AN INVESTIGATION OF THE EFFECTIVENESS OF PROGRAMMED LEARNING IN THE TEACHING OF HARMONIC DICTATION IN A BEGINNING COLLEGE MUSIC THEORY COURSE

DISSERTATION

Presented to the Graduate Council of the North Texas State University in Partial Fulfillment of the Requirements

For the Degree of

DOCTOR OF EDUCATION

By

Melvin L. Daniels, M. Ed.
Denton, Texas
August, 1964
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CHAPTER I

INTRODUCTION

The problem of the study was to investigate the comparative effectiveness of two methods of teaching harmonic dictation to beginning college music students. The methods were (1) the conventional teacher-classroom approach as suggested by Robert Ottman's *Elementary Harmony* (2), and (2) a linear programed book to be used in conjunction with a series of tape recordings.

The purpose of the study was to compare the achievement of students in their ability to take harmonic dictation as a result of the two methods used. This achievement was determined by a pre-test and post-test of their ability in this area of music theory. The study involved an analysis of the differences according to the following variables:

(1) Scholastic aptitudes as determined by the *American College Test* and achievement in harmonic dictation, (2) Interaction (Relationships) between initial ability and the method used in the teaching of harmonic dictation, and (3) Predictive ability of the composite and sectional scores of the *North Texas State University Freshman Placement Theory Examination* in determining the competency of the student to take harmonic dictation.
Hypotheses

The first hypothesis of the study was that there is no difference in the effectiveness of the conventional teacher-classroom approach and that which utilizes altogether the programed text and tape recordings. A second hypothesis was that an analysis of the differences of achievement of the students taught by the two methods would reveal no significant relationship to scholastic aptitude as measured by the American College Test.

Additional aspects of the problem were to determine (1) the interaction (relationships) between initial ability and the method used in the teaching of harmonic dictation, and (2) the predictive ability of the composite and sectional scores of the North Texas State University Placement Theory Examination.

Definition of Terms

1. Harmonic Dictation—The term used in music theory which refers to the process of a student's writing down on music staff paper the notes of the harmonies which he hears played (usually on the piano) by the instructor. It may also refer to the writing down of chord functions or chord numbers alone, or in conjunction with the notes on the staves.
2. Melodic Dictation—The term used in music theory which refers to the process of a student's writing down on music staff paper the notes of the melodic line (melody) which he hears played (usually on the piano) by the instructor.

3. Programed Instruction—A term used to describe a method of instruction which makes use of the following features: small learning steps, immediate confirmation of answer, active participation, self-pacing, and fairly errorless learning.

4. Programing—The preparing of a program of instruction.

5. Programed Text—The linear type book prepared by the experimenter for use in conjunction with a tape recorder in teaching harmonic dictation.

6. Tape Recorder—The Wollensak T-1616 Electronic Control model used to play the tapes which were designed for use with the programed test. One of its features is that it will automatically continue to replay any frame or section of a properly prepared tape until an override procedure is followed. The override procedure guides the tape to the following frame.

7. Conventional Teacher-classroom Method—The term used to describe the method which is presently used to teach harmonic dictation at North Texas State University. It consists of teacher-explained procedures, practice sessions in
the classroom, and the eventual testing of students. For the purposes of this study it also involved out-of-class supervised practice. These practice sessions were timed so that the aggregate time spent would equal that of the experimental group.

8. Teaching Machine—Any book, machine, or device used for the presentation of programed material.

9. Frame—A single step of a program, most often containing information as well as a question to be answered.

10. Branching Technique—A method of programing in which the steps are presented in such a way that the nature of the response will determine the sequence of the steps or the route through the material.

11. Linear Technique—A method of programing which elicits and reinforces correct responses only. (The type used in this study). In linear programing the steps are presented in a fixed sequence with no opportunity to employ alternate frames.

The Need for the Study

While a great deal of research in the field of programed learning has been carried on in the last few years, little scientific research has been done in the specific area of aural perception as pertains to college level music theory (see Chapter II). Because there are many facets to aural
perception as taught in the college music theory classroom it has been difficult to isolate a specific problem for investigation. The work of Spohn (3) at Ohio State University in using programmed materials to identify melodic intervals and Carlsen (1) at Northwestern University using a programmed text to teach melodic dictation have been helpful in initiating the present study using programmed materials to teach harmonic dictation.

Situational Setting of the Problem

Students entering the School of Music at North Texas State University are given the North Texas University Freshman Placement Theory Examination. Those who fail to make the required percentage of correct responses on this examination are not allowed to enroll in the regular music theory courses but are required to take a semester of Music Fundamentals (Music 126). Their grouping into sections of Music 126 is determined by their scores on the North Texas University Freshman Placement Theory Examination. Those scoring highest are placed in section one, those scoring next highest in section two, etc. Those who successfully complete Music 126 are allowed to enroll in the regular music theory courses the following semester but must remain in the same section to which they were originally assigned.
One of the regular theory courses is entitled Elementary Sight-Singing and Ear-Training (Music 138). The four sections of those students progressing from Music 126 into Music 138 were the population used for this study.

One of the major objectives of Music 138 is to teach the student to take harmonic dictation. Until the spring semester of 1964, the course had been taught by the conventional teacher-classroom method.

Limitations of the Study

The study was limited to measures of achievement in harmonic dictation as taught to first semester music theory students at North Texas State University and was not concerned with the other aspects of music theory.

The measure of each student's achievement in harmonic dictation was limited to a departmental test, which was used to pre-test and post-test the students, and will apply to other institutions only if their expected levels of achievement are the same as those at North Texas State University.

Any results of the study are limited to the School of Music at North Texas State University and will apply to other institutions only if their music theory program is similar to that at North Texas State University.

Basic Assumptions

The following basic assumptions are related to this
1. There was no difference in the effect on the students by the four teachers involved in the study because each teacher was using the same texts and teaching methods and was pursuing common instructional goals.

2. The differences between the control and experimental groups with regard to any variable such as time of day for practicing harmonic dictation and attitude toward programed learning were not significant.

3. Any small differences in the time spent in learning and practicing the various aspects of harmonic dictation will not be significant because in the design of the study every attempt was made to equalize this factor for each group.

Procedures for Collecting Data

Since no commercial programed materials were available for the teaching of harmonic dictation, materials were constructed for the purpose of the study. A book of 228 frames was printed, and tape recordings of a piano were made to accompany the book. Each frame of the tape recording was so constructed that it would replay automatically until an override procedure was followed.
Before the study was begun, a pilot study was made to determine the adequacy of the programmed materials. Sixteen students were involved in the pilot study, and each had a musical background similar to those students who were involved in the main study. When the pilot study was completed, the results were analyzed and necessary refinements were made in the programmed materials.

The data for this study were obtained from students enrolled in the four sections of Music 138, taught by four different teachers. Near the beginning of the semester a tape recorded departmental test in harmonic dictation was administered as a pre-test to the students involved in the study. Each student's score on the pre-test was placed on his master card which also contained all the other data necessary to the study. While the students had already been grouped into the various sections according to their scores on the placement test, it was felt that a further grouping as a result of the harmonic dictation pre-test scores would allow even stronger controls for the study. Therefore, in each of the four sections of Music 138 the two students scoring highest on the pre-test were randomly assigned to the control group and experimental group by a chance drawing. The next two highest scoring students were assigned to a group in the same manner. This continued
until all students in each of the four sections of Music 138 were assigned to either the experimental or control groups.

All the students in each section of Music 138 received the same instruction in music theory with the exception of harmonic dictation. When the teacher of each section began the specific study of harmonic dictation, the following schedule was observed:

1. The control group remained in class and received the traditional teacher-classroom instruction in harmonic dictation. The instructors involved recorded the amount of time spent in classroom instruction and supervised practice outside of class, with the amount of time spent being made to approximate that of the experimental group.

2. The experimental group did not remain in class, but used the teaching machine for both instruction and practice. A log sheet was signed each time a student used the teaching machine, thus allowing an accurate check on the amount of time spent.

At the end of the semester the same tape recorded pre-test was administered as a post-test, and each student's score was recorded on his master card along with the other scores.
Procedures for Treating Data

When the data were tabulated, computations were made by data processing machine, and a comparison of the results of the study determined whether the hypotheses were to be accepted or rejected.

The small sample or \( t \) technique was used to determine the significance of the mean differences between the control group and experimental group.

The correlation technique was used to determine the correlation of the mean changes of each group with composite and sectional scores of the American College Test, and the significance of each correlation was tested.

Analysis of variance was used to determine the interaction (relationships) between initial ability and the method used in teaching harmonic dictation.

The correlation technique was used to determine the predictive ability of the composite and sectional scores of the North Texas State University Freshman Placement Theory Examination.

Organization of the Study

The study has five major divisions. Chapter One introduces the problem of the study. Chapter Two deals with the background and significance of the study as well as the related research. Chapter Three explains the methods and
procedures used in collecting the necessary data, and Chapter Four contains an analysis of the data and the results. The final chapter gives a summary of the study, conclusions, and recommendations.
CHAPTER BIBLIOGRAPHY


CHAPTER II

RELATED RESEARCH AND SIGNIFICANCE OF THE STUDY

In 1958, B. F. Skinner (14, p. 969) pointed out that the educational demands of our time can only be met if education becomes more efficient. He said the curriculum must be revised and textbook and classroom techniques improved. Many other educational authorities are in agreement with him, suggesting that teaching machines and programed learning can be a way of making our educational process more efficient.

It has been suggested by Blyth (1) that the teaching machine makes it possible to provide some of the conditions that have long been known to be necessary for efficient learning.

Fry points out that while "teaching machines and programed instruction methods are not panaceas, they are important enough to deserve serious consideration by every educator" (6, p. viii).

Teaching machines are not really new. A sort of teaching machine was used in medieval times to train knights to use a sword, and devices aimed at aiding teaching were
patented as early as 1809 (7, p. 127). However, the first device labeled as such can be traced to Sidney L. Pressey in the 1920's. He devised several machines for the automatic testing of intelligence and information. If the student responded incorrectly on a multiple choice selector he was immediately notified, and he continued to respond until he made the correct choice.

Pressey pointed out that his machine could not only test and score, but because of its emphasis on immediate feedback, could also teach (14, p. 969). In 1934, an associate of Pressey's, James K. Little, concluded that students profited greatly when informed immediately of the accuracy of their response (10, p. 6).

Experimental psychology suggests that the best environment for learning is one in which

(1) the learner is active; (2) the learner gets frequent and immediate feedback on his performance; (3) learning proceeds gradually from the less complex toward the more complex in an orderly sequence; (4) the learner is allowed to develop his own best pace of learning; and (5) the teacher's strategies are constantly reappraised on the basis of an objective analysis of the learner's activity (8, p. 292).

These conditions form the basis for Skinnerian programmed learning through teaching machines. In this type of programmed learning the student must compose his own response. He is made to recall rather than recognize. Also, the machine guides the student through a carefully designed
sequence of steps, each one small enough to be taken without excessive stumbling.

Skinner has stated that a comparison of the teaching machine and a private tutor shows similarities in several respects:

(1) There is a constant interchange between program and student. Unlike lectures, textbooks, and the usual audio-visual aids, the machine induces sustained activity. The student is always alert and busy.

(2) Like a good tutor the machine insists that a point be thoroughly understood . . . before the student moves on. Lectures, textbooks, and their mechanized equivalents, on the other hand, proceed without making sure that the student understands and easily leave him behind.

(3) Like a good tutor the machine presents just that material for which the student is ready. It asks him to take only that step which he is at the moment best equipped and most likely to take.

(4) Like a skillful tutor the machine helps the student to come up with the right answer. It does this in part with techniques of hinting, prompting suggesting, and so on, derived from an analysis of verbal behavior.

(5) Lastly, of course, the machine, like the private tutor, reinforces the student for every correct response, using this immediate feedback not only to shape his behavior most efficiently but to maintain it in strength in a manner which the layman would describe as "holding the student's interest" (15, p. 143).

In explaining the assets of programed learning, Markle (11, p. 12) remarks that while in the classroom the student may not listen, the program waits until he does. These things have prompted one educator to say, "The teaching machine is not simply another audio-visual aid. It represents
the first practical application of laboratory techniques to education" (7, p. 122).

A considerable amount of the investigation in the field of programing techniques has centered around either the linear approach advocated by Skinner (15, p. 140 ff.) or the branching (intrinsic) approach proposed by Crowder (4, pp. 266-298). An exploration designed to discover the more adequate of these techniques was carried out by Coulson and Silberman (3, pp. 452-468). The results of their experiment indicated that there was no significant difference in scores as a function of programing technique.

While the Coulson and Silberman instructional material employed both verbal stimuli and verbal responses, a study by Carlson (see page 18) which dealt with aural stimuli also found no significant difference in scores between branching and linear subjects. It was thus concluded that either one of the techniques of programing investigated is as effective as the other.

In the field of music only a few attempts have been made to teach the fundamentals of music through programed texts, and even fewer attempts have been made to teach the various aural aspects of music theory. Sherburn (13) has noted that in the midst of technological advances in other fields, we are trying to teach the basic skills of musicianship as if electricity had never been discovered.
One of the first attempts to help music theory students with their aural problems through the use of recorded materials was that made by Kenneth L. Dustman in 1951 at Columbia University (5). He realized that the practice given students in harmonic dictation was insufficient for their needs. Students were forced to practice their listening outside of class by teaming with other students and playing musical excerpts for each other on the piano. Dustman produced recordings (in wax) of actual music performed in the medium for which it was composed. They were suitable for outside practice drill in aural techniques, and, as he said, were "primarily organized to facilitate work in harmonic ear-training" (5, p. 25). Although no programmed instruction was involved, the recordings were limited to the harmonic vocabulary usually found taught in the first year of music theory, and were indexed in such a way that listening practice would proceed from the less complex to the more complex.

About seven years after the recordings produced by Dustman, Music Minus One (12) produced a set of ten long playing recordings designed to help the music student in his elementary ear-training problems. These ear-training records were originated by A. Kunrad Kvam of Rutgers University, and were designed to be used by the teacher in the classroom as well as the students working alone. Many
schools are still using these recordings to help in their ear-training programs (9).

There are brief descriptions and explanations on the Kvam recordings, whose sounds are produced not only by piano, but by organ, clarinet, and violoncello as well. While Dustman's recordings dealt with only harmonic dictation, the Kvam recordings encompass such aural problems as melodic dictation, intervals, triads, rhythmic patterns, and two-part dictation.

While there has evidently been no investigation carried out to ascertain the effectiveness of those recordings, Kvam states that "the records save us a great deal of classroom time, do not hold up the bright student, and afford the slower student a greater opportunity for drill" (9).

In a study which he completed in 1959, Spohn (16) used an experimental and control group to explore the use of recorded melodic and rhythmic exercises to develop aural comprehension. The experimental group made use of specially prepared tape recordings for aural practice outside of class. Although it was not labeled as programmed learning, many of the features of programing were present. His conclusions were that the experimental group showed a significantly greater decrease in the number of errors than did the control group (16, p. 185).
In 1960, programed materials and self-presentation methods were used at The Ohio State University School of Music to teach students to identify melodic intervals. All the training was done outside of class, and each tape was to be repeated until the student mastered it at the specified level. Although some of the students did not complete the series, a comparison of pre-test and post-test scores "revealed in each case an improvement in the ability to identify intervals" (17, p. 28).

In 1962, James Carlsen of Northwestern University completed a study in which he investigated the effects of programed learning in melodic dictation using a branching technique. The student made his response in a programed text which Carlsen had prepared. The stimulus was received from tape recordings of melodies and melodic fragments which were also prepared by Carlsen.

The experimental section was divided into three groups. The linear programing group used every frame in Carlsen's text while the branching groups used only selected frames within each concept unless an error was made. In this event, they branched to a frame for additional practice. A third group was not taught with programed materials.

Analysis of the data indicated a significant difference in scores between the programed learning group and the
conventional teacher-classroom group. It was concluded that teaching melodic dictation is more effectively done by programed learning than by the traditional teacher-classroom method (2, p. 4).

An analysis of the data concerning programing technique indicated no significant difference in scores between branching and linear subjects. It was concluded that if achievement is to be the criterion, either one of the techniques of programing investigated is as effective as the other. The decision to use a linear programing technique in the present study was based primarily upon this finding by Carlsen.

Michigan State University is now teaching ear-training to all its freshman and sophomore music students in a language laboratory, using three or four hundred tapes. Each tape consists of either instruction or practice, and the students move through the courses automatically at their own rate of speed.

Some of the tape reels are designated as preparatory and some as practice. The preparatory reels are designed along the principles of immediate reinforcement with the correct answer being given as soon as the student responds. After the student has mastered the preparatory reels to his satisfaction, he proceeds to the progressively graded practice reels. Each practice reel begins with a test exercise
representative of the most difficult material on that reel. If the student answers this test 100 per cent correctly, he omits that reel and proceeds to the next one in the series. When a student encounters a test exercise he fails to pass, he then practices the remedial material on the rest of the reel (13, pp. 7, 8).

The recorded practice material falls into two large classifications:

I. Melodic and Rhythmic
   A. Isorhythmic tone drills
   B. Pulse and meter
   C. Rhythmic dictation
   D. Melodic dictation
   E. Error detection

II. Harmonic
   A. Intervals
   B. Isolated chords
   C. Harmonic dictation
   D. Contrapuntal dictation
   E. Error detection
   F. Cadences and form

Since this type program is only in the experimental stage, no definitive results are available.

While there has been some opposition to programed learning, a field so new is certainly in need of further investigation.
If it is possible for the music theory teacher to be freed from a certain amount of the routine drill he now encounters, he will be able to devote more time to matters of more importance.

The investigations in music involving tape recorded materials in conjunction with teaching machines thus far have been primarily the work of our nation's universities in the North and Midwest; it seemed that the time was ripe for investigations of this nature in our southern geographical area.
CHAPTER BIBLIOGRAPHY


CHAPTER III

METHODS AND PROCEDURES FOR COLLECTING THE DATA

Planning the Programed Text

The objectives of instruction in harmonic dictation during the beginning semester at North Texas State University are twofold:

1. To help the student to recognize chord progressions involving tonic, subdominant, and dominant harmonies in both major and minor keys. The course involves the use of all three chords in first inversion, and the tonic chord in second inversion when used as the cadential $I_4^5$.

2. To help the student to recognize the soprano and bass parts which are involved in these progressions, with melodic skips limited to those found in the tonic, subdominant, and dominant triads.

Because no commercial harmonic dictation programed text was available for the study, it was necessary to write one (see Volume II). The programed text was so constructed as to coincide with the Ottman text, Elementary Harmony (1), which is the basic text used during the first semester of ear-training (Music 138) at North Texas State University.

In the programed text the rhythms used were kept quite simple so that they would not distract from the study of
the harmonies involved. The time signatures used were simple rather than compound, and in almost all cases each exercise began on the first beat of the measure. When the exercise began on some other beat, the student was so informed; and because the tempos for the exercises did not vary, there was no need to indicate pulsations on the recordings which accompanied the text. Because it is customary at North Texas State University for students taking both melodic and harmonic dictation to be "given" only the key signature (in melodic dictation the beginning pitch is sometimes "given," and it becomes necessary for the student to determine the key signature to be used) a wide variety of both major and minor keys was used in the programmed material.

The first lesson in the programmed text deals with cadence recognition. The first fifty-three frames of Lesson I deal with authentic (V-I) and authentic half (I-V) cadences only, and coincide with Chapter Seven of Ottman's text. Frames 54 through 123 deal with plagal (IV-I) and plagal half (I-IV) cadences, and coincide with Chapter Nine of the Ottman text. These latter frames also include "practice frames" which involve both authentic and plagal cadences. These practice frames are designed to take the place of the outside practice which the traditional student finds necessary to do.
Lesson II also deals with I, IV, and V chords in root position, but is designed to teach the student to take harmonic dictation which involves extended progressions, and not just cadences.

The first section of Lesson II deals with the progressions I-V, V-I, I-IV, and IV-I in both major and minor keys. There are (in the first section) instructional frames followed by practice frames involving these limited progressions. The second section of Lesson II adds the progression IV-V in both major and minor keys. After appropriate instructional frames involving this progression, a final series of practice frames makes use of all the usual chord progressions involving I, IV, and V chords in both major and minor keys. This lesson coincides with Chapter Ten in the Ottman text.

Lesson III introduces first inversions of the three principal triads and the cadential $I_4^6$ as well. This lesson is to be used in conjunction with Chapter Eleven of the basic text.

There are three sections in Lesson III. The first section involves the playing of major and minor chords in root position, first inversion, and second inversion. This short section does not involve written responses from the student, but rather asks the student to listen, and then to sing the chords involved.
The second section deals with the cadential $I_4^6$ (the only second inversion taught during the semester's work), and the third section with first inversions of all the principal triads. As usual, the lesson ends with practice frames which involve all the data covered in the lesson.

The T-1616 Electronic Control Wollensak tape recorder was chosen for use in the study because it was capable of rewinding and replaying each recorded frame of a properly prepared tape. However, preliminary investigation indicated that the automatic rewind and replay mechanism of the recorder did not operate successfully when a tape was traveling at the usual 7.5 inches per second. At this rate of speed the tape would rewind so fast that it usually bypassed the metallic tabs which cause the frame to replay. Therefore it was necessary to record the tapes at 3.75 inches per second. Recording at this slow speed caused a slight distortion in the sound, but was certainly not serious enough to be detrimental.

The T-1616 Wollensak tape recorder was also used to make the recordings for the study, and except for a slight hum which it constantly emitted, served the purpose quite well. Metallic contact tabs (manufactured by the Wollensak company) were stuck to the prepared tape at the beginning and end of each frame. A contact tab placed on the top half
of the tape caused the frame to rewind when it came in contact with an electronic post on the recorder. A tab placed on the bottom half of the tape caused the recorder to automatically stop rewinding and to begin replaying the frame. The placing of the tabs on the tape proved to be a very tedious task, because it was imperative that they be placed exactly on either the upper half or lower half of the tape.

The Pilot Study

During the fall semester of 1963, eighteen students who were registered for ear-training (Music 138) volunteered to be in the pilot study. Two of the students never began the study, and only nine students completed it.

For use in the pilot study, the programmed book was written on ditto masters, and about twenty copies were made. Since more than 4000 lines had to be drawn, a stencil was constructed from wood and heavy wire, and all the musical staves were drawn onto the ditto masters with the aid of the stencil. There were three frames to a page, with the first page containing frames one, two, and three. A half page between each full page carried the necessary instructions, and each half page was cut horizontally into three equal parts. This enabled the student to view the correct answer for a particular frame without seeing the answer to the preceding or following frame. Two holes were punched
in the left margin of each sheet, and large paper fasteners were used in binding each book.

The tapes and recorder were placed in the listening room of the music building, and students desiring to use the materials signed for a time on a chart placed on the wall above the recorder. Each student was told how to use the recorder, and was required to demonstrate his ability before he was allowed to begin. The students using the recorder were checked at regular intervals so that any arising difficulty might be overcome.

The tapes broke approximately fifteen times during the pilot study, and while it was not always possible to determine the cause, the student's action was usually responsible. The recorder malfunctioned on a few occasions, causing the student to panic to the extent that he pressed every button and lever available, and this action seemed to cause some of the tape breakage.

All the books were collected at the end of the pilot study, and an evaluation of the responses was made. The students had been asked to circle any incorrect responses made, and to listen again to the frame involved in order to determine why the mistake was made. They were assured that no grade would be involved, and were thus expected to be frank in admitting their mistakes.
Evaluation and Revision of the Programed Text

Many of the better students made almost no mistakes, while some of the slower students made numerous errors. The vast majority of mistakes followed no pattern whatsoever, and it was decided that no major changes in the text were necessary. The mistakes that did follow a pattern were rather insignificant, such as a student's placing a bass note in the wrong octave. In these cases a written suggestion (prompt) was added to the instructions to help the student overcome the mistake.

The programed instruction used in the pilot study suggested that the student might fill in the "inner voices" (following part-writing rules) after he had written the more important bass line, soprano line, and chord numbers. Observations during the study showed that the majority of the students attempted to do this task, and that they were slowed down a great deal because they were not very accomplished at it. Since this was primarily a part-writing problem, and not one of aural perception, the suggestion was eliminated from the revised programed text.

A printer and binder were asked to evaluate certain aspects of the book. Their criticisms were the same: the three-sectioned half sheet would be very difficult to cut and to bind. Also, it was pointed out that even if bound
successfully, the small sections would be exceptionally easy to tear. For these reasons it was decided that the format of the programmed text would be changed; the revised text would have the first frame on the first page, the second frame on the second page, etc. These revisions would eliminate the need to have the instructional half page cut into sections.

The tapes used in the pilot study were found to be faulty in one respect. Early experimentation had shown that one foot of tape between frames was adequate distance to facilitate the automatic rewinding and replaying of each frame. When the recordings were made, however, it was not always possible to get an exact measure between the frames on the tape. While a footage counter was available on the recorder, it varied a small amount in accuracy. As a result, a great many of the frames were too close together, and when the tape rewound, a contact tab from the previous frame would interfere. In these cases, the tape would continue to rewind rather than replay. This problem was overcome by splicing in extra footage between the recorded frames. It was believed that some of these splices were responsible for the numerous tape breakings during the pilot study. In order to avoid this difficulty when revised tapes were made, the recorded frames were separated by two feet of tape rather than one.
Observations made during the pilot study indicated that the adhesive used to hold the contact tabs to the tape had a tendency to "bleed" onto the tape recorder head and contact posts. This adhesive substance would interfere with the operation of the recorder if allowed to accumulate for more than two days. It was decided, then, that the tape recorders used in the main study would receive a thorough cleaning after each day's use.

The programed book used in the pilot study was difficult to handle because of the way it was bound. The paper fasteners did not allow the book to lie flat when opened, and the students using the book found that when they released their grip on the book it would close. Also, the half pages had a tendency to stand up rather than lie flat over the given answers. Thus it was decided to have books printed for the main study. The revised book was bound with a plastic comb binding which allowed it to lie flat when in use. It was entitled Harmonic Dictation, A Programed Text (see Volume II).

The Development and Administration of the Criterion Test

In order to match the students of the control group as equally as possible with those of the experimental group, a departmental test in harmonic dictation was constructed.
(see Appendix A). Because the students who were to take the pre-test had little or no experience in harmonic dictation, the first items on the test were designed in such a way as to be answerable with a very limited knowledge of harmonic nomenclature. Later items gave both aural and written examples, and it was not until the end of the test that the items were of the level of difficulty expected of students who had finished an elementary course in ear-training (see Appendix B).

The instructions for each test section were not only written on the test but also were recorded on the accompanying tape. A time lapse of three seconds occurred between items within a section and a lapse of five seconds between sections. The exercises were played at a speed of forty-eight beats per minute, and the time required to take the test was thirty minutes.

The validity of the test lies in the fact that no musical concepts were contained in it except those upon which the course was predicated.

In order to determine the reliability of the test it was given to sixty-two students enrolled in a high, medium, and low ability section of elementary ear-training (Music 138) near the end of the 1963 Fall Semester. When it was given again a month later, many of the students were
absent, and only forty-nine pairs of scores were obtained. A list of the absentees was placed on the bulletin board along with a note to encourage participation at a rescheduled session. When this endeavor proved to be fruitless no other attempt was made to retest.

Reliability was determined by the product-moment method of correlation (2, p. 95) and found to be quite high \( r = .95 \).

\[
    r = \frac{xy}{\sqrt{x^2 \cdot y^2}} = \frac{28767}{\sqrt{28817 \cdot 31199}} = .95
\]

In this case \( r \) was significant at better than the one per cent level of confidence. Therefore, the test was thought to possess the necessary validity and reliability to begin the main portion of the study.

The method of measurement used for the test was to assign a score of .43 for each of the 232 possible correct responses so that the score for a totally correct test would be 100. The mean score of the first test was 49.10 and the mean score of the retest was 50.08 with a range from 16 to 98.

Near the beginning of the 1964 Spring Semester the pre-test was given to the four sections of beginning ear-training (Music 138). In each section the two students who scored
highest were paired, and a chance drawing determined which student was placed in the experimental group. This procedure was followed until all the students in each section were assigned to either the control or experimental group. A pre-test score of each student and his group assignment are shown in Table I.

The null hypothesis was tested to determine if there was any significant difference between the experimental and control groups. The computation was done by data processing machine, and indicated a t value of .0110. The null hypothesis was thus accepted.

**TABLE I**

**THE ASSIGNMENT OF STUDENTS TO THE CONTROL AND EXPERIMENTAL GROUP**

<table>
<thead>
<tr>
<th>Ability Level</th>
<th>Paired Students</th>
<th>Pre-test Scores for Students Assigned to Experimental Group</th>
<th>Pre-test Scores for Students Assigned to Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Ability</td>
<td>1</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>13</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>16</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>17</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>18</td>
<td>17</td>
</tr>
</tbody>
</table>
TABLE I--Continued

<table>
<thead>
<tr>
<th>Ability Level</th>
<th>Paired Students</th>
<th>Pre-test Scores for Students Assigned to Experimental Group</th>
<th>Pre-test Scores for Students Assigned to Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium Ability</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>18</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>19</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>20</td>
<td>20</td>
<td></td>
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<tr>
<td>5</td>
<td>18</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>19</td>
<td>19</td>
<td></td>
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<tr>
<td>7</td>
<td>20</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>20</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>21</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>21</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>. .</td>
<td>24.1153</td>
<td>24.0769</td>
</tr>
</tbody>
</table>

Even numbers of students were available in all but one section of Music 138, and fifty-six students (twenty-eight pairs) were made available for the study. However, dropouts during the semester reduced the number of paired students to twenty-six.

Control Group Procedures

With the exception of harmonic dictation, both the experimental and control groups received the same instruction
in all aspects of music theory. When the specific study and practice of harmonic dictation was to be done in the classroom, the experimental group was dismissed. The control group was thus involved in the usual teacher-classroom situation, and the time spent in this specific area was recorded by each classroom teacher involved.

The regular text book used in Music 138 suggests that two students rotating in the role of instructor might practice harmonic dictation outside of class (1, p. 119). However, candid replies from students enrolled in ear-training courses in the past indicate that this suggestion is seldom heeded, and that when it is attempted, there is usually an inadequate pianist involved. For these reasons, plus the fact that it was desirable to keep a log of the time spent in outside practice, the experimenter scheduled both morning and evening practice sessions which were attended by those in the control group who were interested in extra practice. The exercises played by the experimenter for the control group in these practice sessions were the same as those entitled "practice frames" in the programmed book (see Volume II). At the close of each practice session the number of students attending and the amount of time spent was recorded on a special log sheet (see Appendix C). Periodic checks of the tape "sign out sheets" of the experimental
group (see Appendix E) indicated the amount of time being used by that group, and in order to equate the times of the two groups, the length and frequency of the control group practice sessions were varied accordingly.

Experimental Group Procedures

Certain facilities and equipment were necessary for use with the experimental group. For the purpose of this study, two booths were made available in the regular record listening room in the music building at North Texas State University. A Wollensak T-1616 Electronic Control Stereo-Tape Magnetic recorder was placed in each booth, and a set of Koss Stereophonic earphones was plugged into each tape recorder. Each week a new schedule card (see Appendix D) was taped to the wall behind each recorder, and students in the experimental group signed their names on the schedule card for a time which was convenient for them to use the recorder.

Four Ampex 1.5 mil acetate tapes contained the recorded material. Each tape was wound on a five inch tape reel, and a duplicate set was made so that two students might listen at the same time. When a student arrived for a listening session, he checked out the desired tape by signing his name and tape number on a sign out sheet (see Appendix E) provided at the check out desk. These sign out sheets also
contained columns for listing the time that each tape was checked out and checked in. A large wall clock in the room near the check-out desk was convenient for this purpose.

The experimental group was dismissed from each class when the teacher began the specific study and practice of harmonic dictation. Because there were only two tape recorders available for their use, it was not possible for all the students in the experimental group to use the recorders at the specific time that they were dismissed from class. Analysis of the schedule cards revealed that the times for using the recorded materials were quite scattered, thus indicating that there was apparently no particular preference for a time of day among those in the experimental group.

When the programed texts were issued to those in the experimental group, a series of practice sessions were scheduled for the purpose of teaching the students how to use the programed text and tape recorder. While there seemed to be no real difficulty in the students' mastering of these techniques, the experimenter remained in the listening room the majority of the time during the first week of the experiment. When it appeared that the students had gained confidence in the operational proceedings, the experimenter made only periodic visits to the listening room for the remainder of the semester.
During the semester, the older of the two tape recorders malfunctioned on three occasions, but a local repairman was able to overcome the difficulty quickly in each case. Because a daily cleaning of the electronic posts on the tape recorders helped the machines to function more efficiently, tape breakage was a lesser problem during the semester than it had been during the pilot study.

In order to encourage the experimental group to use the programmed materials regularly, the teachers occasionally scheduled harmonic dictation tests to be taken by students in both the control and experimental groups. On such occasions there was a noticeable increase in the number of students scheduled to use the recorded material. Near the close of the semester a marked increase in the use of the recorded materials necessitated a scheduling of two extra practice sessions for the control group in order to keep the time of the groups equated.

TABLE II

AMOUNT OF TIME SPENT BY CONTROL AND EXPERIMENTAL GROUPS DURING THE SEMESTER

<table>
<thead>
<tr>
<th>Groups Involved</th>
<th>Time Spent on Programed Material</th>
<th>Time Spent in Class</th>
<th>Time Spent in Special Practice Sessions</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>. .</td>
<td>62 hrs. 40 min.</td>
<td>38 hrs.</td>
<td>100 hrs. 40 min.</td>
</tr>
<tr>
<td>Experimental</td>
<td>102 hrs.</td>
<td>. .</td>
<td>. .</td>
<td>102 hrs.</td>
</tr>
</tbody>
</table>
As shown in Table II, the total amount of time spent in studying and practicing harmonic dictation by all the students in the experimental group was 102 hours, while the time spent by all the students in the control group was 100 hours and 40 minutes.

At the close of the semester the recorded pre-test was given as the post-test, and each student's grade was placed on his master card along with other pertinent information. Data processing cards were punched for each student, and the necessary statistics were computed by the data processing machine at North Texas State University.
CHAPTER BIBLIOGRAPHY


CHAPTER IV

ANALYSIS OF THE DATA AND RESULTS

An analysis of the data obtained by the procedures outlined in the previous chapter provided the results reported in this chapter.

The first hypothesis of the study states that there was no difference in the effectiveness of the conventional teacher-classroom approach and that which utilized altogether the programmed text and tape recordings. In order to test this null hypothesis, the small sample or t technique was used to determine the significance of the mean differences between the control group and experimental group. Data for this analysis were obtained from all the students in the control and experimental groups.

The pre-test, post-test, and difference scores for each student in the control group are presented in Table III. Each pre-test and post-test score represents the percentage of correct responses made on the test. As indicated in Table III, the mean score of the control group pre-test was 24.08 and the mean post-test score was 44.58. The mean difference (increase during the semester) for the control group, therefore, was 20.50.
TABLE III
PRE-TEST, POST-TEST, AND DIFFERENCE
SCORES OF CONTROL GROUP

<table>
<thead>
<tr>
<th>Student</th>
<th>Pre-test Score</th>
<th>Post-test Score</th>
<th>Difference (Post-test Less Pre-test)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>25</td>
<td>56</td>
<td>31</td>
</tr>
<tr>
<td>2</td>
<td>25</td>
<td>59</td>
<td>34</td>
</tr>
<tr>
<td>3</td>
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<td>33</td>
<td>21</td>
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<tr>
<td>4</td>
<td>11</td>
<td>28</td>
<td>17</td>
</tr>
<tr>
<td>5</td>
<td>20</td>
<td>56</td>
<td>36</td>
</tr>
<tr>
<td>6</td>
<td>41</td>
<td>71</td>
<td>30</td>
</tr>
<tr>
<td>7</td>
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<td>39</td>
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<td>17</td>
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<td>16</td>
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<td>9</td>
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<tr>
<td>10</td>
<td>15</td>
<td>30</td>
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<tr>
<td>11</td>
<td>31</td>
<td>55</td>
<td>24</td>
</tr>
<tr>
<td>12</td>
<td>12</td>
<td>43</td>
<td>31</td>
</tr>
<tr>
<td>13</td>
<td>22</td>
<td>23</td>
<td>1</td>
</tr>
<tr>
<td>14</td>
<td>28</td>
<td>49</td>
<td>21</td>
</tr>
<tr>
<td>15</td>
<td>16</td>
<td>57</td>
<td>41</td>
</tr>
<tr>
<td>16</td>
<td>19</td>
<td>36</td>
<td>17</td>
</tr>
<tr>
<td>17</td>
<td>34</td>
<td>52</td>
<td>18</td>
</tr>
<tr>
<td>18</td>
<td>61</td>
<td>83</td>
<td>22</td>
</tr>
<tr>
<td>19</td>
<td>18</td>
<td>37</td>
<td>19</td>
</tr>
<tr>
<td>20</td>
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<td>32</td>
<td>16</td>
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<tr>
<td>23</td>
<td>51</td>
<td>77</td>
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</tr>
<tr>
<td>24</td>
<td>30</td>
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<td>0</td>
</tr>
<tr>
<td>25</td>
<td>21</td>
<td>36</td>
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</tr>
<tr>
<td>26</td>
<td>23</td>
<td>35</td>
<td>12</td>
</tr>
</tbody>
</table>

Mean  24.08  44.58  20.50

Table IV indicates these same criterion scores for the experimental group. The mean post-test score of 46.12 less
the mean pre-test score of 24.12 produced the mean difference score of 22.00 for the experimental group.

**TABLE IV**

**PRE-TEST, POST-TEST, AND DIFFERENCE SCORES OF EXPERIMENTAL GROUP**

<table>
<thead>
<tr>
<th>Student</th>
<th>Pre-test Score</th>
<th>Post-test Score</th>
<th>Difference (Post-test Less Pre-test)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>11</td>
<td>15</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>20</td>
<td>41</td>
<td>21</td>
</tr>
<tr>
<td>3</td>
<td>17</td>
<td>31</td>
<td>14</td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td>31</td>
<td>21</td>
</tr>
<tr>
<td>5</td>
<td>29</td>
<td>30</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>43</td>
<td>80</td>
<td>37</td>
</tr>
<tr>
<td>7</td>
<td>24</td>
<td>55</td>
<td>31</td>
</tr>
<tr>
<td>8</td>
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<td>40</td>
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</tr>
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<td>9</td>
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<td>18</td>
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<td>20</td>
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<td>21</td>
<td>18</td>
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<td>61</td>
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<td>22</td>
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<td>70</td>
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<td>23</td>
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</tr>
<tr>
<td>26</td>
<td>24</td>
<td>43</td>
<td>19</td>
</tr>
<tr>
<td>Mean</td>
<td>24.12</td>
<td>46.12</td>
<td>22.00</td>
</tr>
</tbody>
</table>
For easier comparison, Table V presents the mean scores for both groups as well as the mean difference between the groups.

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean Pre-test Score</th>
<th>Mean Post-test Score</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>24.12</td>
<td>46.12</td>
<td>22.00</td>
</tr>
<tr>
<td>Control</td>
<td>24.08</td>
<td>44.58</td>
<td>20.50</td>
</tr>
<tr>
<td>Mean Difference</td>
<td>. .</td>
<td>. .</td>
<td>1.50</td>
</tr>
</tbody>
</table>

As shown in Table V, the mean difference between the groups was 1.50 in favor of the experimental group. However, the t test indicated a t value of .4365 which was not significant at the 5 per cent level of confidence, and the null hypothesis was accepted.

While the groups were matched as closely as possible as a result of their scores on the pre-test, a later comparison of the experimental and control groups based on mean scores of the American College Test and North Texas State University Freshman Placement Theory Examination showed that the control group scored considerably higher in seven out of nine sections in these areas, thus indicating that the
acceptance of the null hypothesis constituted a danger of making a Type II error* (accepting a null hypothesis that was false). These further comparisons are shown in Table VI. The differences in favor of the experimental group totaled .72 while the differences in favor of the control group totaled 23.03. While a Type II error may not have been made, the mean difference score of 1.50 in favor of the experimental group (see Table V) must be considered a conservative one.

A second hypothesis was that an analysis of the differences of achievement of the students taught by the two methods would reveal no significant relationship to scholastic aptitude as measured by the American College Test.

The data needed for this analysis were not complete because American College Test scores were not available for three students in the experimental group and five students in the control group. However, this hypothesis was tested by correlating the mean changes of each group with the composite and sectional scores of the American College Test which were available. Table VII lists the correlation coefficient obtained for each group in the areas specified.

### TABLE VI

**COMPARISONS OF CONTROL AND EXPERIMENTAL GROUPS BASED ON MEAN SCORES OF THE AMERICAN COLLEGE TEST AND THEORY PLACEMENT EXAM**

<table>
<thead>
<tr>
<th></th>
<th>American College Test</th>
<th>Theory Placement Examination*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>English</td>
<td>Math</td>
</tr>
<tr>
<td><strong>Experimental Group</strong></td>
<td>21.00</td>
<td>15.62</td>
</tr>
<tr>
<td><strong>Control Group</strong></td>
<td>20.87</td>
<td>18.91</td>
</tr>
<tr>
<td><strong>Difference</strong></td>
<td>.13</td>
<td>.29</td>
</tr>
<tr>
<td><strong>in Favor of</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Experimental</strong></td>
<td>.13</td>
<td>.29</td>
</tr>
</tbody>
</table>

*North Texas State University Freshman Placement Theory Examination*
TABLE VII
CORRELATION COEFFICIENTS FOR MEAN CHANGES OF EXPERIMENTAL AND CONTROL GROUPS WITH COMPOSITE AND SECTIONAL SCORES OF THE AMERICAN COLLEGE TEST

<table>
<thead>
<tr>
<th>Test Section</th>
<th>Control Group</th>
<th>Experimental Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>.06</td>
<td>.13</td>
</tr>
<tr>
<td>Mathematics</td>
<td>.13</td>
<td>.45*</td>
</tr>
<tr>
<td>Social Science</td>
<td>.16</td>
<td>.24</td>
</tr>
<tr>
<td>Natural Science</td>
<td>.10</td>
<td>.06</td>
</tr>
<tr>
<td>Composite</td>
<td>.10</td>
<td>.32</td>
</tr>
</tbody>
</table>

*Significant at the 5 per cent level of confidence.

With the exception of a significant correlation (.45) in the experimental group between achievement in harmonic dictation and mathematical aptitude as measured by the American College Test, the null hypothesis was accepted. While the interpretation of this significant correlation may be uncertain, it appears to indicate that the programmed method of teaching used by the experimental group (as opposed to the traditional teacher-classroom method) helped the student to better utilize his ability in mathematics. Or, in other words, it may have indicated that the student who rated high in mathematical aptitude achieved more when using the programmed text. This would parallel the findings of Carlsen.
(1, p. 68) when he discovered that the student with high mathematical aptitude was penalized when taught melodic dictation in a teacher-classroom situation as opposed to his programed text.

Another aspect of the study was to determine the interaction between initial ability and the method used in the teaching of harmonic dictation. Table VIII shows the mean improvement made during the semester by low, medium, and high ability students in both the control and experimental groups.

**TABLE VIII**

<table>
<thead>
<tr>
<th>Ability Level</th>
<th>Control Group</th>
<th>Experimental Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Ability</td>
<td>22.75</td>
<td>22.00</td>
</tr>
<tr>
<td>Medium Ability</td>
<td>26.80</td>
<td>23.87</td>
</tr>
<tr>
<td>Low Ability</td>
<td>15.25</td>
<td>20.33</td>
</tr>
</tbody>
</table>

As shown in Table VIII the most improvement made during the semester was by the medium ability students assigned to the control group. The least improvement was made by the low ability students who were also in the control group. The largest difference demonstrated between the control and
experimental groups was at the low ability level where the mean improvement difference was 5.08 in favor of the experimental group.

Analysis of variance was used to determine the interaction between initial ability and the method used. The data obtained are shown in Table IX.

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Variance Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Columns</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Control and Experimental)</td>
<td>1</td>
<td>3.521</td>
<td>3.521</td>
</tr>
<tr>
<td>Rows (High, Medium and Low Ability)</td>
<td>2</td>
<td>86.542</td>
<td>43.271</td>
</tr>
<tr>
<td>Interaction</td>
<td>2</td>
<td>445.542</td>
<td>222.771</td>
</tr>
<tr>
<td>Within Cells</td>
<td>42</td>
<td>5341.375</td>
<td>127.175</td>
</tr>
<tr>
<td>Totals</td>
<td>47</td>
<td>5876.980</td>
<td></td>
</tr>
</tbody>
</table>

The F ratio for column effects was .03.

\[ F_c = \frac{3.521}{127.175} = .03 \]

The F ratio required for significance with 1 and 42 degrees of freedom associated with the numerator and denominator,
respectively, is 4.07 at the 5 per cent level. Thus the control and experimental differences were not significant at the 5 per cent level.

The F ratio for row effect was 0.34.

\[
F_r = \frac{43.271}{127.175} = 0.34
\]

The F ratio required for significance at the 5 per cent level with 2 and 42 degrees of freedom is 3.22. Thus the differences in improvement made by the low, medium, and high ability groups also were not significant at the 5 per cent level.

The F ratio for interaction was 1.75.

\[
F_i = \frac{222.771}{127.175} = 1.75
\]

The F ratio required for significance at the 5 per cent level with 2 and 42 degrees of freedom is 3.22. It was therefore concluded that there was no significant interaction between the teaching methods used and initial ability as determined by the pre-test scores of the students.

The last aspect of the study was to determine the predictive ability of the composite and sectional scores of the North Texas State University Freshman Placement Theory Examination (see Appendix F). In order to do this, the post-test scores of all the students involved in the study were correlated with the composite and sectional scores of the
The results of the correlations which pertain to the experimental group appear in Table X.

<table>
<thead>
<tr>
<th>Test Section</th>
<th>Correlation Coefficient</th>
<th>t Value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fundamentals</td>
<td>.38</td>
<td>1.72</td>
<td>. . .</td>
</tr>
<tr>
<td>Hearing Test</td>
<td>.56</td>
<td>3.06</td>
<td>1% level</td>
</tr>
<tr>
<td>Dictation</td>
<td>.55</td>
<td>3.05</td>
<td>1% level</td>
</tr>
<tr>
<td>Composite</td>
<td>.69</td>
<td>4.35</td>
<td>1% level</td>
</tr>
</tbody>
</table>

The correlation coefficients of .56 for the hearing test, .55 for dictation, and .69 for composite scores of the placement test were all significant at the 1 per cent level in the experimental group. The correlation coefficients of .38 for the fundamentals section was not significant at the 5 per cent level.

The correlations for these same variables pertaining to those in the control group appear in Table XI.
TABLE XI
VALIDITY COEFFICIENTS FOR POST-TEST SCORES AND THEORY PLACEMENT* SCORING FOR CONTROL GROUP

<table>
<thead>
<tr>
<th>Test Section</th>
<th>Correlation Coefficient</th>
<th>t Value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fundamentals</td>
<td>.48</td>
<td>2.42</td>
<td>5% level</td>
</tr>
<tr>
<td>Hearing Test</td>
<td>.24</td>
<td>1.10</td>
<td>. . .</td>
</tr>
<tr>
<td>Dictation</td>
<td>.60</td>
<td>3.38</td>
<td>1% level</td>
</tr>
<tr>
<td>Composite</td>
<td>.61</td>
<td>3.43</td>
<td>1% level</td>
</tr>
</tbody>
</table>

*North Texas State University Freshman Placement Theory Examination.

In the control group those test sections whose correlations were significant at the 1 per cent level were dictation (.60) and the composite scores (.61). The correlation coefficient for the fundamentals section (.48) was significant at the 5 per cent level, and the hearing test section correlation coefficient of .24 was not significant.

While the validity coefficients for the dictation and composite scores of both the control and experimental groups were significant at beyond the 1 per cent level of confidence, the significance of the correlations for the other test sections appeared less valid. While the correlation coefficient for the hearing test of the experimental group was significant
at the 1 per cent level of confidence, the correlation coefficient for the same section in the control group was not significant at the 5 per cent level. On the other hand, the correlation for the control group's fundamentals section was significant at the 5 per cent level while the same section in the experimental group was not significant at this level.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

During the 1964 spring semester a programmed learning experiment was conducted with beginning ear-training classes in the School of Music at North Texas State University. The purpose of the experiment was to compare the achievements of a programmed learning group and a conventional teacher-classroom group in their ability to take harmonic dictation. Other aspects of the problem were:

1. To determine if any significant relationships existed between each group's achievement in harmonic dictation and scholastic aptitude.

2. To determine the interaction between initial ability and the method of teaching used.

3. To determine the predictive ability of the composite and sectional scores of the North Texas State University Freshman Placement Theory Examination.

A programmed text and accompanying magnetic tape recordings were developed and tested with a pilot study. The programmed text was revised and printed and the revised musical exercises were recorded a second time. Three lessons were
contained in the programed text: (1) cadence recognition, (2) extended exercises using the three principal triads in root position, and (3) extended exercises using first inversions of the principal triads as well as the cadential I\textsuperscript{6}.

A tape-recorded pre-test was constructed and its reliability checked. The students involved in the study were divided into control and experimental groups which were matched as closely as possible on the basis of scores made on the pre-test.

During the semester the experimental group used the programed materials to learn harmonic dictation, and did their practicing by using special "practice frames" which were provided in the programed text. They recorded (on log sheets) the amount of time spent in using the programed materials.

The control group was taught harmonic dictation in the traditional teacher-classroom situation. They were involved in supervised practice outside of class, and the amount of time spent in these proceedings was recorded on log sheets. The time spent by this group was made to approximate that of the experimental group.

At the end of the semester the recorded pre-test was given to both groups as a post-test. The post-test score less the pre-test score determined the achievement (difference) score for each student.
When the data were collected, statistical treatment was applied to the following hypotheses.

1. There is no difference in the effectiveness of the conventional teacher-classroom approach and that which utilizes altogether the programmed text and tape recordings.

2. An analysis of the differences of achievement of the students taught by the two methods would reveal no significant relationship to scholastic aptitude as measured by the American College Test.

Statistical treatment was also applied to determine (1) the interaction between initial ability and the teaching method used, and (2) the predictive ability of the composite and sectional scores of the North Texas State University Freshman Placement Theory Examination.

To test the first hypothesis, the small sample or $t$ technique was used to determine the significance of the mean differences between the control and experimental groups.

The correlation technique was used to determine the correlation of the mean changes of each group with composite and sectional scores of the American College Test.

Analysis of variance was used to determine the interaction between initial ability and the teaching method used.

The correlation technique was also used to determine the predictive ability of the composite and sectional scores
of the North Texas State University Freshman Placement Theory Examination.

Analysis of the data for the first hypothesis indicated that while the experimental group achieved more than the control group during the semester, the achievement was not significant at the 5 per cent level of confidence, and the null hypothesis was accepted. However, a comparison of the control and experimental groups based on scores of the American College Test and North Texas State University Freshman Placement Theory Examination revealed that the control group rated considerably higher in seven out of nine areas, and indicated that the mean difference score in favor of the experimental group was a conservative one.

Analysis of the data for the second hypothesis indicated that with one exception there was no significant relationship between achievement in harmonic dictation and scholastic aptitude. In the experimental group a significant relationship existed between achievement in harmonic dictation and mathematical aptitude. With the exception of this one significant relationship the null hypothesis was accepted. Because of the significant relationship (in the experimental group) between achievement in harmonic dictation and mathematical aptitude it was determined that the programed method of teaching (as opposed to the teacher-classroom method) may
have helped the student to better utilize his ability in mathematics.

Two additional aspects of the study received statistical treatment. Analysis of the data for the first of these aspects indicated that there was no interaction between initial ability and the teaching method used.

Analysis of the data for the final aspect of the study indicated that the composite score and dictation section of the North Texas State University Freshman Placement Theory Examination were the most valid predictors of success in first semester harmonic dictation at North Texas State University. Both the fundamentals and hearing test sections of the placement examination revealed significant correlations in either the control or experimental group, but not in both. Therefore, while the fundamentals and hearing test sections showed some ability to predict success in harmonic dictation, their predictive ability was not considered as valid as that of the composite test or the other sections of the test.

Conclusions

From the study it was concluded that harmonic dictation can be effectively taught by programmed materials. While the higher mean difference score made by the experimental group was not statistically significant, it did show that the
learning of this aspect of music theory is not dependent upon teacher-pupil interaction.

The study also indicated that with one exception scholastic aptitude as measured by the American College Test bears little relationship to achievement in this type of aural perception. Because a significant relationship was found to exist between mathematical aptitude and achievement in harmonic dictation by those using the programed materials, it was concluded that the programed method of teaching may have helped the student to utilize his mathematical ability better than did the traditional teacher-classroom method.

There was no interaction indicated between initial ability (as measured by the pre-test) and the type of teaching method used. It was therefore concluded that low, medium and high ability students learn harmonic dictation equally well in either the traditional teacher-classroom situation or by using programed materials.

The data concerning the predictive ability of the North Texas State University Freshman Placement Theory Examination indicated that success in first semester harmonic dictation at North Texas State University can be best predicted by the composite score and dictation section of the placement test. The other test sections also indicated predictive ability, but at a less significant level.
Recommendations

1. The population used in the present study must be recognized as an atypical one, for it consisted of those students who had failed to pass the placement test during the 1963 fall semester. It is therefore recommended that the programmed materials used in this study be tested in a more typical music theory situation. This might be done by employing music theory students who do pass the placement examination, or perhaps by testing the programmed materials in a smaller college or university where theory placement examinations are not used. While there is no statistical inference that the results might be different in the recommended situation, they would certainly apply to the majority of music theory situations better than those of the present study.

2. It is recommended that any further experiments of this nature be made to last more than one semester or quarter, for observations indicated that the students in the experimental group were not really proficient in their use of the recorded materials until the semester was almost over. It is thus hypothesized that a similar experiment lasting for at least a year would cause the students in the experimental group to show significant improvement over those in the control group.
3. Because melodic intervals and melodic dictation have been shown to be more effectively taught by programed materials than by the usual teacher-classroom situation, and because harmonic dictation has been shown to be as effectively taught by programed materials as by the usual teacher-classroom situation, it is recommended that the School of Music at North Texas State University set up a listening laboratory employing programed materials for the teaching of these aspects of music theory as soon as perfected machinery is available. This arrangement would not only give the music theory teacher more time to deal with other aspects of theory which heretofore have been forced into a crowded schedule, but would also give each student a chance to develop aural perception at a pace more suitable to him.

4. Because the majority of music students graduating from North Texas State University begin working with bands, orchestras, and choral groups rather than pianos, it is suggested that recordings involving these three media (as well as individual voices and orchestral instruments) be employed in further investigations involving programed materials. Experimentation to determine the effectiveness of recordings involving these media might prove valuable since the distraction of sympathetic overtones on recorded piano music is a problem.
5. Because the manufacturing of the Wollensak T-1616 Electronic Control model tape recorder has been discontinued, it is recommended that a tape recorder manufacturer be urged to consider designing a machine primarily for the presentation of programmed materials in music theory. It is further recommended that any rewind or replay mechanism on the recorder be activated by painted strips (or a similar device) rather than gummed metallic tabs which have a tendency to "bleed" onto the tape and machine.

6. It is recommended that dictation and composite scores made on the North Texas State University Freshman Placement Theory Examination be used in counseling situations whenever applicable. Also, in order to determine the predictive validity of the placement examination in the more general area of music theory, it is suggested that sight-singing ability, melodic dictation scores, and part-writing scores also be correlated with the composite and sectional scores of the examination.
APPENDIX A

THE CRITERION TEST

Student's Name__________________________

I. Two chords will be played. They may be the same chord played twice (with voices re-arranged) or they may be two different chords. Check whether same or different.

1. same__ different__ 5. same__ different__
2. same__ different__ 6. same__ different__
3. same__ different__ 7. same__ different__
4. same__ different__ 8. same__ different__

II. Check whether each example ends on a tonic (I) chord or some other chord. The first chord in each exercise is a tonic chord.

1. tonic__ other__ 4. tonic__ other__
2. tonic__ other__ 5. tonic__ other__
3. tonic__ other__ 6. tonic__ other__

III. Listen to the following plagal (amen) cadence, noticing that the bass notes in the cadence are 4 to 1, or Fa to Do. (Listen)

Listen to the following authentic cadence, noticing that the bass notes in the cadence are 5 to 1, or Sol to Do. (Listen)

Now check whether the following cadences are authentic or plagal.

1. authentic__ plagal__ 4. authentic__ plagal__
2. authentic__ plagal__ 5. authentic__ plagal__
3. authentic__ plagal__

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IV. Listen to the following authentic half cadence, noticing that the last two bass notes in the cadence are 1 to 5, or Do to Sol. (Listen)

Listen to the following plagal half cadence, noticing that the last two bass notes in the cadence are 1 to 4, or Do to Fa. (Listen)

Now check whether the following cadences are plagal half or authentic half.

1. authentic half__ plagal half__
2. authentic half__ plagal half__
3. authentic half__ plagal half__
4. authentic half__ plagal half__

V. Using half notes, write only the final two soprano and bass notes you hear played. Indicate chord numbers below the bass notes. Each exercise will be played three times.

1. (A minor)

2. (G major)

3. (Eb major)

4. (D minor)

5. (D major)
VI. Using Roman numerals (I, IV, V for major and i, iv for minor), write all the chord numbers for the following exercises. Notice that there is a box for each chord number. Each exercise will be played twice.

1. 

2. 

3. 

4. 

5. 

VII. Write chord numbers, bass and soprano parts for the following exercises. Indicate first inversions with the number "6" to the right of a chord number (I6), and second inversion with a "6" (I6). The rhythms will consist of quarter notes, half notes, and whole notes, and the tempo will be indicated before each playing. Each exercise will be played five times.

1. 

2. 
APPENDIX A—Continued

3.

4.
APPENDIX B

MUSICAL EXAMPLES PLAYED FOR THE CRITERION TEST

II

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APPENDIX B--Continued
## APPENDIX C

**LOG OF STUDENTS IN CONTROL GROUP ATTENDING PRACTICE SESSIONS**

<table>
<thead>
<tr>
<th>Session Number</th>
<th>Number of Students Attending</th>
<th>Amount of Time Spent</th>
<th>Total Student Time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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**Totals**

---

76
<table>
<thead>
<tr>
<th>Music</th>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
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</table>

**APPENDIX D**

---

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APPENDIX E

EXPERIMENTAL GROUP SIGN OUT SHEET

<table>
<thead>
<tr>
<th>Student's Name</th>
<th>Tape Number</th>
<th>Time Checked Out</th>
<th>Time Checked In</th>
</tr>
</thead>
</table>

78
Mm mMr-

1#
W

W FRESHMAN PLACEMENT THEORY EXAMINATION • SOUTH TEXAS STATE COLLEGE

PART A: FUNDAMENTALS

1. Place the treble clef sign on the staff and name the lines and spaces on the staff:

2. Place the bass clef sign on the staff and name the lines and spaces on the staff:

3. Draw each of the following notes and rests:

   - Whole note
   - Half note
   - Quarter note
   - Eighth note
   - Sixteenth note
   - Thirty-second note
   - Whole rest
   - Half rest
   - Quarter rest
   - Eighth rest
   - Sixteenth rest
   - Thirty-second rest

4. Give the number of sharps or flats and name the sharps or flats for each of the following keys (Example: D Major = 2 sharps, F# and C#):
   - C Major
   - D Major
   - E Major
   - F# Major
   - G Major
   - A Major
   - B Major
   - E Harmonic Minor
   - F# Melodic Minor
   - G Major
   - Bb Melodic Minor
   - C# Pure Natural Minor
   - E Harmonic Minor
   - F# Melodic Minor
   - G Major
   - Bb Melodic Minor

5. Spell the following scales with letter (alphabetical) names. Be sure to include whatever sharp, flat, or natural signs that may be necessary:
   - C Major
   - D Minor
   - E Minor
   - F# Minor
   - G Minor
   - A Minor
   - Bb Minor
   - C# Pure Natural Minor
   - E Harmonic Minor
   - F# Melodic Minor
   - G Major
   - Bb Melodic Minor
   - C# Pure Natural Minor
   - E Harmonic Minor
   - F# Melodic Minor
   - G Major
   - Bb Melodic Minor

6. Explain the meaning of these time signatures:
   - 2
   - 4
   - 6
   - 8
   - 12
   - 16

7. Write a I - IV - V - I progression in the key of D Major:
PART B: HEARING TEST

1. Half step or whole step — encircle the correct answer: (Illustrations J 1)
   (1) J 1 (2) J 1 (3) J 1 (4) J 1 (5) J 1
   (6) J 1 (7) J 1 (8) J 1 (9) J 1 (10) J 1

2. SAME rhythm or DIFFERENT rhythm — encircle the correct answer: (Illustrations S D)
   (1) S D (2) S D (3) S D (4) S D (5) S D
   (6) S D (7) S D (8) S D (9) S D (10) S D

3. Ten short melodies will be played. Listen carefully to each melody and concentrate your attention on the pitch of the first note and the pitch of the last note. Notice that the last note may be HIGHER or LOWER or the SAME in pitch as compared to the first note. Encircle the correct answer: (Illustrations H L S)
   (1) H L S (2) H L S (3) H L S (4) H L S (5) H L S
   (6) H L S (7) H L S (8) H L S (9) H L S (10) H L S

4. For each of the following ten problems two melodies will be played which are the same except for one note. Which note is different? Encircle the correct answer: (Illustrations 1 2 3)
   (1) 1 2 3 4 (2) 1 2 3 4
   (3) 1 2 3 4 5 (4) 1 2 3 4 5
   (5) 1 2 3 4 5 (6) 1 2 3 4 5
   (7) 1 2 3 4 5 6 (8) 1 2 3 4 5 6
   (9) 1 2 3 4 5 6 7 (10) 1 2 3 4 5 6 7 8

PART C: DICTATION

1. Listen to the chords played at the piano. Identify each as Major or Minor:
   (Abbreviate: M for Major; m for minor)

2. Listen to the chords played at the piano. Identify each by chord number: (I, IV, V, etc.)

3. Two melodies will be played at the piano. Write each one on the staves below:
   (1) [Stave]
   (2) [Stave]
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