at the .01 level. Neither achievement nor retention produced F-Ratios that equaled or exceeded the critical value of F at the .05 level. Attitude was dropped from the program because of an insufficient F-Ratio. The analysis does indicate that one combination produced an F-Ratio in excess of the critical value of F at the .01 level. The F-Ratio of the variables time and achievement was 11.05; this combination classified eighty-two percent of the students correctly. Although the F-Ratio of the achievement variable alone was not statistically significant, it was the second highest F-Ratio (2.75) for a single variable, which possibly explains why the combination of achievement and time

Table 4. F-Ratios, Degrees of Freedom, and Probability of Correct Classification for Each Single Variable and for the Most Successful Combination of Variables for the Music Major Group

Variable	F-Ratio	D.F.	Correct Classification Percentage
Single Variables			
Time #	18.30	1,43	76%
Achievement	2.75	1,43	56%
Retention	0.38	1,43	53%
Attitude *			
Most Successful Combination			
Time-Achievement #	11.05	2,42	82%

Significant at .01 level

* F-Ratio not large enough for inclusion

classified more students correctly than did time alone. It is also worthy of mention that the third highest F-Ratio for a single variable dropped considerably from that of achievement (retention, 0.38).

Because of the high F-Ratio of time in relation to the other single variables it was decided to re-run the program omitting time, in order to better ascertain the contribution of the other single variables. The re-run produced no further variables with F-Ratios that equaled or exceeded the critical value of F at the .05 level.

Prospective elementary teacher group. The analysis revealed that mean scores for the dependent variable achievement (based on posttest scores) were 66.48 for the linear subgroup and 76.46 for the branching subgroup; the respective standard deviations were 26.13 and 22.54. The dependent variable retention yielded mean scores of 40.41 for the linear subgroup and 40.21 for the branching subgroup. The standard deviations were 14.40 and 12.06 respectively. The linear subgroup produced a mean score of 13.53 for the dependent variable time, as compared to 7.99 for the branching subgroup. The standard deviations produced by the linear and branching subgroups for the dependent variable time were 12.91 and 8.14, respectively. Mean scores for the dependent variable attitude were 66.96 for the linear subgroup and 81.23 for the branching subgroup; the respective standard deviations were 21.47 and 15.38. These data are illustrated in Table 5.

As indicated by the analysis, the within-groups correlation coefficient for the dependent variables retention and achievement was 0.82. Achievement and attitude yielded a correlation coefficient of 0.36, while the correlation coefficient of retention and attitude was 0.28. Attitude and time produced a correlation coefficient of 0.17. No greater corre-

Table 5. Size of Sample, and Mean and Standard Deviation of Each Variable for the Prospective Elementary Teacher Group

	Linear Subgroup (n=27)		Branching Subgroup (n=28)	
Variable	Mean	S.D.	Mean	S.D.
Achievement	66.48	26.13	76.46	22.54
Retention	40.41	14.40	40.21	12.06
Time	13.53	12.91	7.99	8.24
Attitude	66.96	21.47	81.23	15.38

Table 6. Within-Groups Correlation Matrix for the Prospective Elementary Teacher Group

	Achievement	Retention	Time	Attitude
Achievement	1.00			
Retention	0.82	1.00		
Time	-0.06	-0.05	1.00	
Attitude	0.36	0.28	0.17	1.00

lation coefficient was present. Table 6 provides a within-groups correlation matrix giving all correlation coefficients for the dependent variables achievement, retention, time, and attitude.

As illustrated in Table 7, the variable attitude produced an F-Ratio of 8.30, which exceeded the critical value of F at the .01 level. The F-Ratios produced by the variables time and achievement did not equal or exceed the critical value of F at the .05 level. Retention was dropped from the program because of an insufficient F-Ratio. Table 7 reveals three combinations of variables with F-Ratios in excess of the critical value of F at the .01 level. The combination of attitude and time produced an F-Ratio of 6.97 and classified sixty-seven percent of the students correctly. Attitude, time, and retention in combination had an F-Ratio of 4.99 and classified sixty-nine percent of the students correctly, while the combination of attitude, time, retention, and achievement had an F-Ratio of 3.83 and classified seventy-five percent of the students correctly.

On inspection, Table 7 seems at first to be inconsistent. Both attitude and achievement had sixty percent correct classification, but both did not have significant F-Ratios. The variable time yielded sixty-five percent correct classification; greater than either attitude or achievement. The following discussion should clarify these matters. As was mentioned earlier, it must be remembered that in discriminant function analysis once the weighting coefficients have been determined establishing maximum sepration between the two groups, the means or centroids of the groups are plotted on a new single axis, and a point on the new axis midway between the intersecting lines from the two centroids becomes the cutting point for assigning students to one of the two groups. Obviously,

Table 7. F-Ratios, Degrees of Freedom, and Probability of Correct Classification for Each Single Variable and for the Most Successful Combinations of Variables for the Prospective Elementary Teacher Group

Variable	F-Ratio	D.F.	Correct Classification Percentage
Single Variables			
Attitude #	8.30	1,53	60%
Time	3.62	1,53	65%
Achievement	0.83	1,53	60%
Retention *			
Most Successful Combinations			
Time-Attitude #	6.97	2,52	67%
Time-Attitude-Retention #	4.99	3,51	69%
Time-Attitude-Retention-Achievement #	3.83	4,50	75%

Significant at .01 level

* F-Ratio not large enough for inclusion

if the groups are homogenous, or nearly so, their respective mean scores will be close together. Conversely, if the two groups are truly different, their mean scores will be farther apart. When the means lie close together the resulting F-Ratio will be low. However, as the distance between the means becomes greater, the F-Ratio produced will be larger. The writer mentioned in Chapter III that in evaluating probabilities for misclassification for members within a group, such probabilities are not uniform for all possible scores; those individuals whose scores lie near the cutting point are more likely to be placed in the wrong group than individuals whose scores are more distant from the cutting point.[1] Obviously, the closer the means, the greater the number of students whose scores lie near the cutting point.

Therefore it is possible to have two different variables with the same number of correctly classified members, but one having a large F-Ratio, and the other small. Such is the case with the attitude and achievement variables. Both have thirty-three correctly classified and twenty-two incorrectly classified cases representing sixty percent correct classification. The mean scores for the achievement variable were seventy-two and sixty-six for the branching and linear subgroups respectively, with a resultant F-Ratio of only 0.83. This ratio did not equal or exceed the critical value of F at the .05 level. On the other hand, the mean scores for the attitude variable were eighty-one for the branching subgroup and sixty-six for the linear subgroup; this yielded an F-Ratio of 8.30 which was in excess of the critical value of F at the .01 level.

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[1]John E. Overall and C. James Klett, Applied Multivariate Analysis (New York: McGraw-Hill Book Company, 1972), p. 253.

As mentioned, the time variable classified more members correctly (sixty-five percent) than did attitude, but the resulting F-Ratio was not significant. The explanation for this differs from that of achievement. The variable time, although exhibiting a fair degree of separation between mean scores, had extremely large standard deviations. The linear subgroup had a mean score of 13.53 and a standard deviation of 12.91. The branching subgroup mean was 7.99 and the standard deviation was 8.24. When this much variability exists within subgroups, little confidence can be placed in the respective means. This is substantiated by Tate:

> The reduction of a series to an average value is not without danger of distorting information. Variability is an important feature of a statistical series. . . . An average does not have meaning independent of the other characteristics of a statistical series; in fact, if a series is highly variable or irregular an average may have no real meaning and serve no useful purpose at all.[1]

An examination of raw data for the branching subgroup reveals that 215.41 total hours were utilized studying programed material. Three of the involved twenty-eight students used 80.5 hours. This means that approximately ten percent of the students accounted for approximately thirty-seven percent of the total time. The discriminant function analysis for this variable indicates the program classified all but three students correctly in the branching subgroup. Of the twenty-seven students following the linear format, sixteen were incorrectly classified for the variable time. The linear subgroup spent an average of 13.53 hours studying programed material. An investigation of raw data for this subgroup reveals that sixteen students each spent 8.6 hours or less working

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[1]Merle W. Tate, Statistics in Education and Psychology: A First Course (New York: The Macmillan Company, 1965), pp. 56-57.

the material (a total of 76.41 hours). This indicates that over fifty percent of the students in this subgroup account for only approximately twenty-one percent of the 365.3 total hours utilized.

These facts indicate the program classified the students correctly, but because of the extremes in time to work programed material of those branching and linear students mentioned above the resultant standard deviations were considerably higher than they would otherwise have been. This ultimately resulted in a low F-Ratio.

Statistical Findings

Based on the analysis of data in the previous section and in light of the described null hypotheses, the following statistical findings are noted. Because of the diverse nature of the two involved extant groups utilized in the study, the findings for each group are listed separately.

Music major group. The first null hypothesis states there will be no difference in the achievement rate of students as a result of the program format utilized. The achievement variable classified only fifty-six percent of the students correctly. Because the resultant F-Ratio of 2.75 did not equal or exceed the critical value of F at the .05 level, the null hypothesis was retained as it relates to the music major group.

The second null hypothesis states there will be no difference in the retention rate of students as a result of the program format utilized. The variable retention classified fifty-three percent of the students correctly. Because the resultant F-Ratio of 0.38 did not equal or exceed the critical value of F at the .05 level, the null hypothesis was retained as it relates to the music major group.

The third null hypothesis states there will be no difference in the time needed by students to complete material as a result of the program format utilized. The obtained F-Ratio of 18.30 for time exceeded the critical value of F at the .01 level. Considering the seventy-six percent correct classification for time, the null hypothesis was rejected as it relates to the music major group.

The fourth null hypothesis states there will be no difference in students' attitude toward instruction as a result of the program format utilized. Attitude was deleted from the program because of an insufficient F-Ratio. The null hypothesis was thus retained as it relates to the music major group.

The fifth null hypothesis states that no significant relationship will exist for any combination of the dependent variables--achievement, retention, time, and attitude--as a result of the program format utilized. The combination of time and achievement resulted in an obtained F-Ratio of 11.05 which exceeded the critical value of F at the .01 level. This combination successfully classified eighty-two percent of the students, therefore, the null hypothesis was rejected as it relates to the music major group.

Prospective elementary teacher group. The first null hypothesis states there will be no difference in the achievement rate of students as a result of the program format utilized. Although achievement classified sixty percent of the students correctly the resultant F-Ratio was only 0.83. The F-Ratio did not equal or exceed the critical value of F at the .05 level, therefore, the null hypothesis was retained as it relates to the prospective elementary teacher group.

The second null hypothesis states there will be no difference in the retention rate of students as a result of the program format utilized. The variable retention was dropped from the program because of an insufficient F-Ratio. The null hypothesis was thus retained as it relates to the prospective elementary teacher group.

The third null hypothesis states there will be no difference in the time needed by students to complete material as a result of the program format utilized. The time variable correctly classified sixty-five percent of the students, however, the resultant F-Ratio was only 3.62 which did not equal or exceed the critical value of F at the .05 level. The null hypothesis was thus retained as it relates to the prospective elementary teacher group.

The fourth null hypothesis states there will be no difference in students' attitude toward instruction as a result of the program format utilized. The variable attitude correctly classified sixty percent of the students. The obtained F-Ratio of 8.30 exceeded the critical value of F at the .01 level. The null hypothesis was thus rejected as it relates to the prospective elementary teacher group.

The fifth null hypothesis states that no significant relationships will exist for any combination of the dependent variables--achievement, retention, time, and attitude--as a result of the program format utilized. Three different combinations of variables had F-Ratios exceeding the critical value of F at the .01 level. The combination of the variables attitude and time had an F-Ratio of 6.97 and classified sixty-seven percent of the students correctly. The addition of retention to the attitude-time combination resulted in an F-Ratio of 4.99 and sixty-nine percent correct classification. The combination of all four variables produced the highest percentage of correct classification: this combination yielded an F-Ratio of 3.83 and classified seventy-five percent of the students correctly. The fifth null hypothesis was thus rejected as it relates to the prospective elementary teacher group.

An interesting observation might be made concerning the variable retention. As a single variable, retention was dropped because of an insufficient F-Ratio; however, it was included in combination before achievement. No explanation of this is available except that neither achievement or retention produced significant F-Ratios. Because of the closeness of the mean scores between subgroups for both of these variables many scores were close to the cutting point, and possibly the program misclassified different students at subsequent steps of the program. As mentioned previously, those individuals whose scores lie near the cutting point are more likely to be placed in the wrong group than individuals whose scores are more distant from the cutting point.[1]

It is worthy of mention that while neither retention or achievement had significant F-Ratios as single variables, they both contributed when included with the attitude-time combination. The combination of all four variables produced the highest percentage of correct classification while maintaining an F-Ratio that exceeded the critical value of F at the .01 level. Eisenbeis indicates that it is possible for a variable with an insignificant F-Ratio, when used in combination with other variables, to aid in the ability to accurately classify observations.[2]

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[1]Overall and Klett, p. 253.

[2]Robert A. Eisenbeis and Robert B. Avery, Discriminant Analysis and Classification Procedures: Theory and Applications (Lexington, Massachusetts: D. C. Heath and Company, 1972), pp. 63-67.

CHAPTER V

SUMMARY AND CONCLUSIONS

Purpose of the Study

The study was concerned with the effect of branching and linear formats in programed learning of music fundamentals as they relate to achievement, retention, completion time required for the programed material, and attitude toward programed learning.

Experimental Procedures

The study, conducted during the fall semester of the 1972-1973 academic year, utilized two extant groups of students from the University of Oklahoma, Norman, Oklahoma.

The first group was comprised of freshman music majors enrolled in the first term of the regular course sequence of study in music theory in the School of Music. The second group consisted of College of Education students enrolled in the second course of the music education course sequence designed for the prospective elementary teacher. Students from each group were divided according to a stratified random procedure employing scholastic ability. The basis for division into subgroups within the music major group was ACT scores. The prospective elementary teacher group was divided on the basis of grade point averages. The subgroups then were arbitrarily assigned to follow either the branching or linear format of self-instructional study of music fundamentals.

The pretest was administered to the music major group and the prospective elementary teacher group during the first and third weeks of the fall semester, respectively. During the experimental periods the music major group spent a total of four weeks studying music fundamentals, while the prospective elementary teacher group worked in the programed texts for ten weeks. At the end of the experimental periods, each group was administered the posttest and the attitude assessment instrument. Both groups were administered the retention test at the end of the fall semester as a portion of the final examination for the respective music courses in which they were enrolled.

The experimental design, as adapted for use in the present study, approximates design six as described by Campbell and Stanley.[1]

Findings and Conclusions

The findings reported in Chapter IV form the basis for the following conclusions. These conclusions partially support the general hypotheses of the study and are limited to the generalizations allowed by the experimental procedures, the criterion measures employed, and the programed material utilized.

The preliminary analysis supported the assumption of homogeniety of the subgroups within the limits of the two variables pretest scores and scholastic ability. No significant differences existed between the subgroups of either extant group when t-tests for independent means were computed for the two variables.

The discriminant function analysis used in the primary analysis of data classified subjects into linear and branching subgroups based on the four dependent variables: achievement, retention, time, and attitude.

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[1]Donald T. Campbell and Julian C. Stanley, Experimental and Quasi-Experimental Designs for Research (Chicago: Rand McNally and Company, 1970), pp. 25-31.

The first null hypothesis stated there would be no difference in the achievement rate of students as a result of the program format utilized. The analysis resulted in the retention of the null hypothesis. Although branching subgroups in both the music major group and the prospective elementary teacher group had higher mean achievement scores, the differences were not significant. Consistent with the findings of the present study, Beane,[1] Carlsen,[2] and Coulson and Silberman,[3] reported that differences in achievement scores between branching and linear groups could not be distinguished from chance occurrence. Conversely, Larkin and Leith[4] found that linear sections produced significantly higher scores than did the branching sections. In a related study concerned with the effect of content repetition on achievement in linear formats, Valverde and Morgan[5] concluded that achievement is facilitated by the use of programs containing less redundant material. Although the study was not concerned with a comparison of branching and linear formats *per se*, redundancy is, generally speaking, a characteristic of linear programing. On the basis of the evi-

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[1]Donald G. Beane, *A Comparison of Linear and Branching Techniques of Programmed Instruction in Plane Geometry*, Technical Report No. 1 (Urbana, Illinois: University of Illinois, 1962), ERIC no. ED020677.

[2]James C. Carlsen, "Programmed Learning in Melodic Dictation," *Journal of Research in Music Education*, XXI (Summer, 1964), pp. 139-148.

[3]J. E. Coulson and H. G. Silberman, "Results of an Initial Experiment in Automated Teaching," *Teaching Machines and Programmed Learning: a Source Book*, A. A. Lumsdaine and Robert Glasser (Washington: National Education Association, 1960), pp. 452-458.

[4]T. C. Larkin and G. O. M. Leith, "The Effects of Linear and Branching Methods of Programmed Instruction on Learning and Retention of a Topic in Elementary Science," *Programmed Learning*, I (May, 1964), pp. 12-16.

[5]Horace H. Valverde and Ross L. Morgan, "Influence on Student Achievement of Redundancy in Self-Instructional Materials," *Programmed Learning and Educational Technology*, VII, No. 2 (July, 1970), pp. 194-199.

dence currently available, it does not appear that achievement is affected by program format.

The second null hypothesis stated there would be no difference in the retention rate of students as a result of the program format utilized. The analysis resulted in the retention of the null hypothesis as retention scores between subgroups of both extant groups of the study could not be differentiated from chance occurrence. This is in agreement with findings reported by Beane,[1] and Coulson and Silberman.[2] Larkin and Leith,[3] however, found that linear sections had significantly higher retention scores than did the branching sections. The findings of the present study support the position that retention is not a function of program format.

The third null hypothesis stated there would be no difference in the time needed by students to complete material as a result of the program format utilized. Analysis of data for the prospective elementary teacher group revealed a substantial degree of difference in time between subgroups; however, there was considerable variance in individual times. As a result, the null hypothesis was retained as it relates to the prospective elementary teacher group. The highest percentage of correctly classified students for a single variable found in the entire study was for the time variable within the music major group. The branching subgroup required significantly less time to complete the programed materials than did the linear subgroup. The null hypothesis was therefore rejected as it relates to the music major group. The findings of related research indicate that students studying from a branching format required significantly less time to complete pro-

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[1]Beane, p. 93.

[2]Coulson and Silberman, pp. 460-461.

[3]Larkin and Leith, pp. 12-16.

gramed materials than did students following a linear format.[1,2,3] Based on the findings of the present study and those of related research, it appears that program format is a critical factor in the amount of time required to complete a unit of instruction.

The fourth null hypothesis stated there would be no difference in students' attitude toward instruction as a result of the program format utilized. As with time, student attitude toward programed instruction appeared to vary with the nature of the student group involved. There was virtually no difference in mean attitude scores between subgroups of the music majors; consequently, the null hypothesis was retained as it relates to this group. However, with the prospective elementary teacher group, attitude was a significant factor; members of the branching subgroup displayed more positive attitudes toward programed instruction than did members of the linear subgroup. The null hypothesis was therefore rejected as it relates to the prospective elementary teacher group. In a related study, Beane[4] reported no significant difference in attitude toward programed instruction as a result of the program format employed. The reported findings support the conclusion that program format is sometimes a factor influncing student attitude toward self-instructional material.

The fifth null-hypothesis stated that no significant relationship would exist between any combination of the dependent variables--achievement, retention, time, and attitude--as a result of the program format utilized. A significant relationship did exist between the time and

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[1]Beane, p. 94.

[2]Larkin and Leith, pp. 12-16.

[3]Coulson and Silberman, pp. 452-468.

[4]Beane, pp. 93-94.

achievement variables of the music major group, the higher scores being manifested by the branching subgroup. Results from the analysis of the prospective elementary teacher group revealed significant relationships between the combination of all four variables. In addition, significant relationships were apparent between the attitude-time combination, and between the attitude-time-retention combination. Again, the higher scores were produced by the branching subgroup. These findings indicate that combinations of variables sometimes reveal significant relationships although the mean-score differences for one or more of the individual variables are not significant. For example, as a single indicator, differences in the achievement variable for music majors was not significant; both groups demonstrated requisite achievement. Members of the branching subgroup, however, utilized significantly less time while demonstrating a higher rate of achievement than did their linear counterparts. Within the prospective elementary teacher group the obtained relationship between attitude and time disclosed that time was an influence on attitude toward programed instruction. Members of the branching subgroup utilized less time while demonstrating significantly more positive attitudes than did their linear counterparts.

The combination of variables within the prospective elementary teacher group that resulted in the highest percentage of correctly classified students was the combination of all four variables. The implication is that students employing the branching format have more positive attitudes toward programed instruction, require less time to complete the programed material, and maintain higher rates of retention and achievement than do students employing the linear format. A practical interpretation, however, would seem to require that this statement be qualified; especially concerning the relationship of retention to the other variables. As mentioned in Chapter IV, retention was dropped from the program because of an insufficient F-Ratio. Therefore, it would seem that the contribution of retention was not significant.[1] These findings support the conclusion that significant relationships do exist between certain combinations of the dependent variables as a result of program format, in favor of students utilizing branching materials.

As discussed earlier in the present section, differing results were obtained between the prospective elementary teacher group and the music major group for both time and attitude. The writer believes that certain factors inherent in the nature of the two groups explain, in part, these differences. Within the music major group, for example, a significant difference in time required to complete programed materials existed between subgroups in favor of those utilizing a branching format. Results from the prospective elementary teacher group revealed that although a considerable difference in mean-times existed between subgroups, there was a rather high degree of variance within subgroups. Within the branching subgroup three students accounted for approximately thirty-seven percent of the total time required to complete the materials. Within the linear subgroup over fifty percent of the students accounted for only twenty-one percent of the total time. Occasionally, students studying from a scrambled text will read the entire text, thereby utilizing more time than otherwise would be needed. This was possibly the situation with the three

[1]It is possible, however, for a variable with an insignificant F-Ratio, when used in combination with other variables, to aid in the ability to accurately classify observations. Robert A. Eisenbeis and Robert B. Avery, Discriminant Analysis and Classification Procedures: Theory and Applications (Lexington, Massachusetts: D. C. Heath and Company, 1972), pp. 63-67.

students in the branching subgroup whose reported time was excessive compared to the remainder of the subgroup.[1] The available data does not allow for further explanation.

Concerning the variation for time within the linear subgroup, music fundamentals represented only a part of the subject matter included in the course curriculum for the prospective elementary teacher group. Consequently, the posttest score accounted for only a portion of the final grade. Possibly a number of the students, especially those engaged in the more time-consuming linear format, worked only a portion of the programed materials. Within the music major group a passing score on the posttest was essential to successful completion of the freshman theory course; therefore, the students tended to finish the programed materials regardless of the time required. A visual examination of posttest scores between the two extant groups indicates this to be true. The total mean score for the music major group was 113.64 and for the prospective elementary teacher group, 69.53. Branching students who read the entire text and linear students who did not complete the programed material probably contributed to the differing results for time between the two extant groups, but these situations cannot be considered the only explanations.

The two extant groups utilized in the present study, representing samples from two different populations, also differed in results on the attitude variable. Within the prospective elementary teacher group a significant relationship existed between attitude and time. Students who utilized less time to complete the programed material exhibited more

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[1]Although this could occur with any student studying from a scrambled text, it did not seem to occur with branching students of the music major group.

positive attitudes toward programed instruction. There was no evidence of this relationship with the music major group. Attitude toward programed instruction seemed to be a more stable variable with little observable difference between subgroup means. Considering the differing nature of the two extant groups this appears reasonable. The assumption that the primary concern of the music majors was the successful completion of the music fundamentals material in order to receive a passing grade in the freshman theory course also seems reasonable. Members of the prospective elementary teacher group were not music majors and music fundamentals represented only a portion of the requirements for the methods course in which they were enrolled. Therefore, it seems logical to assume that attitude toward programed instruction would be more closely related to the time required to complete music fundamentals for the non-music majors than for those in the music major group.

In summary, the investigation seemed to indicate that time required to complete materials and students' attitude toward instruction are important factors to be considered when selecting programed materials for the learning of music fundamentals. Students following a branching format require less time to complete the programed materials and have more positive attitudes toward this instructional mode. While achievement and retention ability were not significant factors in themselves, it should be noted that students following the branching format of programed instruction demonstrated consistently higher rates of achievement and retention than did the linear students, and that the achievement and retention variables did exhibit significant relationships with both time and attitude in favor of the branching format. These findings would seem to support the general conclusion that students following a branching format of programed instruction in the learning of music fundamentals require less time to complete the material and exhibit more positive attitudes while maintaining achievement and retention rates at least comprable to students utilizing a linear format.

Implications

On the basis of the findings and conclusions drawn, the following implications are suggested:

1. It appears that achievement rate does not vary significantly as a result of the branching or linear format employed. The two techniques seem to be equally effective for the learning of music fundamentals. Although the study did not attempt a comparison of programed versus conventional instruction, a visual examination of achievement scores of both extant groups utilized seems to indicate that significant learning did occur.

2. The findings indicate that retention rate is not a function of programing technique. Branching and linear techniques seem to be equally effective regarding retention. Again, a comparison of scores indicates that students of both extant groups displayed the ability to retain significant amounts of the material learned.

3. The findings of the study imply that time required to complete programed instruction is a critical factor. Students following a branching format tend to complete the required materials in considerably less time than their linear counterparts.

4. Another important consideration appears to be students' attitude toward programed instruction. Students engaged in a branching format tend to display more positive attitudes toward programed material than students following a linear format.

5. Considered separately, achievement and retention rates did not seem to be functions of program format; however, relationships were found to exist between each of these variables and those of time and attitude. The implication seems to be that achievement and retention vary to some degree with the time required to complete programed material and with attitude toward programed learning. Achievement and retention rates of branching students were consistently higher than for linear students.

Hopefully, the implications of the present study can be projected beyond those specific observations made above. Chapter I attempts to develop the efficacy for programed instruction in meeting certain needs for achieving current educational goals. It was shown that programed instruction can release the teacher from much of the direct responsibility of teaching fundamental concepts, skills, and factual material. This is compatible with the rationale underlying contemporary developments in musicianship curricula. Both the Manhattanville Music Curriculum Program and the Comprehensive Musicianship Project suggest that programed instruction can facilitate the achievement of musicianship goals.[1,2]

If programed instruction is to successfully meet this challenge, the most effective and efficient methods of programing must be determined. In employing programed instruction as a teaching resource it is imperative that students be able to complete assigned or supplementary materials in an effective and efficient manner. It is equally important that students maintain healthy and positive attitudes toward this type of instruction.

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[1]Paraphrased from a statement by Ronald B. Thomas, personal interview July 27, 1973.

[2]David Willoughby, Comprehensive Musicianship and Undergraduate Music Curricula (Washington: Contemporary Music Project/Music Educators National Conference, 1971), p. 15.

In light of the strategic role programed instruction can play in meeting current educational needs, and in view of the findings of the present study, the implication is that a branching format of programed instruction be employed when the situation allows.

On the basis of the information presented, larger generalizations are suggested. A review of available programed courses of study in music theory reveals far more material developed by means of a linear rather than a branching format. Although the writer recognizes that some areas of music theory might be more compatible with a linear programing format, authors of programed music texts need to give serious consideration to the writing of branching materials when practical.

A possible explanation of the abundance of linear programs in music theory deals with the nature of program development. By design linear programs are constructed so that the format functions to guide the student through the program. Because all students follow the same path and respond to every frame in identical sequence, the writer of linear programs is primarily concerned with constructing a program that will introduce pertinent subject matter in a logical sequence. In a branching format the student's progress through the program is contingent, to a large extent, upon his response. Students who give different answers will automatically be directed to different material. Thus, ideally, the writer of a branching program will anticipate and make allowances for all possible responses. Considering these differences in program development, the construction of a linear program appears simpler than that of a branching program. This facilitation of construction should not be a deterrent to the writing of branching programs if one accepts the premise that branching programs appear to be more effective and effecient; however, the implication should go beyond the mere adoption of a linear or branching format. One criticism of programed instruction deals with the length of the programed unit. results of the present study indicate a direct relationship between the amount of time required to complete a programed unit and students' attitude toward programed instruction. Many programed courses of instruction currently available in music theory include from one to four semesters of instruction. Chapter I suggested the purpose of programed instruction is not to replace the teacher, but to supplement the teacher's instruction. This seems to indicate the need for a series of shorter programs, each dealing with a single concept or with a specific area of subject matter. The writer contends this need exists regardless of the program format employed and that such programs would have greater potential for use by a teacher of music theory.

Another criticism concerning programed instruction in music theory deals with the absence of aural material to be integrated with written theory. While some available programs do contain aural material, many times this amounts only to the inclusion of aural drills and not actual programed instruction in aural theory. The need exists for hardware to be adapted or developed for this purpose. The availability of cassette recorders, film strip projectors, and other such equipment indicates that adequate and economical hardware could be developed and satisfactory aural programs written to be used with this equipment.

Another area deserving mention is the development of programed materials by in-service teachers of music theory. The innovative teacher need not be wholly dependent upon published programed materials, but can develop through study and experimentation, programs tailored to the needs of his or her course of instruction.

The bulk of programed material in music theory deals with music fundamentals, aural theory, and the first two years of written theory. Programs of the type mentioned above should be written for use in other areas of music theory instruction, such as form and analysis, counterpoint, arranging, and composition.

Finally, the need for proper testing and evaluation of programed materials should be considered. The writer contends that authors of published courses of programed instruction, as well as the publishers, have an obligation to furnish information concerning the testing, evaluation, and refinement of the materials. This would greatly aid the prospective user in determining the effectiveness of the programed unit. Much of the programed material currently available in music theory offers no such information.

Recommendations for Further Study

1. A replication of the present study employing larger and more diverse groups. Such a study might deal with music students at the secondary level, as well as college students from other geographical locations.

2. Research to determine the effects of previous musical, academic, or social background in relation to the program format used in learning music theory.

3. A study to determine the effects of scholastic ability in relation to the program format utilized in learning music theory. Such a study might be structured to include both branching and linear programed formats stratified into high and low scholastic ability levels, in an attempt to determine the effectiveness of program format in relation to each of the scholastic ability levels.

4. A more in-depth study to investigate attitudes of students toward program format in learning music theory. A study of this type might follow the general outline of the present study, but involve a shorter, more concentrated experimental period. The study also might be designed in a manner that would allow students to be independent of classroom influences.

5. Studies dealing with the construction of programed materials in music theory written in a branching format. This general concept area also could include further studies in Computer Assisted Instruction in music theory.

6. Development of programed material in music theory to be integrated with other areas of music study. Such an approach might be concerned with the development of programed material for use in a comprehensive musicianship format. This could involve the integration of music theory material with music history, literature, and applied music.

7. A study to develop a series of graded programed lessons for learning music theory. By nature each lesson would be relatively short, enabling the student to work toward an immediate goal for accomplishing an immediate task. The lessons could be arranged with progressively difficult levels for the student who desired a more in-depth study within a particular area. One such study might be directed toward the elementary grades, while others could be devised for use on the secondary or college levels.

8. A formal evaluation of short programed units versus longer ones, involving the same concept areas. Such a study might investigate the effect of program format in relation to achievement, the effect of students' attitude toward the method of programing, and the time required to complete the

program units.

9. The development of hardware and related programs for the integration of aural and written theory. Such hardward might utilize cassette recorders, film strip projectors, and/or commercially available audio-visual teaching machines.

10. The development of programed material specifically concerned with teaching the principles of programing techniques to in-service teachers enabling them to construct informal programs for use in their own classes.

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APPENDIX A

Pretest-Posttest

Pretest-Posttest

NAME____SECTION____________________

PART I SYMBOLS: RECOGNITION OF MUSICAL SYMBOLS

Column one (1) contains fifteen musical symbols. Identify each symbol by matching it with its name in column two (2). Place your answer in the blank space to the left of each symbol in column one.

COLUMN ONE (SYMBOLS)

_____ 1. ♯

_____ 2. $\frac{3}{4}$

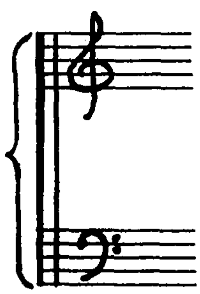
_____ 3. 𝄾

_____ 4. ♭

_____ 5. ♩.

_____ 6. 𝄞

_____ 7. ♪

_____ 8. 

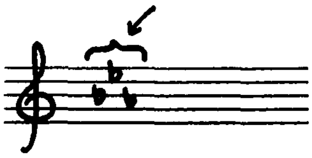
_____ 9. 𝅗𝅥

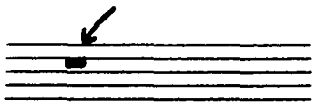
COLUMN TWO (NAMES)

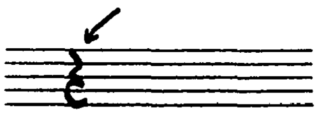
1. Key Signature
2. Whole Rest
3. Tie
4. Dotted Quarter Note
5. Treble Clef Sign
6. Great (or Grand) Staff
7. Sixteenth Note
8. Eighth Rest
9. Meter (or Time) Signature
10. Half Note
11. Measure
12. Quarter Rest
13. Sharp
14. Flat
15. Eighth Note

PART I (CON'T.)

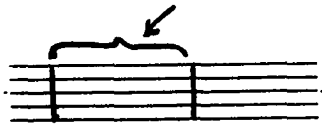
COLUMN ONE (CON'T.)

_____ 10. 

_____ 11. 

_____ 12. 

COLUMN ONE (CON'T.)

_____ 13. 

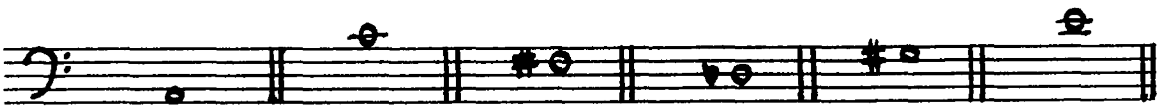
_____ 14. 

_____ 15. 

PART II NOTATION: NOTE IDENTIFICATION

In the following examples, give the letter name of each note (and accidental when applicable). Place your answer in the space provided.

1._____ 2._____ 3._____ 4._____ 5._____ 6._____

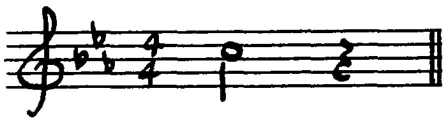


7._____ 8.____ 9.____ 10.____ 11.____ 12._____

PART III METER: MEASURE COMPLETION

The following musical examples are based upon different meters. The rhythmic pattern of each example represents an incomplete measure. Complete each measure by adding the proper single note or rest as indicated. Place your answers in the space provided.

SAMPLES

1.  (note) 

2.  (rest) 

1.  (note) ______

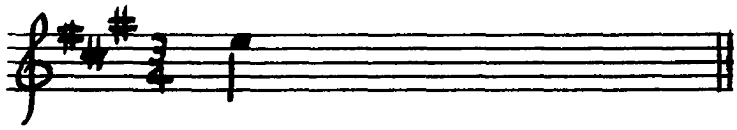
2.  (rest) ______

3.  (note) ______

4.  (rest) ______

5.  (note) ______

PART III (CON'T.)

6.  (rest) ______

7.  (note) ______

8.  (rest) ______

PART IV SCALES: SCALE WRITING

Write each of the following scales, using accidentals (not key signatures), on either the bass or treble staff (not both).

1. Eb Major,
   Ascending

2. g Natural minor,
   Ascending

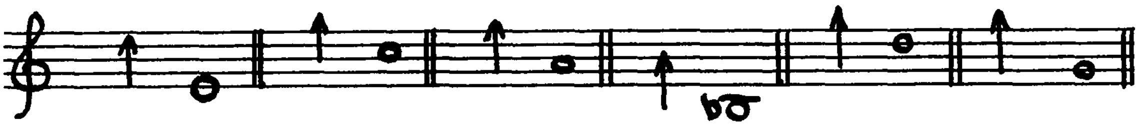
3. e Melodic minor,
   Ascending

4. b Harmonic minor,
   Ascending

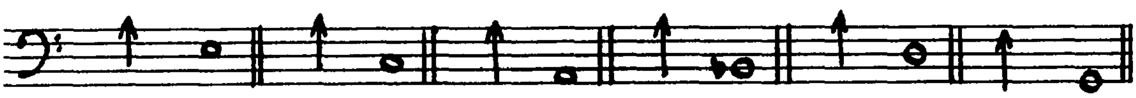
5. f Melodic minor,
   Descending

PART V INTERVALS: INTERVAL WRITING

In the following examples, write the indicated interval above the given note, in either treble or bass staff (not both). Do not change the given note.

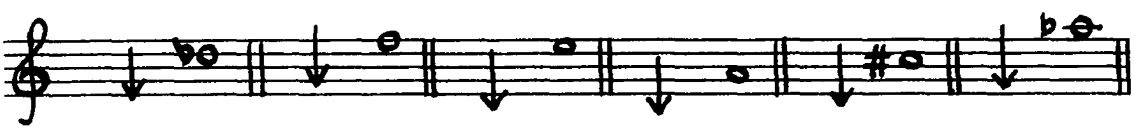


(1. Maj. 6)(2. Per. 4)(3. Maj. 2)(4. Aug. 5)(5. min. 3)(6. dim. 5)

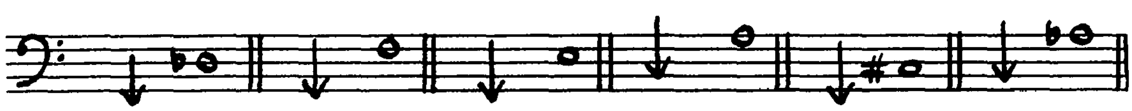


(1. Maj. 6)(2. Per. 4)(3. Maj. 2)(4. Aug. 5)(5. min. 3)(6. dim. 5)

In the following examples, write the indicated interval below the given note, in either treble or bass staff (not both).



(7. Per. 5)(8. dim. 4)(9. min. 2)(10.Aug. 4)(11.Maj. 3)(12.min. 6)

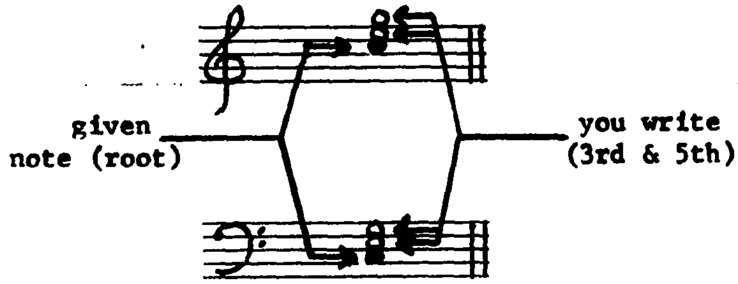


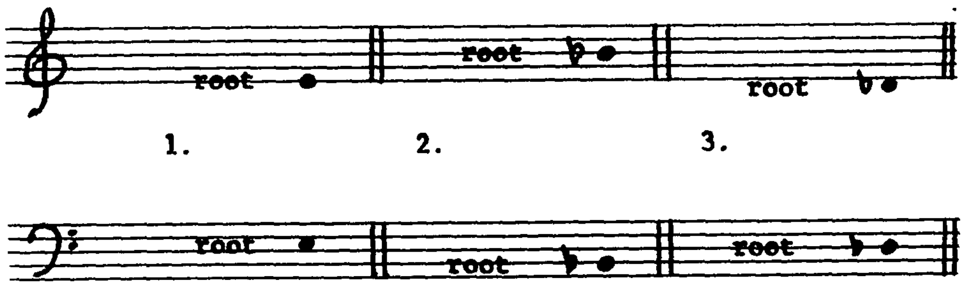
(7. Per. 5)(8. dim. 4)(9. min. 2)(10.Aug. 4)(11.Maj. 3)(12.min. 6)

PART VI TRIADS: TRIAD WRITING

In the following examples, the root of a Major triad is given. Complete the triad by adding its 3rd and 5th. Do not change the given note. Write the triads in root position on either the treble or bass staff (not both).

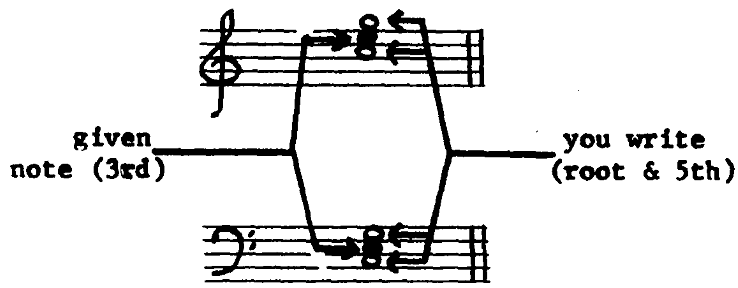
SAMPLES

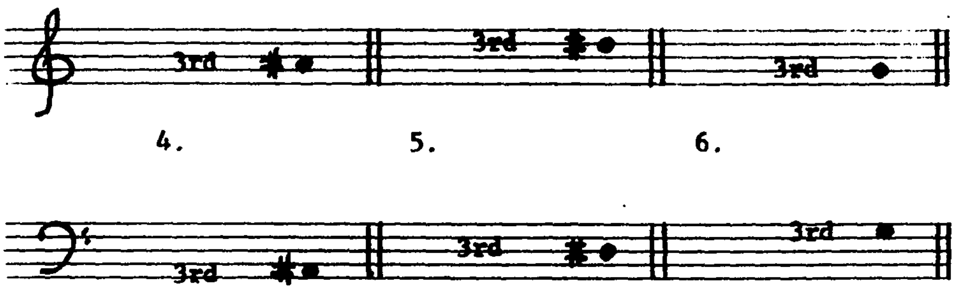




In the next examples, the 3rd of a Major triad is given. Complete the triad by adding the root and 5th. Do not change the given note. Write the triads in root position on either treble or bass staff (not both).

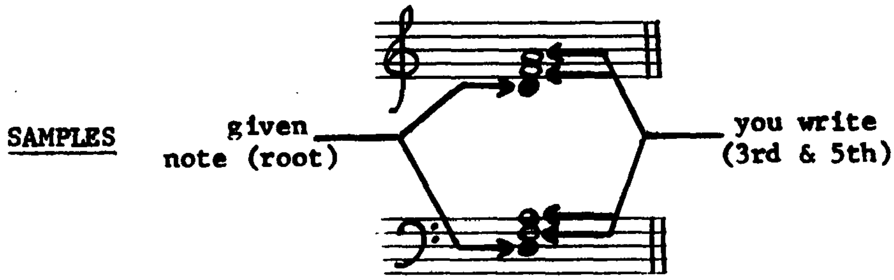
SAMPLES

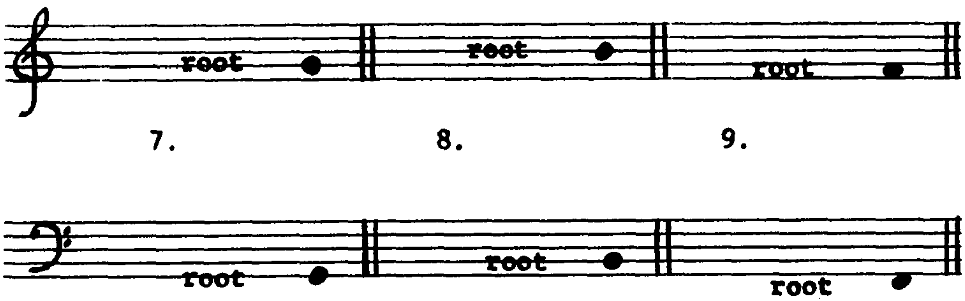




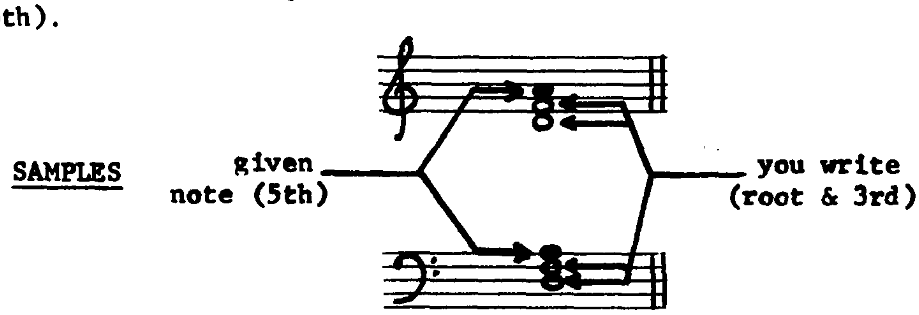
PART VI (CON'T.)

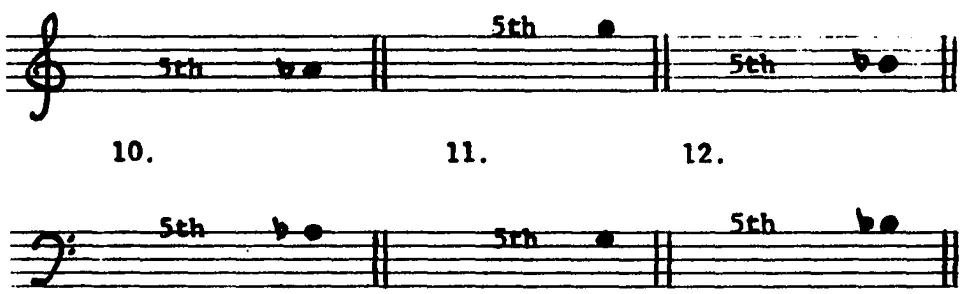
The given note is now the root of a minor triad. Complete the triad by adding the 3rd and 5th. Do not change the given note. Write the triads in root position on either the treble or bass staff (not both).





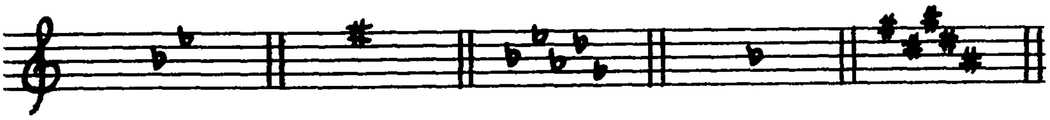
The given note now represents the 5th of a minor triad. Complete the triad by filling in the root and 3rd. Do not change the given note. Write the triads in root position on either the treble or bass staff (not both).



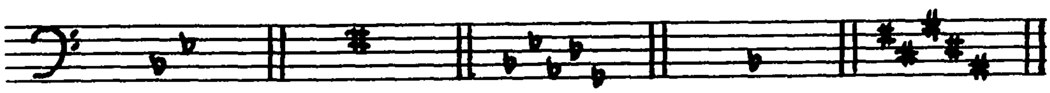


PART VII KEYS: KEY IDENTIFICATION

Identify the following Major key signatures by placing your answer in the blank space below each example. Write your answer for either the treble or bass staff (not both).

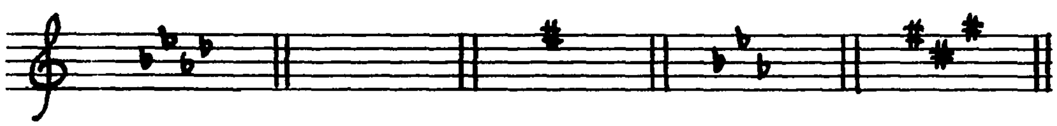


1._____ 2._____ 3._____ 4._____ 5._____



1._____ 2._____ 3._____ 4._____ 5._____

Identify the following minor key signatures by placing your answer in the blank space below each example. Write your answer for either the treble or bass staff (not both).



6._____ 7._____ 8._____ 9._____ 10._____

6._____ 7._____ 8._____ 9._____ 10._____

Indicate the relative minor key (letter name) of each of the following major keys.

11. Eb Major _____ minor

12. F Major _____ minor

13. Db Major _____ minor

14. A Major _____ minor

15. G Major _____ minor

APPENDIX B

Time-Log-Sheet

Time-Log-Sheet

NAME____SECTION__________________

Please keep an accurate record of the time you spend working in the programed text. This time-sheet will not be a factor in arriving at your grade, but it is needed for purposes of the experiment.

	MON.	TUE.	WED.	THU.	FRI.	SAT.	SUN.
Week 1							
Week 2							
Week 3							
Week 4							
Week 5							
Week 6							
Week 7							
Week 8							
Week 9							
Week 10							

APPENDIX C

Attitude Assessment Instrument

Attitude Assessment Instrument

NAME____SECTION_______________

Indicate your opinion of the following statements by placing the appropriate number in the blank space to the left of each one. Please make a response to each statement. The code used is as follows.

+1 = I agree a little	-1 = I disagree a little
+2 = I agree on the whole	-2 = I disagree on the whole
+3 = I agree very much	-3 = I disagree very much

EXAMPLE

+2 1. People with an extreme overbite should not play trumpet.

(this response would indicate that you agree on the whole)

______ 1. I do not like programed texts because they tend to present the material too slowly.

______ 2. I would like to continue the rest of the semester in music using programed materials.

______ 3. I would like to use programed texts in more of my college courses.

______ 4. *When studying in a programed text, it is easy to see the answer before thinking the question through completely.

______ 5. I like the manner in which material is presented in a programed text.

______ 6. I like the traditional teacher-classroom method of instruction because I know exactly how much I am expected to do each day.

______ 7. I did not like studying in the programed text because I frequently needed the assistance of a teacher.

______ 8. Repetition of material, as used in a programed text, is helpful to me.

______ 9. Studying in a programed text is an excellent method of learning, for me.

(CODE)

+1 = I agree a little	-1 = I disagree a little
+2 = I agree on the whole	-2 = I disagree on the whole
+3 = I agree very much	-3 = I disagree very much

______ 10. I hope I never see another programed text.

______ 11. When studying programed material, I enjoy being able to work at my own speed, as opposed to having definite daily assignments.

______ 12. Studying in a programed text is boring.

______ 13. I enjoy studying in a programed text.

______ 14. I do not like programed texts because the answers are too obvious.

______ 15. I enjoy working in a programed text without the direct supervision of a teacher.

______ 16. The procedure used in a programed text of immediately telling me if my response to a question is right or wrong, is helpful.

* This item was not considered for scoring purposes.

APPENDIX D

Retention Test

Retention Test

NAME____SECTION__________________

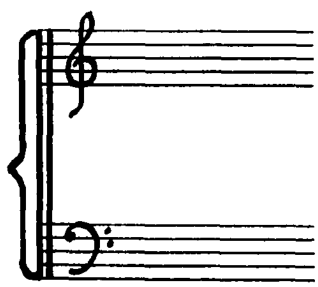
PART I SYMBOLS: RECOGNITION OF MUSICAL SYMBOLS

Column one (1) contains seven musical symbols. Identify each symbol by matching it with its name in column two (2). Place your answer in the blank space to the left of each symbol in column one.

COLUMN ONE (SYMBOLS)

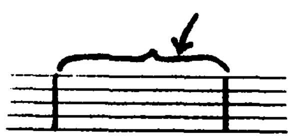
______ 1. 

______ 2. 

______ 3. 

______ 4. 

______ 5. 

______ 6. 

______ 7. 

COLUMN TWO (NAMES)

1. Measure
2. Key Signature
3. Dotted Quarter Note
4. Whole Rest
5. Treble Clef Sign
6. Great (or Grand) Staff
7. Eighth Rest
8. Tie
9. Meter (or Time) Signature
10. Sharp

PART II NOTATION: NOTE IDENTIFICATION

In the following examples, give the letter name of each note (and accidental when applicable). Place your answer in the space provided.

1._____ 2._____ 3._____ 4._____ 5._____ 6._____

PART III METER: MEASURE COMPLETION

The following musical examples are based upon different meters. The rhythmic pattern of each example represents an incomplete measure. Complete each measure by adding the proper single note or rest as indicated. Place your answers in the space provided.

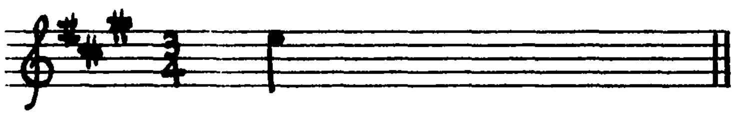
SAMPLES

1.  (note) 

2.  (rest) 

1.  (note) _____

2.  (rest) _____

3.  (note) _____

4.  (rest) _____

PART IV SCALES: SCALE WRITING

Write each of the following scales, using accidentals (not key signatures), on either the bass or treble staff (not both).

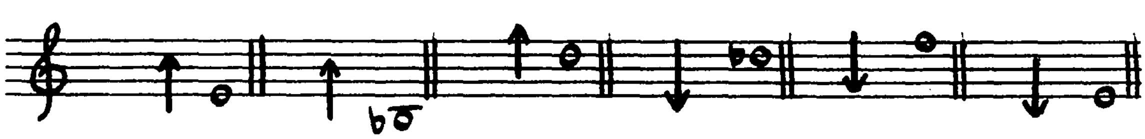
1. Ab Major,
Ascending

2. c Harmonic minor,
Ascending

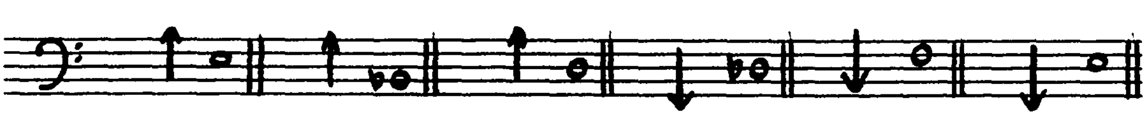
3. g Melodic minor,
Descending

PART V INTERVALS: INTERVAL WRITING

In the first three examples, write the indicated interval above the given note, in either treble or bass staff (not both). Do not change the given note. In the second three examples, write the indicated interval below the given note.



(1. Maj. 6) (2. Aug. 5)(3. min. 3)(4. Per. 5)(5. dim. 4)(6. min. 2)

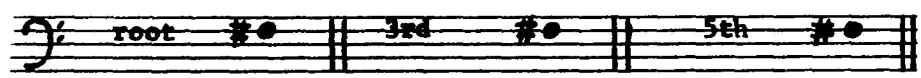


(1. Maj. 6) (2. Aug. 5)(3. min. 3)(4. Per. 5)(5. dim. 4)(6. min. 2)

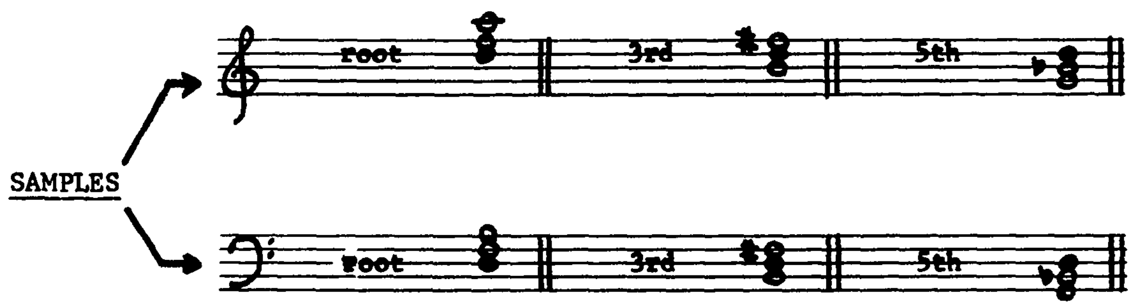
PART VI TRIADS: TRIAD WRITING

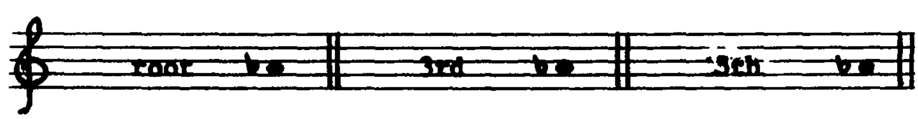
In the following examples, use the given note as root, 3rd, or 5th (as indicated), of a Major triad. Do not change the given note. Write the triads in root position on either the treble or bass staff (not both).

1. 2. 3.



In the next examples, use the given note as root, 3rd, or 5th (as indicated), of a minor triad. Do not change the given note. Write the triads in root position on either the treble or bass staff (not both).



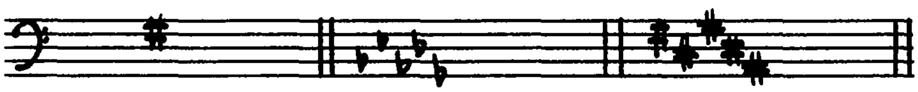


4. 5. 6.

PART VII KEYS: KEY IDENTIFICATION

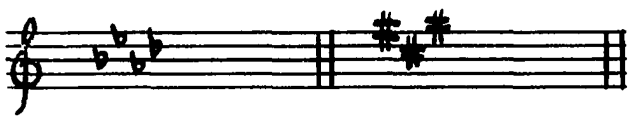
Identify the following Major key signatures by placing your answer in the blank space below each example. Write your answer for either the treble or bass staff (not both).

1.______ 2.______ 3.______



1.______ 2.______ 3.______

Identify the following minor key signatures by placing your answer in the blank space below each example. Write your answer for either the treble or bass staff (not both).



4.______ 5.______

4.______ 5.______

Indicate the relative minor key (letter name) of each of the following Major keys.

6. Eb Major ______ minor

7. F Major ______ minor

APPENDIX E

A Comparison of the Contents of Two Programed Texts

in Music Fundamentals

A Comparison of the Contents of Two Programed Texts in Music Fundamentals

Basic Materials in Music Theory by Paul Harder

Basic Concepts in Music by Gary M. Martin

Harder	Martin
Chapter I "The Basic Materials of Music"	
Chapter II "The Notation of Pitch"	Chapter I (part) "Basic Components of Notation" Chapter III (part) "Notational Components of Melody"
Chapter III "Time Classification" Chapter IV "Note and Rest Values" Chapter V "Time Signatures"	Chapter II "Notational Components of Rhythm" Chapter I (part) "Basic Components of Notation"
Chapter VI "Intervals"	Chapter IV (part) "Harmonic Structure of Music"
Chapter VII "The Basic Scales" Chapter VIII "The Major Scale" Chapter IX "The Minor Scales" Chapter X "Key Signatures"	Chapter III (part) "Notational Components of Melody" Chapter V (part) "Major Scales, Chords, and Keys" Chapter VI (part) "Minor Scales, Chords, and Keys"

Harder	Martin
Chapter XI "Triads"	Chapter IV (part) "Harmonic Structure of Music" Chapter V (part) "Major Scales, Chords, and Keys" Chapter VI (part) "Minor Scales, Chords and Keys"
	Chapter VII "The Structure of Music"