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THE DEVELOPMENT AND TESTING OF A PROGRAM
ON THE FUNDAMENTALS OF VOICE
PRODUCTION IN SINGING

DISSERTATION

Presented in Partial Fulfillment of the Requirements for
the Degree Doctor of Philosophy in the Graduate
School of The Ohio State University

By

Gary Jacob Warmink, A.B., M.A.

* * * * *

The Ohio State University

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CHAPTER I

INTRODUCTION

There is a constant need in the field of education for the development of new instructional materials. This need is prompted not only by the growth of information, but also by changes in curricular structure and teaching methodology. The field of vocal music has gained a large body of information about voice production from recent research and inquiry concerning the physiological and acoustical aspects of singing. While this by itself is a strong motivation for developing new instructional materials, a more urgent need arises due to numerous changes in curricular structure.

In view of growing numbers of students, increasing curricula demands upon the teacher of singing, greater interest in the academic aspects of voice production, and demands for greater educational efficiency, beginning students of singing are often enrolled in voice classes rather than tutored on an individual basis. Lesson times for private students and rehearsal times for choristers have often been shortened while demands for performance have generally been increased. This has made it increasingly more difficult for teachers of singing to deal with vocal and musical problems and also supply academic information about the vocal mechanism.
Other fields of education, faced with similar needs and changes have turned to programmed instruction as a possible solution to problems related to greater student mobility, wider variance of student background, and larger student to teacher ratios. This is because programmed instruction leads students toward uniformly higher levels of performance, reduces instructional time, and guarantees that all students will obtain a pre-determined level of proficiency. ¹

The definitions, developments, and designs of programmed instruction have changed and are changing so rapidly that it is difficult to assess the impact of the last three decades of inquiry, research, and implementation associated with the introduction of programmed instruction upon educational thought and practice. Programed instruction was primarily associated with teaching machines in the 50's and considered simply as "a device to control students behavior and help him learn without the supervision of a teacher".² As self instructional principles and approaches were extended to include the use of tapes, slides, films, programmed textbooks, and computers, more generalized definitions of programmed instruction were stated such as:

A well disciplined and experimental approach to instruction, characterized by explicitness, by sophisticated behavioral analysis, and by careful control of stimuli and student response and organized to elicit behavioral sequences that have been empirically determined.³


³Definition given in the introduction to NSSE Yearbook (University of Chicago Press, 1967) p. 3.
The scope of programmed instruction has expanded so much that many of the elements which were considered essential characteristics in the 60's such as active student response, small steps, few errors, immediate feedback, and self-pacing are no longer deemed necessary. Thus Razik in a recent extensive bibliographic analysis and survey of programmed instruction, stated that "no definition appeared adequate as a basis for organizing present knowledge" related to programmed instruction.

One of the most important developments in programmed instruction has been the discovery that a programmed textbook can be constructed that is just as effective as the highly effective teaching machine. This has prompted a great deal of research as well as the publication of hundreds of programmed textbooks in a wide variety of subject areas. Music educators, searching for more efficient and effective means of teaching in areas such as the fundamentals of music, tonal materials, technical skills for instruments, score reading, aspects of musical form, and music appreciation, have been active in the development of programmed materials.

New designs in programmed instruction have been accepted with varied degrees of enthusiasm. But whether educators are critical or enthusiastic about current trends in programmed instruction, there is considerable research evidence and general agreement among leaders in education that auto-instructional materials, especially

---


the programmed textbook, can be an academically feasible, economically efficient, and educationally effective means to alleviate the expanding curriculum demands of the knowledge explosion, spiralling educational costs, and teacher overload.\(^6\)

Authorities place few limits on what subject matter areas are feasible to program. As early as 1962 Deterline pointed out:

There have been many studies designed to test the feasibility of auto-instruction in various types of courses, and the results tend to be in the same direction, if it can be learned it can be programed, auto-instruction has either time or efficiency advantages or both.\(^7\)

In the early stages of programing, some educators questioned the academic usefulness of programed materials. This was largely because much early programing, especially that associated with research, often resulted in brief segmentary programs on very specific topics. Programers and researchers who responded by developing and testing longer programs have found that students learn well and like to use programed materials even when the programs are of considerable length.\(^8\) The warm response of educators to longer programs, especially those which are designed to complement and supplement existing materials or to provide instructional materials where little is available, demonstrates that there is a need and use for programs


of this type.

Probably the most consistent finding reported regarding programs as opposed to conventional teaching techniques or regular textbooks is that programs are efficient. Reduction in learning time is often more than fifty percent.9

Concerns that programed instruction will replace the teacher and dehumanize education are unfounded.

Programed instruction and automated teaching rather than dehumanizing man will humanize him. It is poor teaching and poor, dull and boring instructors who have hidden behind routine and drill, that have led to much student failure and to the subsequent dehumanization of man.10

Garner points out that:

Properly designed programs may, in fact, be the answer to the creative learner's problems of getting information at his level.11

There is no longer any reason, based on research and hundreds of programs in use, to question the educational effectiveness of programed instruction. Hargiss commenting on the state of the program in music said:

Do students really learn from programed instruction? They do indeed, and from all kinds of programs. Research has left no doubt of this. Do they learn as well as from a teacher? . . . As efficiently . . . However, it is becoming more and more apparent that programed instruction by a teacher is better than either alone.12

---


Educators, noting the effectiveness of programmed instruction, have also observed its effect. Programed instruction has pointed education in the direction of more explicit educational objectives, more concern for individual student differences, greater sensitivity toward achieving greater educational efficiency, more realistic approaches toward evaluation-testing, more consideration of defining the structure and appropriate sequence for subject matter, and increasing interest in providing a measure of control over the educational process.

There can be no question but that programmed instruction has had a greater impact on the field of teaching and learning than has any one innovation in education history.13

Since music educators and researchers were among the first to explore the feasibility, efficiency, and effectiveness of programed instruction, it is not surprising that well over one hundred programs are available in music and over half this number are published and in use.14 Most programs in music, like the over two thousand programs in other areas,15 are directed to the college age student and a great number are in the programed textbook format.16

Considering that programs have been developed in nearly every


16Razik, op. cit.
content area in music and for almost every family of instruments, it was surprising that no programed texts or materials could be found concerning the singing voice.

The beginning student of singing, whether studying privately or in class, must become acquainted with the terminology and physiology associated with his voice. Instrumentalists and future music teachers who may not demonstrate sufficient vocal talent to allow them to qualify for private study are often required to enroll in a voice class in order to become acquainted with the terminology, physiology, and techniques of voice production. And the advanced private student is usually required to enroll in a vocal techniques course or to search out more specific or technical information about his voice.

While there are a considerable number of highly technical books intended for the teacher of singing, there are relatively few books designed for use by the beginning class or private student. No such published auto-instructional books could be found. Teachers of voice have often been unable to present this information as systematically and thoroughly as they would like because they prefer to use as much time as possible to listen to and to guide the student as he sings. Choral directors also find it difficult to meet performance commitments as well as make an orderly presentation of information about the physiology, functions, and principles of voice production. Used as an ancillary adjunct to regular voice class teaching or as a means of presenting background material for the private voice student, a program could release the voice teacher from tedious presentations and repetitions of basic information about the voice and supply a
much needed basic source book for the student.

The individualized nature of instruction for the teaching of singing, the increasing demands upon teachers of singing to instruct larger numbers of private students and voice classes, and the need for student level materials which can provide the voice student with basic terminology and fundamentals of singing without taking excessive time from lessons and rehearsals, are just a few factors which point to the need and feasibility of developing programed materials concerning the fundamentals of voice production for singing.

PROBLEM

This study is concerned with the construction, development, and evaluation of a programed textbook containing information about the voice for use by a variety of students of singing.

Specific problems regarding the preparation and construction of the program are:

1. What will be judged by experts on singing to be the most appropriate objectives for a programed textbook on the fundamentals of voice production?
2. What is the most relevant content to be included in the program?
3. What is the most logical sequence for the program?
4. What is the most effective format for a program intended as an ancillary or adjunctive aid?
5. Which programing techniques are the most appropriate to the subject matter, will be most effective, will aid in transfer of learning
and retention, and will be motivating to the learner?

Problems relative to the development and revision of the program are:

1. Which frame construction techniques are most appropriate and effective?
2. What is the most appropriate length for a program conceived as material for an entire semester course?
3. Which response mode (written or unwritten answers) is the most appropriate?
4. Which are the most effective kinds of feedback, reinforcement, cueing, and review?
5. Which step size is most appropriate for the various types of information that is programed?
6. How much time should the students be allowed in which to complete the program?

Specific problems related to the evaluation and testing of the program include:

1. Can a programed textbook be developed that will be effective enough to approach the 90/90 ideal, where 90% of the students master 90% of the test over the program?
2. Will the percentage of gain between the pre-test and the post-test indicate that a sufficient amount of learning has taken place as a result of the program?
3. What effect will differences in the experience level of the students have upon the effectiveness of the program?
4. What effect will forcing some of the students to complete the
the program in a shorter time (forced-pacing) have upon the effectiveness of the program?

5. What will be the reactions and attitudes of the students to the program?

6. How much time will the students spend on reading the program?

PURPOSES

The major purposes of this study were to construct a programed textbook on the fundamentals of voice production in singing and to test the effectiveness of the program as a learning aid for voice classes and various age private students of singing.

SUB-PURPOSES

Sub-purposes include:

1. The determination of the effectiveness of various programing formats within a multiple technique design.

2. The determination of the effect that differences in the experience level of the subjects have upon the effectiveness of the program.

3. The determination of the effect that pacing mode has upon the effectiveness of the program.

4. The determination of student reactions to the program, the programed textbook design, and the various programing techniques employed in each unit of the program.

5. The determination of the relationship between the amount of time required to complete the program and program effectiveness.
6. The development of a valid criterion test for evaluating the program.

QUESTION AND HYPOTHESES

Since this study uses both normative and experimental designs, it is appropriate to state questions relative to the normative aspects of the study and hypotheses relative to the experimental aspects of the study. The following questions are raised:

1. What is the most appropriate content, sequence, length, program format, and programing technique for a program on the fundamentals of singing?

2. What is the effectiveness of the program and the six units employing different programing techniques when compared with the 90/90 ideal?

3. What does the percentage correct on the post-test and the percentage of gain between the pre-test and the post-test indicate concerning the effectiveness of the program for the four groups: self-paced beginning private, forced-paced intermediate voice class, self-paced intermediate voice class, and self-paced advanced private?

4. What is the student reaction and attitude toward the program and each of the programing techniques (units) as measured by an opinionnaire?

5. What is the relationship between the amount of time required to complete the program and the effectiveness of the program?

The following null hypotheses can be stated relevant to the experimental aspects of the study:

1. There will be no significant difference between the pre-test and post-test scores on Unit I utilizing small step linear technique for the following four groups: the beginning private voice students
(Group A), intermediate level students in voice class I (Group B), intermediate level students in voice class II (Group C), and advanced private voice students (Group D).

2. There will be no significant difference between the pre-test and post-test scores on Unit II utilizing a modified linear technique for the four groups: beginning private, voice class I, voice class II, and advanced private.

3. There will be no significant difference between the pre-test and post-test scores on Unit III utilizing linearized branching techniques for the four groups: beginning private, voice class I, voice class II, and advanced private.

4. There will be no significant difference between the pre-test and post-test scores on Unit IV utilizing a large step linear technique for the four groups: beginning private, voice class I, voice class II, and advanced private.

5. There will be no significant post-test scores on Unit V utilizing an eclectic technique for the four groups: beginning private, voice class I, voice class II, and advanced private.

6. There will be no significant difference between the pre-test and post-test scores on Unit VI utilizing mathetic techniques for the following four groups: beginning private, voice class I, voice class II, and advanced private.

7. There will be no significant difference between the pre-test and post-test scores on the total test for the four groups: beginning
private, voice class I, voice class II, and advanced private.

8. There will be no significant difference between the pre-test scores of the three different experience level groups: beginning private, intermediate voice class, and advanced private.

9. There will be no significant difference between the post-test scores of the three different experience level groups: beginning private, intermediate voice class, and advanced private.

10. There will be no significant difference between the percentage of gain between the pre-test and post-test for the three groups: beginning private, intermediate voice class, and advanced private.

11. Variance between the three different experience level groups will have no significant effect upon the amount learned as measured by pre-test and post-test variance.

12. There will be no significant difference between the pre-test and post-test scores of the forced-paced intermediate voice class and the self-paced intermediate voice class.

13. There will be no significant difference between the amount of gain (mean gain) between the pre-test and post-test for the force-paced intermediate level group and the self-paced intermediate level groups.

**ASSUMPTIONS**

1. It is possible to determine a stable and valid subject content for a program in the fundamentals of voice by means of existing books on voice and judgments of experts in the field.
2. It is possible to obtain an adequate and reliable measure of student learning from a program by means of pre-test to post-test differences.

3. It is possible to gain general information regarding student reactions and attitudes toward a program through the use of an opinionnaire.

LIMITATIONS

1. Only information regarding the basic fundamentals of voice, of a verbal-visual nature, which is intended as general background information for ancillary use will be included in the program.

2. The population will include beginning adult and high school voice students, intermediate voice class students, and advanced college voice students from several midwest colleges and towns.

3. Programed construction techniques employed were learned through readings and limited experience with programing and represent an initial attempt at programing this material.

4. This study will be limited to reporting the procedures and findings of four revisions of the program.

DEFINITIONS

Program: A sequence of carefully constructed items leading the student to mastery of a subject with minimal error. The distinguishing characteristic of programmed materials is the testing procedure to which
they are subjected. Empirical evidence of the effectiveness of each teaching sequence is obtainable from the performance records of students.

**Programing, linear**: A programing technique developed by B. F. Skinner. Set sequences of items present information in small units and require a response from the student at each step. The steps are so designed that errors will be minimal for even the slower students in the target population. Every student does each item in the program, his progress differing only in the rate at which he proceeds through the sequence. Constructed responses are demanded of the student.

**Programing, intrinsic (branching)**: A programing technique developed by Norman Crowder, characterized by relatively lengthy items, multiple-choice responses, and consistent use of branching. If, after reading the information section of each item, the student selects the correct response to the question based on the material, he is sent to an item presenting new information. If he selects an incorrect alternative, he is sent to an item which provides information as to why his choice was incorrect. To the extent that the programer has correctly predicted the possible response that the student population will make, the program taken by each student is under the control of his own responses, and will differ for students of differing abilities.

**Programed Textbook**: A special book in which the subject matter to be learned has been arranged into a series of sequential steps leading from familiar concepts to new materials. When following a linear approach, page one gives the stimulus and requires a constructed response while page two gives the feedback (answer) and presents a
new stimulus requiring another constructed response. The student turns the page after each item, finding the answer and the next item on the following page, so that he progresses through the book doing all the items on one level, then returns to the beginning to repeat the process on another level on each page.

**Branch:** A point of choice at which students are sent to alternative items depending on their responses to the particular item. A common use of branching is in intrinsic programs, where the branch (or loop) consists of a single item explaining why a particular answer is incorrect and returning the student to the original item for another try. A criterion item may be inserted in a linear program. If the student answers it, he is sent ahead several items (forward branching); if he fails the criterion item, he takes an intervening sequence of review or remedial items. A student may, at a criterion item, be sent backward in the program to repeat items he has already seen but has inadequately mastered (backward branching or washback). Students may be branched on the basis of either constructed responses or multiple-choice responses, although the latter predominates.

**Ancillary Program:** Program designed and intended to supplement and compliment rather than replace conventional teaching.

**Fundamentals of Voice Production in Singing:** Basic concepts of voice production of a general, foundational nature including the five basic functions in singing; posture, breathing, phonation, resonance, and diction.
Frame: A segment of material which the student handles at one time. An item may vary in size from a single incomplete sentence, question, or instruction to perform some response, up to a sizable paragraph. In almost all programing methods, it will require at least one response and will provide for knowledge of results before the student proceeds to the next item.

Step: The increment in subject matter level to be learned with each succeeding item or frame in the program.

Step Size: Average amount of difference between successive frames. A function which is inversely proportional to the number of frames in an instructional unit.

Pace: The rate at which the subject is permitted to work through the programed material. The pace may be determined by the learner (self-pacing) or by a pacer (forced pacing).

Prompt: Programing techniques designed to insure the desired response to a frame. Types include emphasis prompts such as underlining and capitalizing key words, formal prompts using first and last letters and dashes for key words, sequence prompts where words from previous frames are key words, and thematic prompts which depend on common association to elicit key words.

Error Rate: Generally, the percentage of incorrect responses on an item, a set of items, or a whole program. A relatively low error rate—though programers do not agree on the range that is low—is a necessary but by no means a sufficient condition for a program to be considered acceptable.
Skip Branching: A programming technique which allows students who know the material or learn quickly to move rapidly through the main sequence frames by skipping items. Persons who err progress step by step.

Linearized Branching: While the basic format follows a step by step path, student response can change the sequence which he follows. Students who err follow one sequence, students who make correct responses follow another, thus combining the characteristics of both linearized and branched programs.

Backward Branching: A student who errs at a criterion test frame is asked to review previous items.

Baboon Frame: An item in which the student must respond to a multiple choice question, in which he chooses between both A and B, A, B, or neither A or B. The underlining shows how the name baboon was applied to this frame type.

Multiple Technique Design: The designation given a program which uses several different programming approaches. In the program developed for this study, this included the use of small step linear, modified linear, linearized branching, large step linear, eclectic, and mathetic approaches.

Programming, Mathetic: A programming technique based on the philosophical approach posited and promoted by Gilbert, Hartley, and others called praxeonomy, which posits that minimum training greatly improves the effectiveness and value of an individual's performance capability. Content outlines, summary presentation pre-testing, interim review tests, algorithms (an exact prescription leading to the achievement of a specific outcome), linked statements, and visual diagrams are some of the devices used in this approach.
Retrogressive Chaining: A mathetic technique where the mastery step or desired learning outcome is identified first, followed by intervening sub-mastery steps in the chain which provide the information necessary to understand the answer or how it was derived.

Praxionomy: A philosophic approach posited by Gilbert which asserts that minimal training will result in doubling or even tripling the effectiveness and value of an individual's performance capability. This approach has had impact upon programming to the extent that more program utilizing mathetic technique have been developed.
CHAPTER II

RELATED LITERATURE

This chapter reviews writing and research concerning program development procedures, research designs and approaches, and specific program and subject variables appropriate for study. Program development procedures reviewed include program definition, stating objectives, choosing program content, selecting a target population, building the criterion test, and choosing appropriate program format.

Program development and research in music and voice is reviewed under the headings program designs, content, and research approaches.

Research on program variables is included in the sections on length, sequence, response mode, feedback and reinforcement, step size and error rate, and pacing. And findings related to evaluating subject variables, such as, age, intelligence, and previous experience are included with information gathered from the literature concerning procedures and results of evaluating program construction and design, program effectiveness, and opinionnaire and attitude surveys.

Program Development

Program Definition

In an effort to identify the basic processes, nature, and scope of programing, nearly all authorities, researchers, and program development experts make program definition the first step in the program
development procedure. The process involved, whenever programed materials are utilized to achieve educational objectives, is called programed instruction. As defined by the AERA-APA-DAVI joint committee on programed instruction and teaching machines, programed instruction has the following characteristics:

The use of materials or procedures which incorporate an "auto-instructional" (self-instructional) program. Such a program commonly attempts to provide conditions under which a student can learn something efficiently with little or no outside help. Current programs typically employ a prearranged sequence of material that is presented to the student one small unit at a time (e.g., a sentence or paragraph). Most programs require the student to respond actively at least once for each unit (or frame) of material—for example, by composing or selecting an answer to a question. Programs also commonly provide prompt confirmation or correction, as the case may be, for each response the student makes. In some cases, the program is presented by a mechanism or device called a "teaching machine"; in other cases it is presented by a specially designed form of book.17

The essential characteristics or essential ingredients of programed instruction have been the subject of research for the past two decades. Authorities in the early sixties maintained that for a program to produce optimal learning it should include (1) logical sequence, (2) active student response, (3) immediate knowledge of results, (4) low error rate, and (5) self-pacing.18 Recent research has shown, 


however, that "many of the 'critical' features of programmed learning
have been modified and with them the techniques and range of applica-
tions." While definitions of the nature and scope of programed learn-
ing abound, "research leaves us without a specific answer to the ques-
tion, 'What are the characteristics of good programed instruction?'
We must ask it, and discover our own answer each time, in terms of
'good for what and for whom?'"

Definitions including procedural directives such as Pocztar's ex-
planation of programed instruction were especially helpful in this study.
He explains that programing includes a clear statement of behavioral ob-
jectives, continuous testing, evaluation, and revision along with a
balanced concern for subject matter presentation, the learning process,
and specific learner behavior. He notes that the research attitude
necessary in program development demonstrates that programed instruction
is not "merely another teaching technique, but takes the form of the
practical application of laws established in accordance with the rules
of the scientific method." This attitude was assumed to be fundamental
to this study.

Stating Objectives

The necessity for a clear statement of objectives during all stages
of programing is emphasized by almost all writers on programed instruc-
tion. Since a program is designed to produce specific changes in student

19 W. Kenneth Richmond, Ed., The Concept of Educational Technology.
20 Hargiss, op. cit., p. 39.
21 Jerry Pocztar, The Theory and Practice of Programmed Instruction;
behavior it is necessary to specify very clearly the end products—the responses the student is supposed to make when he completes the program and the skills and understandings to be learned. This represents a characteristic of programmed instruction that puts the burden of success on the program or programmer not the student. "When a program does not work, it is the programmer's fault."22

The phases and purposes for stating objectives identified in the literature include:

1. Stating broad program objectives based on program definition which will aid in developing a content sequence outline.23

2. Stating student learning outcome objectives which supply test items for the final exam or criterion test.24

3. Stating behavioral objectives which will aid in choosing appropriate sequence, step size, response mode, pacing, etc.25

4. Stating specific performance levels objectives (i.e., emotional, psychomotor, memorization, complex which affect wording, spacing, illustrations, and general frame construction.26

De Haan's diagram (see Figure 1) of the relationship between objectives, program frames, and test items illustrates how closely related the development and the stating of objectives are to choosing content.

22Pipe, op. cit., p. 7.


Fig. 1 - Diagram of Relationship of Objectives and Criterion Outline

Choosing Program Content

In almost every commercial program and most research studies "there is little information available on how carefully and by what logic the program was derived." In a survey by Frances Meade only two of twenty-two major publishers were able to supply developmental and field test data. Less than half of the recognized leaders in programmed instruction responded to Horn's survey requesting that they select the ten programs with the best presentation of content from a list of programs available in 1965. A widely varied list was received, indicating that even authorities do not agree on what represents a good choice of material or good program design.

According to Espich and Williams, the first stage of choosing content involves a three step analysis of material; (1) a subject matter expert interview phase, (2) a curriculum phase which searches existing written material and especially existing examinations for the material, and (3) an observation phase in which typical students are confronted with some of the material and his responses are observed.

In many research studies subject matter experts were consulted during the development stage of research with helpful results. Del.


29Frances Meade, in Garner, _op. cit.,_ p. 76.


The problem of objectives is further complicated by the fact that in most subject-matter fields there is an astonishing lack of agreement among curriculum specialists, subject matter experts, and professional teachers as to just what constitutes the subject matter content of any given course in their field.  

Research and books on voice, the voice class, and singing represent a wide variety of opinions and concerns. Nonetheless, when considering what the basic fundamentals of voice production include, there is considerable agreement among authorities in research literature. An excellent content source is research in physiology, acoustics, and linguistics which is directed toward the fundamental functions involved in correct posture, breathing, phonation, resonation, and diction. The most ideal procedure for the second step of the analysis of existing material would be to use existing examinations. None which test the knowledge of the fundamentals of voice production could be found.

While writers recommended that students be used in early stages of choosing content, there is little evidence of this in research literature and no models for a procedure that will be used in the program development of this study.

Building the Content Sequence Outline and Determining Scope

Authorities disagree upon procedures for ordering content and determining program scope. While specific aspects of sequencing can be determined as the program frames are developed, there is general


agreement that content outlines and flow charts should be constructed.

Some authorities suggest that following the gathering of content material and reviewing the usual scope and sequence of material, a prose version should be written. Others contend that the programmer can proceed to write frames once he has built general outlines and articulated objectives in terms of test items for the criterion test and test frames in the program. 36 A third group states that Mager's instructional objective model fails to distinguish the level of behavior and is "to subject matter oriented rather than behavioral." 37 This approach emphasizes choosing the program content and sequence on the basis of stated instructional objectives which reflect more attention to desired learner activity. Books on program procedure revealed that most programers use either the outline or prose version approach. In this study all three approaches were used, with special attention to gathering lists of desired outcomes from subject matter authorities, existing teaching aids, and students.

Selecting Target Population

There is general agreement that the target population used in initial testing, editing, and revisions of the program should be similar in age, intelligence, background, and sex to the population which will be used in field testing and those for whom the program is finally intended. 38


Developing the Criterion Test

Once specific objectives are stated in relation to the subject matter and the target population, test items should be constructed. According to De Haan, when these items make up the criterion test and become terminal frames in the program, there can be assurance that the criterion test is indeed testing the program. Most programers, therefore, consider this extensive process of relating objectives and criterion frames to the criterion test a most effective means of establishing criterion test content validity. As an added assurance of face and content validity, examination of the criterion test by experts in the field is often recommended.

Choosing Program Design

Linear

The linear technique has enjoyed the widest use and has the longest history. Pressey's simple device for testing students by means of multiple choice questions demonstrated in the 20's the effectiveness of giving students immediate knowledge of results, and in the 40's military training devices demonstrated that overt responses to logically ordered stimuli followed by knowledge of results was effective and efficient.

Excluding Pressey's device, B. F. Skinner's introduction of the teaching machine and the linear program technique in the 50's represents the beginning of programed learning as it is most often seen today. Skinner based his approach on the concept that "the whole process of becoming competent in any field must be divided into a very large number of very small steps, and reinforcement must be contingent

upon the accomplishment of each step." Garner notes that "the emphasis in programs of the operant conditioning kind is upon the response. The learner must respond actively and accurately before he is allowed to go to the next step." By the late 50's the terms programmed instruction and teaching machine were no longer synonymous since a variety of formats including sets of cards, sheets of paper, programmed books, slides, films, tapes, and even computers were being considered and experimented with utilizing the Skinnerian linear programing technique.

Linear programs, while easier to build and test, have been criticized for being boring, overly redundant, limited to serial order and basic verbal knowledges, not providing enough opportunity for individual differences, and not developing judgmental, discriminational, or discovery learning abilities. Despite these criticisms this technique "appears in over 80% of the programs currently on the market." Reasons for this include student preferance, a longer background of experience with this approach, and the fact that the linear design can be used in almost any format, from computer to various forms of programed textbook.

Intrinsic Programing (branching)


Garner, _op. cit._, p. 10.

Pipe, _op. cit._, p. 13.

Paul A. Friesen, _Designing Instruction_. (Ottawa, Canada: Friesen, Kaye, and Assoc., 1971).
Crowder, which he called intrinsic programing or branching. Crowder explained:

Linear and intrinsic programing, while having some superficial similarities, are basically different in approach, intention, and rationale. The linear technique is an attempt to adapt a simple conditioning model of learning to educational use; the intrinsic programing technique exploits the possibility of letting the student's choice of answers to questions included in the text direct him to new or remedial materials as appropriate. 44

Pipe notes that:

If Skinner's concern is with the science of learning, Crowder's can be said to be with the art of teaching. Crowder holds that teaching is a process of communication ... The student's response provides feedback to the programmer on whether he managed to communicate. 45

Crowder attempts to allow for individual differences through the feedback supplied by responses to multiple choice questions. Remedial practice or enrichment information can be supplied as needed. Superior learners, thus, may move through the program at a fast pace while the student who errs is given remedial attention by means of remedial information routes (branches) which eventually bring him back to the question he missed for retrial.

Branching compensates for many of the weaknesses of the linear technique, but it is much more difficult to construct and test. The usual scrambled book format is considered awkward and frustrating by some. 46 Students can guess the correct choice and proceed without


45Pipe, op. cit., p. 13.

really knowing the information, and branches can only accommodate some of the individual needs of the learner. Besides the effectiveness of branching in compensating for background differences and its greater effectiveness with more complex conceptual learning sequences, probably the strongest argument for its use is the consistent research finding that retention is better than with the linear technique.  

Current research trends are directed toward audio-visual and computer-assisted research formats. When considering textbook formats, however, the great majority of studies deal with new approaches to linear and branching techniques and their relative effectiveness in relationship to other program variables. Hargiss points out that "the results of studies comparing linear and branching programs are as often in favor of one as the other." Carlsen found no significant difference in his comparison of the two techniques but suggested that branching had the "greater potential." Many studies indicate that the effectiveness and appropriateness of whatever treatment is employed depends largely on the type of material programmed. Martin employed a three track program; one track used criterion questions, the second

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49 Hargiss, op. cit., p. 39.


track, phrase explanations of each concept, and the third, a linear program. He found all technics effective, with branching most effective. Commenting on programed instruction in music, Carlsen stated:

Current activity suggests that step size, sequence, presentation mode, response mode, practice possibilities, nature of reinforcement, and reinforcement schedule interact in an infinite number of ways and degrees, depending upon the material being presented, the nature of the behavior being sought, and the learning profile of the individual student. Economic expediency may demand a program to the confines of a linear or branching format, but search for effectiveness probably would not.

Mathetic and Adaptive Designs...

Garner, overviewing the various program designs, offers this comment:

Linear sequencing, which presents one predominant path for all learners and stresses overt responses; branching, which provides fixed alternate paths (providing partial adaptation to a variety of learners) and which stresses stimuli; learner-controlled instruction (Mager), which finds in each student's existing information and behavior patterns launch points for further instruction; idiographic programing (Stolurow), which determines student needs from examination results, and provides individual sequences (by way of computer) designed to meet each need; mathetic programing (Gilbert), which determines the difference between the trainee's initial repertoire of skills and the desired mastery skills, and programs the discrepancy; and mathemagenic programing (Rothkopf), which provides learners with structured opportunities to internalize and improve their existing learning processes. . . . It is difficult and frustrating even when only briefly outlining the specific techniques a programmer could use, because not only does the process become exhausting but the end-product becomes out-dated as continuously new developments arise.


54Garner, _op. cit._, p. 33, 72.
Some programers are successfully employing mathetic techniques based on a philosophic approach posited by Gilbert called praxeonomy. It is asserted that "minimal training will result in doubling or even tripling the effectiveness and value of an individual's performance capability. For this reason Praxeonomy is particularly concerned with overcoming such performance deficiencies."^55

Included among the techniques which have been found successful by researchers are content outlines, interim review tests^56, the summary presentation method of pre-testing within the program^57, and various algorithmic devices.58 It seems feasible that algorithms (an exact prescription or recipe leading to the achievement of a specific outcome) in the form of linked statements, decision trees, visual diagrams or "whifs" (when or if) could also be effectively employed within a program whether linearly or intrinsically conceived.

While Mager, Stolurow, Gilbert, Rothkopf, and Hartley propose alternatives to the two major techniques, others are attempting to adapt, expand, re-design, or use them in combination. Pipe explains that:

Constructed response is found much more frequently in linear programs than it is in branching programs. But there is no

^55 Hartley, op. cit., p. 98.


^58 Hartley, op. cit.
reason why such responses should not be in a branching program—and even in the form of multiple-choice responses. Branches can also be built into a linear program and interesting combinations of both types such as skip branching and baboon and discrimination frame sequences can be used. Research has shown that the most successful recent adaptive design technique has been linearized branching. This design has not only been highly successful, but as opposed to other branching techniques, there has been "tremendous opinion preference for the linearized version."

Multiple technique design.

The idea of using more than one design in a program is not new. Martin did so effectively with three approaches. Cram demonstrated that using linear technique for one half of a programmed book then utilizing the branching design for the latter half is effective. Each technique has been shown to be effective for specific purposes. Linear programs are most effective with fundamental verbal information. The combination or eclectic technique allows for greater individual differences, relieves boredom, and supplies an excellent test review.

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61Schuster, _op. cit._, p. 312.

62Martin, _op. cit._

of initial concepts. And the "Branching Frame Sequence techniques are most effectively used to teach problem-solving or analytical abilities." 64 It seems reasonable, therefore, that a program utilizing all of these techniques, as well as the newest mathetic and adaptive approaches could be feasible and effective. The nature of the subject matter regarding the fundamentals of voice production lends itself to this eclectic approach as does the topic distribution. 65

Choosing Program Format

Programed Textbook Format

As early as 1961 Eigen noted that:

Almost all of the currently available teaching machines can be simulated by means of books which have a different format than the ordinary textbook. The paper simulator of a Skinner-type teaching machine is usually referred to as a programed textbook; and the simulated counterpart of the Crowder-type teaching machine is called a scrambled textbook. While there are several theoretical advantages to a device, it has been demonstrated that the teaching machine simulator (the programed textbook) is just as adequate a teaching device as a teaching machine itself. 66

Increased use of the textbook format since then is based not only on economy but also on considerable research which indicates that a "textbook can do just what the machine can and . . . without hardware." 67

64 Espich and Williams, op. cit., p. 62.


With the exception of some intrinsic programming limited to computer formats, all other formats, namely linear, linearized branching, skip branching, baboon and discrimination frame sequences, as well as the mathetic and adaptive techniques can be used in textbook format. Goldstein and Gotkin, in an extensive review of machine versus programmed textbook research, found texts took consistently less time than machines. Some authorities have questioned social and group influences and higher possibility of cheating with a textbook. Also, computer-assisted instruction is becoming increasingly more effective with other than verbal information. Based on previous effectiveness, efficiency, and economic feasibility, the textbook seems most appropriate for this study.

Page Format—Of the two typical formats for programmed (linear) texts—page-to-page or down-the-page—the page-to-page design is often preferred. In this design the student reads a frame, turns the page for the answer, and begins a new frame on the next page. Unlike the down-the-page design, where answers appear on the right hand edge of the page and succeeding frames are presented down the page, the page-to-page design needs no masking device to cover answers and has been found to more successfully maintain interest. Schuster combined the flexibility of the scrambled book format and the advantages of the linear format into a linearized branching program suitable for page-to-page format. Page-to-page format also best accommodates the

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70 Schuster, *op. cit.*
inclusion of larger paragraphs, multiple choice response, outlines, graphs, flow charts, reviews, figures, illustrations, summary pre-tests, review tests, and skip branches which is required with a multiple design program.

Program Development and Research in Music and Voice

Programs Designs and Content

The earliest use of programming techniques in music utilized taped recordings as tutors. As early as 1949 Cookson used "self-tutoring", and programming of tonal materials began with the tape techniques of McQuerrey and Spohn. While numerous programers continued the tape approach for teaching tonal and harmonic materials, others such as Reese, Sanders, and Vander Ark demonstrated the effectiveness of using tapes with more extensive written material to teach musical forms, styles, and appreciation.

The main interest of programers in music has been to develop and

71 Frank B. Cookson, Recordings and Self-Tutoring. (Cleveland: The Brush Development Company, 1949).


demonstrate the effectiveness of a particular program or program device for use in teaching a specific aspect or skill in music. A unique study by Carlsen employed a teaching machine using a branching technique to teach melodic dictation.77 Similarly, an early program for music fundamentals by Clough et al made use of machine teaching.78 Ensuing music fundamentals programs largely utilized the linear programmed textbook format and machine teaching in general declined. Among the numerous programmed books on the fundamentals of music, which attest to the popularity and effectiveness of the textbook format, are those by Chakerian79, Barnes80, Wardian81, and Hargiss82. Included among the newer design approaches is Martin's multi-track branching program on music fundamentals.83 This program demonstrated that a multiple program format can be effective for teaching factual fundamental information.

Numerous skill development programs have also been developed


83Martin, op. cit.
using the textbook or the tape and text format. In some cases, such as for brass, piano, and woodwinds, several programs are available for each.

Studies demonstrating the effectiveness of programs for developing performance skills include programs for woodwinds\textsuperscript{84}, brass\textsuperscript{85}, piano\textsuperscript{86}, and strings\textsuperscript{87}.

No knowledge or skill development program has been developed for voice. Probably most related to voice are programs regarding sight singing and music reading skills. Neither DuBois and Batcheller\textsuperscript{88} nor Costanza\textsuperscript{89} dealt with any aspect of voice production. Kanable's\textsuperscript{90} study comparing programmed instruction with classroom teaching of sight singing and Baird's program for "singing with chords"\textsuperscript{91} for elementary music education students represent the only studies in any way related to voice. No attempt, however, is made in either study to present information about the voice or vocal techniques that would be of use to the student.


\textsuperscript{91}Forrest J. Baird, \textit{Singing With Chords.} (Dubuque, Iowa: Wm. C. Brown, 1967).
of singing.

Based on surveys by Dallin\textsuperscript{92} and Rogers\textsuperscript{93} of the available programs and program research in music, and in this thorough review of the literature, it is surprising to find that in over fifty published programs available in music, over seventy programs available through research in over forty educational institutions\textsuperscript{94}, no program has yet been developed in the fundamentals of voice.

Just as there are no studies related to voice in music research, those studies or programs in areas such as speech and linguistics, physiology and medicine, and acoustics which might relate to a program in voice are almost non-existent. A single exception is an excellent fourteen hour program which has undergone six major revisions by Buchanan\textsuperscript{95}. Only the second brief section was related to the production of vocal sounds. Since Buchanan used a linear down the page format throughout, there was little that could be gained from it regarding program design. A recently published programmed handbook\textsuperscript{96} on voice and articulation that included flashcards, records, and


\textsuperscript{96}Voice and Articulation in Three Parts. (Chicago: Scott Foresman and Co., 1968).
several program sequences emphasized the phonetic aspects of speech.

With the exception of the content in the initial program sequence, it was unrelated to this study.

White, reviewing the use of programs for medical instruction, stated:

Courses developed to date have been from a research point of view only, in order to evaluate the effectiveness of programmed learning at the graduate level. The courses tested have been parasitology, biochemistry, a review of the autonomic nervous system in relation to the pharmacology course, gross anatomy and neuroanatomy.97

A review of recent laryngeal programs confirmed that the use of programed instruction related to vocal anatomy and physiology has been geared to the graduate medical student and is inappropriate to this study. While certain design aspects of Branning's98 linear program in elementary acoustics may be applicable to program construction the few acoustical concepts related to voice could better be presented in a format that allows more illustrations and diagrams. Programs in other areas relate more specifically to subject and program variables as identified and tested in research and their applicability must be considered from this point of view.

Research approaches in music and voice

Recent research in voice has been directed to vocal function rather than vocal instruction. While information gained from these


98Howell Branning, A Sequential-Step Program for Elementary Acoustics. (Austin, Texas: University of Texas, n d).
studies in vocal physiology, linguistics, and acoustics is useful, the experimental designs are not applicable to this study. Current directions in music programming follow those of the field in general, in that there is less emphasis in research of a comparative type and a growing concern for identifying and studying specific program construction and subject (learner) variables.

Research on Aspects of Program Construction

Numerous excellent books and articles can supply the programer with specific directions for frame construction, frame content, and other details related to building each item. It is often research on these specific program construction variables, however, which provides the clearest indication of the effectiveness of the technique suggested and also points out program variables that need further research.

Length

While length may be one of the most important issues concerning the educational value of programmed instruction, there is surprisingly little information in the research as to program length. Many pro-


grams used for effectiveness studies are very short and often remain unpublished because of their limited educational usefulness. On the other hand, longer programs that represent a respectable unit of information for publication and use by educators are often produced with less than the necessary concern for research constraints, especially in regard to testing and evaluation.

It is obvious that the less information over which a student is tested, the more likely he will be able to recall it. Many programs are considered ancillary to other instruction and therefore require only a few hours to complete. Others are used as an adjunct to complement course work or to allow self-instruction that is an extension of course work.

Silverman reports several studies that indicate that programs, due in part to a lack of novelty and learner attention span, are less and less effective as they become longer. Evans, Glaser, and Homme contend that effective programs may be constructed of almost any length if well planned and using varied techniques, illustrations, and frequent review tests. Researchers agree that programs

103 Barnes, *op. cit.*

104 Carl B. Nelson, "The Effectiveness of the Use of Adjunct Programmed Analyses of Musical Works on Students' Perception of Form," *Council of Research in Music Education.* (No. 9, Spring, 1967), pp. 29-43.


should be as efficient as possible, but there is increased interest and concern for testing the effectiveness of longer programs. Jones found, for example, that students will respond to as much as four hours of programed instruction a day. In view of this, this study was an attempt to construct and test a longer program conceived as academic material for an entire voice course or voice class course that could be used as ancillary and adjunctive to usual studio, chorus, or voice class study.

Sequence

Of five studies reviewed by Garner concerning logical versus random content order, three studies showed no difference, one favored logical sequencing, and one found that logical sequence was superior when tested by post-test but not when tested for retention. What appears to be logically ordered by the teachers has often not been found so by students. Other researchers have found that in some subject areas random order is more effective. Jeffries found this true for presenting intervals in music.

The most common procedure is to follow the order of content presentation in usual teaching and in books on the subject. A recent finding is that retention is aided by programed reviews. Increasing the number of frames for reinforcement was shown undesirable,

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108 Jones, op. cit.
109 Garner, op. cit.
whereas specific reviews\textsuperscript{111} and interim review tests were effective and appreciated by students.\textsuperscript{112}

**Response Mode**

Both overt (active oral, written, or manipulated response) and covert (internalized response) have been effective. Schramm observed in his summary of research concerning overt versus covert response that:

Results favoring the use of overt response have not often been found when actual programs were studied. Here a frequent finding has been that subjects gain about as much from covert responses and take significantly less time working through the program.\textsuperscript{113}

Multiple choice responding was found to take significantly less time than constructed-answer responding by Coulson and Silberman.\textsuperscript{114} They also observed that results comparing these modes differed according to the type and format of the post-test. They conclude, as do many response-mode researchers, that different subject matter may require differing response modes, implying that both multiple and covert constructed response may be used effectively in the same program. Strong, reviewing later studies, also noted that "response modes do not differ in terms of final scores on a post-test although the covert and multiple choice modes take significantly less time."\textsuperscript{115}

\textsuperscript{111}\textsuperscript{M. D. Merrill, "Specific Review Versus Repeated Presentation in a Programed Imaginary Science," *Journal of Educational Psychology.* (Vol. 61, 1970), pp. 392-399.}

\textsuperscript{112}\textsuperscript{Hartley, Holt, and Swain, *op. cit.*}

\textsuperscript{113}\textsuperscript{Schramm, *op. cit.*, p. 64.}

\textsuperscript{114}\textsuperscript{J. E. Coulson and H. F. Silberman, "Effects of Three Variables in a Teaching Machine," *Journal of Educational Psychology.* (LI, 1960) pp. 135-143.}

\textsuperscript{115}\textsuperscript{Strong, *op. cit.*, p. 225.}
Frames which allow or force the student to experiment with the actions spoken of in the program are highly recommended, especially in skill development programs. Bigham\textsuperscript{116}, for example, discovered actual fingering was a more favorable response mode than blacking-in appropriate portions of a diagram for teaching woodwind fingerings.

**Feedback and Reinforcement**

The importance of knowledge of results has been questioned by recent researchers since many superior students using the typical program format do not even check their answers.

Although the majority of studies did find a significant contribution to learning when knowledge of results was immediate, some found no significant differences in timing of feedback—or if there were no feedback at all.\textsuperscript{117}

While most programs in music use immediate knowledge of results, Jeffries found delayed knowledge of results was superior in teaching intervals.\textsuperscript{118} Proponents of page-to-page format believe that the suspense and immediate answer when the page is turned is very effective. Also, a student's answer can be withheld till a later page, if delayed feedback is desired.

Sparing use of cues and prompts can effectively aid the student to find the answer and act as a reinforcement. Typographical cueing such


\textsuperscript{117}Garner, \textit{op. cit.}, p. 43.

\textsuperscript{118}Jeffries, \textit{op. cit.}
as underlining, capitalization, and italics has been successful,\textsuperscript{119} and there is increased interest in the use of algorithms, diagrams, and other visual learning approaches.\textsuperscript{120} Others point out that when the answer can be longer than a single word, it too can be a powerful reinforcement.

Experimentation has moved toward the conclusions (a) that in many cases partial prompting is more effective than full prompting, (b) that the nature of the prompt is highly significant for transfer of learning to a testing situation, and (c) that fading, the gradual withdrawal of cues, may provide the most efficient situation for learning in many cases. . . . Different degrees of prompting appear to work better for different purposes and subjects.\textsuperscript{121}

**Step Size and Error Rate**

Early studies such as those by Coulson and Silberman\textsuperscript{122} indicated that more learning occurs with small steps, but that more time is needed. There is evidence that a good program can be shortened, thus increasing step size, without significantly affecting post-test scores even in spite of increase in program error rate.\textsuperscript{123} The effectiveness of the branching technique, which uses larger steps and plans on considerable program error, demonstrates that small steps

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\textsuperscript{120}Hartley, op. cit.

\textsuperscript{121}Schramm, op. cit., pp. 54, 55.

\textsuperscript{122}Coulson and Silberman, op. cit.

\textsuperscript{123}Evans, Glaser, and Homme, op. cit.
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and low error rate are not always necessary for an effective program.\textsuperscript{124} Lumsdaine and Glaser report several studies that demonstrated that gradually increasing step size produced maximum learning,\textsuperscript{125} and "when students were given a choice they preferred a gradually increasing length."\textsuperscript{126} Gordon found that varying step size as well as answer types was as effective as a standardized approach and much preferred by students.\textsuperscript{127}

Mathetic, adaptive, and new branching techniques that utilize larger step size and error rates are often as effective as linear programs.\textsuperscript{128} Balson found "the use of operant spans also yielded an advantage over small steps in time taken to complete the program."\textsuperscript{129} Some authorities suggest that the impact of step size, response mode, and knowledge of results has been overestimated. Most, however, agree that each of these, and especially step size, can have a considerable effect upon achievement.\textsuperscript{130}

\textsuperscript{124}Shull, \textit{op. cit.}


\textsuperscript{126}Garner, \textit{op. cit.}, p. 43.


\textsuperscript{128}Mason, \textit{op. cit.}

\textsuperscript{129}Maurice Balson, "The Effect of Sequence Presentation and Step Size Upon Completion Time." \textit{Programed Instruction.} (July, 1965), p. 3.
Pacing

The speed at which a student progresses through a program can be determined by the student (self pacing), by a devise, pacer, or group (controlled pacing), or by time limits and controls (external forced or delayed pacing). Lewis indicated that "one of the basic assumptions of programed instruction is that the student should be allowed to proceed at his own rate.... A review of the literature did not reveal experimental evidence to support this basic assumption."131

In almost all recent pacing studies, achievement and retention are little affected by change in pacing mode. Time to completion, however, is considerably affected. Garner reports seven studies that found no significant difference in achievement between self and externally controlled pacing.132 Lasco found that controlling student pace by extending a program through a school quarter increased the time that students spent studying but did not affect achievement.133 In studies of in-class134 and group pacing, which may reflect the impact of several other variables, "students retained more of material learned


132Garner, op. cit.


during group study conditions."  

Nicholas, using four different pacing approaches, found "there was not a significant difference among the four treatment groups on the retention test."  

Kohn also found that "timing of supplementary activities with a program of music fundamentals will not affect either the initial learning or retention of learning."  

Since there is a saving of student time without a decrease in learning and retention, forced pacing seems to be an appealing approach, especially for longer programs intended for supplying background information.

Program Evaluation

Recent research on program effectiveness has turned from asking whether or not a program works, to asking what kind of program works, with whom, and under what conditions. There is no longer any doubt that programs can be effective. Many studies show a significant increase on post-test scores, along with significant reduction of time. Other studies indicate either better post-test performance, shorter learning time, or both, than conventional teaching techniques.  


138 Strong, op. cit.
that more studies that simply compare conventional teaching and programs are unnecessary. "Psychologists have made comparative studies too numerous to mention; the evidence supports programming in the vast majority of these pilot experiments." As a result "current research is tending to be less concerned with the comparative approach."*4®

Evaluating Program Construction and Design

Program development and construction decisions were based as much as possible upon research findings. Thus, in a limited way, evaluation of the program will be an evaluation of the effectiveness of the multiple technique design, of an extended length ancillary program, of varied sequence and feedback, of gradually increasing step size and error rate, and of self and forced pacing. Since each unit will use a different technique, the effectiveness of each technique can be partially judged by consulting unit post-test results and the student opinionnaire reactions to each unit and to the multiple design in general.

Meierhenry points out that "the distinguishing characteristic of programming materials is the testing procedure to which they are subjected. Empirical evidence of the effectiveness of each teaching sequence is


140Carlsen, "Implications of Recent Research Problems in Programed Music Instruction," _op. cit._, p. 32.
obtainable from the performance record of students.\textsuperscript{141} This extensive testing is ordinarily done by trying the program on one student, revising and editing to compensate for the difficulties encountered, trying it on another student or group of students, revising it again, and so on until eventually, with each item revised to be as effective as possible, the program is presented to a larger group or groups.

Individual Testing

Nearly all researchers and authorities consider individual testing a very important and essential stage of program testing and revision. The programmer has opportunity to hear the student recite the answer, ask him how well the frame communicated, and even give him alternative frames. This observation of student reaction and response is invaluable for editing. Some authorities also suggest final verbal opinionnaires for each subject.

Research has demonstrated that editing based on the pre-testing of a single student can significantly improve the first draft\textsuperscript{142} and that a half dozen represents a reasonable limit since ensuing "run throughs" gain very little.\textsuperscript{143}

Small Group Testing

Most program developers recommend that this phase of testing,


editing, and revision be carried on with from five to eight average students who are as similar as possible to the population to be used in field testing. Students are usually given the program and required to write the answer before proceeding to the next frame. It seems reasonable to use a separate numbered answer sheet upon which the student could write his answer and comment on the frame.

Generally the criterion test and an opinionnaire are also used in this testing. After item analysis of errors on the program and test, the student is interviewed to discuss problem frames and to get other reactions and suggestions which might aid in further revision and editing.

Large Group Testing

Although recommended in the literature, many researchers omit this testing and proceed to field test at this stage. Some especially lengthy published programs, however, have gone through five major revisions and most program developers recommend as many testings and revisions as seem necessary to produce an effective program. This testing offers an excellent opportunity to use subjects of various ages, intelligence, and background and to utilize different pacing modes. The pre-test and post-test, as well as an opinionnaire can be used, evaluated, and revised.

Evaluating Subject Variables

Who can learn from a given program? "Although the data are skimpy,

144 Espich and Williams, op. cit.
145 Buchanan, op. cit.
it is probably true that a good programmed course lessens the effects of individual differences in learning." Since the target population and the subjects used in all stages of testing are generally similar in age, intelligence, and education, this assertion is seldom tested. To determine to what extent a program can compensate for learner differences and to determine the scope of program effectiveness, it would be of research interest to present a program to students of differing age, intelligence, and education.

Age

Programs have accomplished learning at every age ranging from children to graduate school students. But in spite of a growing mass of commercial programs available for schools, little research concerns students of other than college age. Especially neglected is the high school age. Strong, reviewing fifty eight major studies, found only nine using high school age subjects. The studies of Bennet (grade 5), Mandle (upper elementary), and Andrews (high school) are among the few in music related to non-college populations. Vander Ark tested

146 Strong, op. cit., p. 225.
147 Ibid.
his program with university, college, and high school students. He found the program was considerably more effective with university students than with high school students. Since beginners in voice study may be adults, college students, or high school students, all of these age groups were used in this study.

Intelligence

Most researchers who have used cumulative point averages and aptitude scores have discovered that programmed instruction is "able to assist all students, regardless of previous experience and learning ability," and that there is no significant relationship between scholastic achievement and post-test performance. Puopolo reported that his program was especially helpful for the student with lower intelligence. Reed and Hayman, however, found that high IQ students did better with programmed instruction. Other studies relating IQ to program variables, such as step size, have found no significant relationship. De Haan, summarizing a study of one hundred fifty

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151 Vander Ark, op. cit.
152 Barnes, op. cit., p. 95.
153 Carlsen, op. cit.
154 Puopolo, op. cit.
programs indicated that:

programs succeeded as teaching instruments for different reasons. One was most appropriate for underclassmen; the second favored male students with high mathematics ability; the third favored students with generally lower scholastic achievement; the fourth favored female students. 157

While achievement and attitude scores have been used most frequently, there is a trend toward using only the pre-test as an indicator of student ability level. "A pre-test gives a far more precise measure of the student's starting point than do all the achievement and attitude scores that can be obtained." 158

Education (previous experience)

Pre-test scores have also been the most used means to determine ability and experience level when comparisons are made between groups. Since program effectiveness is generally judged by how much was learned, most authorities use only pre-test to post-test gains with little regard for class in school, hours of previous exposure to the subject, and previous experience.

Other Subject Variables

Such variables as sex and environment for learning have only rarely been studied when equating groups. Personality measures have been rarely used in programing research and motivational variables have been discovered by using an opinionnaire or attitude survey following the post-test.

157 De Haan, op. cit., p. 245.

Evaluating Program Effectiveness

Field Testing

Program researchers have leaned heavily upon the criterion pre-test to measure the student knowledge level before he uses the program. This is especially true when several divergent groups are used in field testing. The pre-test can also show more precisely the actual difference in starting point for students or groups with different exposure to the subject, but who are matched in age, class in school, grade point average, and sex, than simply reporting how many years of previous study the student has had. The pre-test is also necessary, along with the post-test, to show if a significant amount of learning took place. It is surprising, therefore, that criteria for developmental testing was supplied by only ten percent of leading program publishers surveyed by Meade. And of two hundred ninety one programs, Komaski found forty percent showed no evidence of any kind of field testing.

Most programmers utilize one or more of several means to assure the face and content validity of the tests used in field testing. These, as noted earlier, include item analysis and evaluation of tests during earlier testing, using test items taken directly from the program test frames which have been carefully matched to program objectives, and presenting the test to experts for evaluation.

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159 Meade, op. cit.
The pre-test and post-test used in field testing usually contain the same items in a different order. Concerns that taking the pre-test will by itself affect the post-test scores has been refuted by Hartley, Holt, and Swain, who found no pre-test retention effect upon post-test performance following self instruction with a programmed textbook.\textsuperscript{161}

Low error rate on the post-test has seldom been the only criteria for measuring program effectiveness. Nonetheless, programers have often aimed for an ideal 90/90 program. Kay explains:

> It is customary to refer to the performance of a particular program by using two percentages. The first refers to number of students, the second to criterion test scores. Thus a 90/80 program has proved that it can be expected to teach at 90 per cent of students up to a standard of 80 percent on a criterion test.\textsuperscript{162}

Some researchers report only recorded gain scores or modified gain scores (i.e., with a pre-test score of 60 and a post-test score of 90 of a possible 100, actual gain (30) divided by possible gain (40) supplies a modified gain of 0.75 or 75\%. Using both approaches should assure the clearest presentation of data.

Davies points out that:

> Most tests used with programed instruction materials, aim to indicate whether or not the student has learned, and not to separate out students. If the aim of a program is, as it is sometimes stated, to achieve 90-90, then it is clear that results on such tests (if the program "works") will be narrowly distributed at the top end of the scale. There is here, therefore, a problem. Tests are required which are valid, reliable, and objective, and yet it is expected that learners will successfully complete them. Conventional measures of validity and reliability are difficult to obtain in this kind of situation.\textsuperscript{163}

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\textsuperscript{161}Hartley, Holt, and Swain, \textit{op. cit.}
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Opinionnaires and Attitude Surveys

Researchers when using an opinionnaire have generally found student attitude to programed instruction is excellent for nearly all age levels. Ninety-two percent of the college students Feldhusen questioned felt that a program was superior to a regular text.¹⁶⁴ Deterline noted that while students did not want programs to replace teachers, they liked both teacher and programed text together and much preferred programed to unprogramed textbooks.¹⁶⁵ Newman also found that ancillary programed instruction led college students to greater satisfaction with regular instruction.¹⁶⁶ Lindvall¹⁶⁷ noted that school children were more attentive when using programed instruction and were in general favorably motivated.

Not all reactions are favorable, however, and this is especially true with levels other than college. Boredom, learner impatience, and generally poor attitude are reported by Silverman¹⁶⁸ in some school situations. Andrews¹⁶⁹ indicated that high school performance group

¹⁶⁵ Deterline, op. cit.
¹⁶⁶ Newman, op. cit.
¹⁶⁷ C. W. Lindvall, "The Impact of Programed Instruction on Selected Student Variables," *Studies of the Use of Programed Instruction in the Classroom.* (Pittsburgh Learning and Research and Development Center, 1966) pp. 91-119.
¹⁶⁸ Silverman, op. cit.
members had a negative attitude toward his program. This may reflect in part the attitude of the teacher, since teacher and administrator attitudes toward programmed instruction has not always been favorable. Ofiesh found teachers and adults have favorable reactions to programmed instruction initially, and many expressed a need for programs which teach background or foundational information. When asked to use them, however, their reactions were occasionally unfavorable. Teachers were judged by students to adjust more effectively when programed materials were supplementary as opposed to the major means of instruction. In view of attitude differences shown with the various ages, the use of questions probing attitude seems especially appropriate when using a program with varied age groups.

**Summary**

In summary, the review of literature aided in defining programmed instruction and demonstrating the need and procedures for stating objectives, for choosing program content, building the content sequence outline, determining program scope, selecting target population, and developing the criterion test. It reviewed research concerning the alternative program designs that could be chosen and demonstrated the advisability of a multiple technique design, page-to-page programed textbook format of considerable length, using logical sequence, either overt or covert response modes, various typographical and color cues, immediate feedback, gradually larger and varied step-size, and both forced and self-pacing.

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A review of programed materials in music and fields related to voice indicated a need to develop and test a program on the fundamentals of voice production in singing. Procedures used in research for evaluating program construction and design were reviewed as well as subject variables such as age, intelligence, and previous experience. Appropriate approach for evaluating program effectiveness and gathering student reactions were also reviewed.

Several areas in which a contribution to research could be made were also identified. These included developing and testing of a program using multiple programing techniques, testing a program with subjects with a wide variance in age and background experience, and testing a program of extended length. The present study was designed to investigate these matters.
CHAPTER III

PROCEDURES OF THE STUDY

The procedures utilized for program development and evaluation were based on the sequence, suggestions, and implications found in research and related literature as outlined and presented in the previous chapter. The procedures are:

1. The feasibility, nature, and scope of the program was determined by reviewing literature, research, and books on voice and interviewing experts in the field of voice and programmed instruction.

2. Broad program, student learning outcome, behavioral, and performance level objectives for the program were gathered from private voice teachers, voice class teachers, and professional voice publications.

3. Content suggestions were gathered by consulting subject matter experts and books on voice, so that a rough program outline could be built.

4. To aid in building the content sequence outline, selecting target population, and choosing program design, various age students of singing were confronted with a rough outline, a draft of possible content, and various possible programming techniques. They were asked to articulate vocal concepts in their own terms, and were asked to indicate if they knew or taught the information suggested for the program, would like to learn or teach it, or thought it was important enough to be programmed.
5. A content sequence outline was built.

6. A target population was selected.

7. A criterion test was constructed.

8. The most appropriate program design, length, sequence, response mode, general frame structure, and pacing was determined.

9. The first draft of the program was constructed.

10. Revision one was made following editing and critique of the program by experts.

11. Eight revisions were made in stage two following the presentation of the program, frame by frame, to eight individual students.

12. Revision of the program and criterion test in stage three were made based on answers to a frame analysis sheets and the criterion test gathered from a class of eight beginning voice class students.

13. The revised program (third revision) was tested with two matched pilot groups (total n = 12) of varied experience level voice students. One group was self-paced, the other forced-paced.

14. Results of the pilot testing of six self-paced and six forced-paced subjects showing percentage of increase, percentage correct on each unit (programming technique), differences between groups, reaction of students and time to completion were computed, interpreted, and used to prepare the final draft and make final revisions of the pre-test and post-test.

15. Subjects for field testing were selected.

16. All subjects were given the pre-test, three groups (A, C, and D), representing three different experience levels (beginning, intermediate, and advanced) were self-paced through the program and given the post-test and attitude questionnaire. Group B (matched to C) was
forced-paced through the program and given the post-test and attitude questionnaire.

17. The program data (data sheet and opinionnaire) and test results were collected and analyzed.

Program Development: Preparation Phase

Determining program feasibility, nature, and scope

A thorough review of the literature and research in music and areas related to voice revealed that no program on voice was available or being researched. While no model existed in music, programs in acoustics, physiology, and linguistics, as well as countless programs on such varied subjects as logic, poem analysis, and creative thinking suggested that a program on the basic verbal-visual aspects of voice production could certainly be constructed.

Ten experts in the field of singing and programed instruction were consulted to determine the feasibility and usefulness of a program concerning the fundamentals of voice production in singing, to identify the needs and objectives of the voice profession which might be fulfilled by programed instruction, and to suggest appropriate program content. A notebook was used to record the responses of each of the ten experts to the following questions:

1. What could be the nature, scope, and feasibility of a program for voice?
2. What are some of the objectives which such a program should attempt to fulfill?

3. What content should be included in a program concerning the fundamentals of singing?

Answers concerning the feasibility and possible usefulness, nature, and scope of the program indicated that:

1. Most authorities felt a program of this type used as ancillary or background study and limited to verbal materials would indeed be feasible and possibly efficient and economical as well.

2. Authorities noted that most books in voice were intended for teacher use and that a program directed to the beginning student could fill a need in the profession.

3. All were enthusiastic about the ancillary self-instructional character of a programed textbook. Each authority considered several possible ways that the program could be useful including:

   a) compensation for individual differences in background so that all students had the same basic knowledges;

   b) relief from the tedium of repeating the same basic information over and over again;
c) saving teacher time for badly needed aural
evaluation of the singer or, in the case of the
choral conductor, allow more time for rehearsal
d) supplying motivation and adding a more academic
dimension to voice study
e) supplying information that could be tested which
would not require extensive student time.

Stating Objectives

Six private voice and two voice class teachers were requested to list,
on an objectives sheet provided, as many objectives as they could which
stated (1) their broad program objectives, (2) objectives stating what
voice students should know, (3) objectives stating what the student
should be able to do, and (4) objectives stating what kinds of decisions,
responses, learning approaches, and attitudes the student should develop.\textsuperscript{171}

An extensive list of objectives was gathered from experts, and
from prefaces, introductions, and statements in textbooks and the pro­
fessional literature on voice. These objectives were catagorized under
the headings: (1) broad program objective, (2) student learning outcome
objective, (3) behavioral objective (what the student will do), and (4)
performance level objective (what kind of learning task is required).
To make these objectives useful in constructing the program content
sequence outline, constructing criterion test items, determining
appropriate program design and format, and suggesting appropriate frame

\textsuperscript{171} See Appendix A.
structures, an objectives-technique sheet was devised.\(^{172}\) Each category of objective statements had a corresponding technique heading. Thus objectives listed under broad program objectives were used to aid in filling in suggestions concerning content sequence outline, objectives stated as student learning outcomes was used in making decisions about possible criterion test items, behavioral objective corresponded to design and program technique, and performance level objectives provided input for decisions concerning the most appropriate frame structure.

Most of the objectives gathered from experts and professional publications were subject matter oriented and were of the broad program or student learning type. It became obvious that in order to develop complete objective listings, especially in the student behavior and performance level categories, that an extensive analysis of subject matter along with presentation of some of this content to students would be necessary.

Choosing Content

Consulting Subject Matter Experts—A content suggestions sheet was constructed for use by the subject matter experts.\(^{173}\) Eight voice authorities, who were also interviewed concerning feasibility and appropriate objectives, were asked to list:

1) In addition to developing correct posture, which other fundamental functions of singing should a singer understand and develop? and
2) Which terms or concepts related to each fundamental function you listed must a singer know and understand?

\(^{172}\) See Appendix B.

\(^{173}\) See Appendix C.
Authorities agreed that included in content should be basic information on posture, breathing, phonation, resonation, and diction. No extensive presentation of vocal techniques outside of general application of basic information was recommended, as this could be reserved for the instructor of the class, student, or chorus. Several suggested the advisability of a general introduction to vocal pedagogy (study) which would provide an overview of approaches to the teaching of singing and general consideration of attitudes, approaches, and other requirements expected of a student of voice. There was surprising similarity in the lists of terms collected. Numerous terms appeared on all eight listings. There was less unanimity on the concepts listed.

Consulting existing books and research

In addition to Field's excellent survey of books on voice, Vennard's extensive synthesis of research and thought on voice, and Warmink's collation and synthesis of research in areas related to voice, an extensive analysis was made of recent books on singing to discover common content relative to the fundamentals of voice production.

174 Fields, op. cit.
175 Vennard, op. cit.
176 Warmink, op. cit.
Analysis of research studies on voice gave considerable information concerning the characteristics of a good singer's voice. Relevant information was also found in books on acoustics as well as in scientific studies on vibrato, vocal registers, and other vocal mechanism functions.

Information that was abstracted from the written sources mentioned above were recorded on the objective-technique sheets and the content suggestion sheet. Based on these source sheets and notes from interviews, six basic content categories were formed for filing the information gathered. These included:

I. Characteristics of the good singer's voice

II. Posture

III. Breathing

IV. Acoustical aspects of singing

V. Phonation

VI. Resonation and diction

Data was also drawn from the source sheets to formulate a rough program outline, to construct fill in the blank statements, to write short paragraphs with multiple choice questions, and to construct some model frame sequences using various program formats.

Reactions of Students and Teachers of Singing—Numerous authorities in the literature suggest that students be used prior to making final decisions about program outline, sequence, format, and design. Although there were few models or suggested procedures available, it was decided to select subjects of differing ages, including one high school age,
one adult, and two college students. They were asked to: (1) Fill in important words deleted from re-typed statements from existing books on singing, (2) answer several multiple choice questions over a short sequence of information, (3) Explain how it felt when one had good posture, for example, (4) Give reactions to samples of various program designs and formats, and (5) Write K=know already, L=would like to learn, V=very important, or N=not important or necessary to know before lists of objectives, terms, and concepts.

Since this procedure seemed especially helpful to aid in determining program scope and sequence, the same procedure excluding the use of K (know) and L (like to learn) in step 5 was used with several teachers of singing. In addition they were asked to comment on the sequence, completeness, and accuracy of the subject outline, the term and concept lists, and the objective-technique lists.

Findings and implications concerning content selection included:

1. Both students and teachers of singing found single blank fill in and multiple discrimination response of less than four items easier to answer than definition, fill ins, listings, or response requiring discrimination between four or more items. This suggested that content should be chosen and sequenced so that single blank fill in responses and short or multiple discrimination responses could be used as much as possible.
2. Observation and comparison of the explanations and language of both students and teachers of singing indicated that proprioceptive aspects of singing could be articulated and therefore could be included in program content.

3. All students favored linear, linearized branching, and mathetic outline and overview approaches. There were several negative reactions to the scrambled book design. The high school student found samples of large step, skip branching, and mathetic pre-testing samples "complicated." Teachers of singing preferred samples using linear designs, shorter frame sequences, and longer steps. There appeared to be a variety of preferences depending on age and background. This suggested the importance of choosing a specific target population or else using various approaches. A decision was made to avoid the scrambled book design.

4. There was considerable agreement on which terms, concepts, and objectives were considered (V) very important by both teachers and students. Teachers suggested that more information on the acoustics and physiology of vocal production should be included and that attempts should be made to relate the factual and terminological information to the actual
process of singing. Students wanted most to learn new terms and the proper functions for correct posture, breathing, and other singing actions. Very few items were marked not important to know (N) by students.

Content Sequence Outline

There was little difficulty in determining the proper sequence for teaching the fundamental functions of vocal development because of the similarity of presentation order in books, the suggested order of experts, and the natural emergence of the psycho-physical functions in singing. Patterns for program format and content sequence also became evident when broad program objectives and content were related to possible programing approaches on the objective-technique sheets.

The logical sequence traditionally associated with the subject was maintained. In addition programed review devices that would allow a type of cyclic recurrence of each unit topic were included. Praxeconomic preview devices that would supply minimal pre-training were also planned into the content format and sequence outline. Thus unit one and four appear with the usual arrangement of the fundamental functions: posture, breathing, phonation, resonation, and diction. The content sequence outline that was developed appears in Appendix D. 177

177 See Appendix D.
Target Population

Based on their need for the program and observations of their responses when interviewed, the college age students with limited exposure and background in voice seemed to be the most ideal target population for use during developmental testing. It also became evident at this time that field testing with various populations would be useful in determining the scope of the program's effectiveness.

Criterion Test

Test items were constructed by referring directly to student learning objectives that had been collected on objective-technique sheets and which had been formulated with the aid of existing books, experts, and student interviews. As an added assurance of face and content validity, the experts consulted concerning feasibility, objectives, and appropriate content were asked to mark each test item with R=relevant and well stated, N R= not relevant, or R S=relevant but needs restatement. Test items judged not relevant by more than half of the experts were eliminated and items needing restatement were revised. Nineteen items were eliminated in this manner. Items which had received a single N R mark were noted for scrutiny when final construction and revision of the pre- and post-test would be made during the development testing process. Experts agreed to re-examine the pre- and post-test developed from this criterion test following small group testing.
Choosing Program Design

Textbook page-to-page format--The selection of the textbook format was prompted by:

1. Research which indicated that textbooks are as effective as machines, more economical than other means, and favorably and enthusiastically accepted by students.
2. The accessibility and convenience of a textbook for ancillary self-study by students.
3. The flexibility of the textbook format to accommodate various programming techniques.

The page to page format was selected instead of the down the page technique since it required no answer masking device and seems to maintain interest more effectively.

Multiple Program Format--Several factors prompted developing a program that was not limited to a single technique (i.e., linear or branching).

Reasons for building a multiple format program include:

1. A variety of learning approaches is necessary;
2. Complete linear programs are often considered boring;
3. The effectiveness of gradually larger delays in feedback, gradually more randomization in sequence, increasingly fewer prompts and cues, and increasingly larger step size can be incorporated into a multiple program format.
4. Reviews can be programmed using different programming techniques, thus testing transfer and hopefully aiding retention; and

5. Student's learnings, reactions, and attitudes toward different programming techniques can be studied.

A thorough study of recent frame construction techniques was made with the objectives and content in mind. Where a specific technique seemed most appropriate to achieve a specific objective or teach a specific content, this was noted on the objective-technique and content suggestions sheets.

**Program Development: Construction Phase**

Construction of the first draft was possible without writing a complete prose version of the entire text because:

1. the content sequence outline supplied a well-planned order for the content,

2. test items from the criterion test supplied terminal frames for most frame sequences,

3. the objective-technique sheets suggested the most appropriate frame construction techniques for these sequences,

4. concept and fact sheets supplied extensive factual information for explanation frames ("set," "practice," and "sub-terminal" frames), and

5. term lists supplied extensive material for use as defining frame sequences.
The introduction was written in paragraph form, explaining as simply as possible the plan-format of the textbook, the objectives of the program, and how to use specific learning aids provided in the program.

Unit One used the typical linear textbook design in which the student turns the page after each item finding the answer and the next item on the following page. Constructed response frame sequences were used which requires the student to complete a sentence, solve a problem, or answer a question based on his own knowledge. Colored pages were used to make it convenient for the student to locate overviews (pink), outlines (green), review frames (blue), and test frames (yellow) as he reviewed.

Unit Two used a basic linear design but employed X-R frames (where a student is asked to experiment with his body and then respond), I-R frames (where an illustration is needed for response), and X frames where the student experiments but needs not respond. Larger learning steps were required and many frames required several answers. Discrimination frame sequences where the student must make a choice or selection between one among various items were also used. The the technics employed in unit two are basically variants of the page-to-page linear format and most employ three fram sequences. Thus, this unit was considered modified linear.

Unit Three used branching technics including skip branching which allows students who know the material or learn quickly to move rapidly through the main sequence frames by skipping items.
Persons who err progress step by step. Washbacks or backward branching (a student at a criterion item is asked to review previous items) and numerous baboon frame sequences, in which the student is given a multiple choice of both, A, B, or neither response (hence the name baboon) were used.

Unit Four, since it was introductory to part two of the program, again employed the typical linear format except step size was especially large and numerous multiple response items were included.

Unit Five employed both linear and page-to-page branching technics as well as paragraph form with retrogressive chaining (a mathetic technic where the mastery step is identified first followed by intervening sub-mastery steps in the chain). There were, therefore, frames called R-R (read-respond) frames where a paragraph was read before responses were made. The wide variety of technics used in this unit resulted in labeling it eclectic.

Unit Six used mathetic techniques including intermin review tests, multiple choice decision sequences, algorithms, and T-R sequences in which the student is given a type of pre-test, then responds, and is given instructions for gaining information on items missed.

Unit Seven was designed largely as review and used typical linear and skip branced linear format with numerous washbacks, reviewing frames, and test frames.

Length and Sequence

Although there was no accurate way of knowing how long it would actually take students to complete the program at this stage, it became
apparent as the rough draft evolved that the program could possibly required up to eighteen hours for completion. Several experts were consulted and a decision was made to abbreviate the program as much as possible but not to eliminate any of the fundamental functions.

Frames concerning student approaches to the study of voice were eliminated from unit one. The use of more illustrations and experiment-respond frames, in place of long frame sequences and explanations, aided in abbreviating unit two. Unit three was left unchanged. Step size was increased in unit four and much technical explanation about range and register was eliminated from unit five. Less was included in unit six on the phonetic alphabet and the final review unit was completely eliminated by the inclusion of review tests following each unit.

Response Mode

The usual programed textbook format seldom makes use of overt (written, oral, or manipulative) response. Since this saves student time without apparent loss of effectiveness, many responses were of the constructed fill in the blank or blanks type. Due to the psycho-physical skill development aspects of voice and the requirements of a multiple technique design some responses, however, suggested physical experimentation in addition to response. Others required multiple discrimination with several responses, and some required no response at all. Students were not recommended to write in frame responses but were encouraged to write in the answers to review tests. Thus, the program used both overt and covert response approaches.
Feedback, Reinforcement, Step-size, and Error Rate

The sequence used made it possible to put into effect several recommendations suggested by research and preferred by students: 1) gradually longer delays in feedback, 2) increasingly fewer prompts and cues, and 3) increasingly longer step-size. Error rate during the program was expected to increase as the techniques employed utilized error responses. Student error and comment during individual and small group testing often leads to more communicative means of presenting material than if the answers are easily answered. Because of this and in an effort to avoid student boredom and to keep the program as brief as possible, the abbreviated program utilized what the programmer considered the longest step-size possible.

A system of typographical cueing was developed using underlining, capitalization, letter, and spacing cues. Other visual cues such as colored sheets, illustrations, algorithms, and figures were systematically interspersed for interest and clarification.

Pacing

Unlike a computer or teaching machine, a programmed textbook cannot be used for controlled pacing from frame to frame. It can, however, be externally paced (forced) by dictating time to completion. It became apparent at this stage that it would be beneficial to

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178 See sample pages, Appendix E.
experiment with the effectiveness of both self and forced pacing during early testing to determine the most appropriate pacing mode for field testing.

Program Development: Revision Phase

Approaches recommended in the literature for editing and revising the technique, composition, and accuracy of a program were used by the author to correct all possible faults in program technique and frame composition. The remaining steps in the development process were charted following methods and flow charts developed by numerous writers on program revision and evaluation. 176

Four stages were followed to provide data for three major revisions, to evaluate program construction and design, to evaluate specific program and subject variables, and to determine program effectiveness. They include:

Stage 1—Experts revision.

Stage 2—One-to-one student response revision. When revisions were based on observing the responses of single individuals to each frame of the program.

Stage 3—Analysis revision. The revisions made were based upon the use of the program by a small group who placed responses to each frame on a frame answer sheet, were given the criterion test, and were interviewed.

Stage 4—Testing revision stage. A pilot group, composed of subjects of varying backgrounds similar to those to be tested in field testing, used the program and were tested.
Stage 1--Experts revision.

Subjects--The five experts included a choir director, a private studio voice teacher, a voice class instructor, and two educators with previous program construction and evaluation experience.

Procedures--The experts were asked to edit the program and to criticize the programming techniques, frame construction, and content accuracy.

Results--Corrections were made where the program did not present information accurately, with correct grammar, or in a logical and easily followed manner. The section in the program which concerned approaches that the student might confront was deleted because experts considered this information inappropriate for a text on the fundamentals of singing.

Stage 2--One-to-one student response revision.

Subjects--Eight college age students of average intelligence (based on college entrance tests and high school grade point average), with little formal exposure to voice training, and in attendance at two colleges and a university in the Midwest, including three freshmen college chorus members, three beginning voice class students, and two private voice students were used.

Procedures and results--Each frame was typed on a separate 8-1/2 x 5 1/2 sheet and was presented to a single student who had no formal training in voice. The student was asked to recite the answer for each frame to the programmer. Each frame was discussed to determine

179 Northwestern College, Iowa, Calvin College, Michigan, and Ohio State University.
how well it communicated, what changes could be made to improve it, and reasons for error when errors occurred. Each response and suggestion of the student was noted and revisions, additions, and deletions were made when appropriate. The revised unit was presented to another student and the same procedure was followed. This was done for each unit with four different students.

Following the fourth frame sequence revision, introductory instructions, overviews, outlines, and reviews were inserted and the fifth student was presented the entire program. Numerous alternative frame sequences and innovative programming devices were also introduced.

So that students would feel no pressure or fatigue, sittings were scheduled on Monday, Wednesday, and Friday of six successive weeks. The same was arranged for the sixth student beginning two weeks later so that revisions could be made. It was possible to eliminate many subterminal frames by adding typographical and subject cues and by supplying overviews and outlines. To get an indication of the appropriateness of the answers and the effectiveness of various answer lengths and types, students six and seven recited the answer but also read answers supplied. The use of longer, typographically cued answers also allowed considerable revision and abbreviation of the program.

The final revision including instructions, overviews, outlines, reviews, alternate branches, mathetic techniques, and answers was bound with plastic rings into six separate units. No tests were employed before, within, or after these program "run throughs."
Stage 3—Analysis revision

Subjects—The small group included eight students enrolled in a beginning voice class at a college in the Midwest. 180

Procedures—An eight member college voice class was presented the revised ring bound program and were asked to complete one unit per week. Each student was asked to write answers and possible revision comments for each frame on a numbered frame analysis sheet. A sample frame analysis sheet appears in Appendix F. Students were also asked to indicate what time it was when they came to each test frame. This made it possible to keep record of the amount of time required to complete frame sequences.

The criterion test was administered following completion of the program and students were interviewed to discuss frame and test items which showed high error rate or required excessive time to complete.

Results—Since the frame analysis sheet numbers corresponded to each frame of the program it was possible to not only analyze each frame but also to see patterns of error as well as changes in pace and progress through the program. Discussions concerning frames which did not communicate, did not teach well, or required excessive time to complete was a great aid in revising, abbreviating, and eliminating frames. Where the student had made a comment about a specific frame on the frame analysis sheet it was corrected or revised. These revised frames were presented to the student at this 180

Dordt College, Sioux Center, Iowa.
time so he could indicate if the problem was solved. Typical student comments received on the frame analysis sheets and in discussion is included in Appendix F.

Preparation for Stage 4—Prior to construction of the pre-test and post-test, an evaluation and revision of the criterion test was made. Evaluation of items on the criterion test revealed that twelve items of the two hundred and eighty item test were answered correctly by less than 60% of the students. These items and corresponding teaching frames were eliminated. Seven of these items had received a single N R (not relevant) mark by an expert in the initial editing of the test. One of the items which had previously been marked R S (relevant but needs restatement) was eliminated.

As an added measure of assuring test validity, the revised criterion test was again presented to experts for evaluation and critique. So that a thorough evaluation of the relationship of the test to the program could be made, six experts evaluated a different unit and unit test. Two experts evaluated the entire test and text. Two items were found to be answered by other items in the test. One item was a duplication and four other items were criticized as not fitting the frame sequences they were intended to test. Four of the items were eliminated and two items were revised to better test the teaching frames.

The pre-test and post-test constructed used all items of the revised criterion test. The post-test included the same items as
the pre-test but in randomized order. The tests appear in Appendixes G and H.

To aid in compiling data needed for testing, a student data sheet and computer data sheet were constructed. A sample of each appears in Appendices I and J.

An opinionnaire, designed to determine student attitude to the program, its length, and specific programming techniques, was constructed using a scaled answer technique. Included was a separate section for student data. The opinionnaire and data sheet appear in Appendix K.

Based on the analysis of criterion test items and data gathered from the frame analysis sheets, the discussions, the critique of experts, and responses on the criterion test, draft three was prepared. Since twenty criterion test items were eliminated, the corresponding frame sequences were taken from the program. Where possible, pertinent information from these frame sequences was included in other frames or in answers. Frame sequences which were found problematic, on the basis of the frame analysis sheets, were revised. Terminology or sentence structure which students pointed out as problematic in the discussions were also revised. Editing for grammatical and factual accuracy followed the suggestions of the experts who critiqued the program.

Stage 4--Testing revision stage.

Subjects--The pilot testing group was comprised of twelve students with varied background and ages including; two high school
choristers, two adult private students, two beginning voice class students, two advanced voice class students, two beginning private college students, and two advanced private college students. Students were taught by several private teachers or were enrolled in college voice classes or high school choruses in three colleges and two high schools located in the Midwest. Each pair was closely matched in age, sex, grade point average, and background experience. Subject data is presented in Table 1.

**Procedures**—Twelve subjects were administered the criterion pre-test and given the entire program. One of each of the pairs (subjects 1, 3, 5, 7, 9, and 11, self-paced Group A) were informed that they could complete the program at their own pace and should request to take the post-test as soon as possible after completion. They were asked to keep record of the time required to complete each unit.

The remaining six subjects (forced paced Group B) were requested to complete the program and were scheduled to take the post-test in three weeks. The opinionnaire and data sheet was distributed to all twelve subjects at the same time as the post test was administered. An hour was allowed for completion of the post-test and opinionnaire.
TABLE 1

MATCHED GROUPS: AGE, GRADE POINT AVERAGE GROUP, EXPERIENCE LEVEL, AND SEX OF SUBJECTS

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>Age</th>
<th>Cumulative grade point average</th>
<th>Experience level</th>
<th>Sex</th>
</tr>
</thead>
<tbody>
<tr>
<td>By Pairs</td>
<td></td>
<td>group</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S1</td>
<td>high school</td>
<td>3.5-4.0</td>
<td>beg. private</td>
<td>f</td>
</tr>
<tr>
<td>F1</td>
<td>high school</td>
<td>3.5-4.0</td>
<td>beg. private</td>
<td>f</td>
</tr>
<tr>
<td>S2</td>
<td>adult</td>
<td>3.0-3.5</td>
<td>beg. private</td>
<td>f</td>
</tr>
<tr>
<td>F2</td>
<td>adult</td>
<td>3.0-3.5</td>
<td>beg. private</td>
<td>f</td>
</tr>
<tr>
<td>S3</td>
<td>sophomore</td>
<td>2.5-3.0</td>
<td>voice class</td>
<td>m</td>
</tr>
<tr>
<td>F3</td>
<td>sophomore</td>
<td>2.5-3.0</td>
<td>voice class</td>
<td>m</td>
</tr>
<tr>
<td>S4</td>
<td>junior</td>
<td>3.0-3.5</td>
<td>voice class</td>
<td>m</td>
</tr>
<tr>
<td>F4</td>
<td>junior</td>
<td>3.0-3.5</td>
<td>voice class</td>
<td>m</td>
</tr>
<tr>
<td>S5</td>
<td>junior</td>
<td>3.5-4.0</td>
<td>adv. private</td>
<td>f</td>
</tr>
<tr>
<td>F5</td>
<td>junior</td>
<td>3.5-4.0</td>
<td>adv. private</td>
<td>f</td>
</tr>
<tr>
<td>S6</td>
<td>senior</td>
<td>3.5-4.0</td>
<td>adv. private</td>
<td>m</td>
</tr>
<tr>
<td>F6</td>
<td>senior</td>
<td>3.5-4.0</td>
<td>adv. private</td>
<td>m</td>
</tr>
</tbody>
</table>

*S1=Subject 1 of Self-paced group  
F1=Subject 1 of Forced-paced group

Tests were scored and results analyzed to determine the effectiveness of each unit, the effectiveness of the entire program, and the effect of pacing mode. The results of the computation of the mean percentage correct on each unit and the percent of increase from pre-test to post-test was consulted as a measure of the effectiveness of the program. To determine if there was a significant difference between the groups on the pre-test and post-test, the mean and standard deviations were computated and the t test for independent samples was applied.

Results of this pilot testing were not intended to represent
the results of this study but only as another device to evaluate the
program and supply information for the fourth revision of the program
and for revisions of the test. The data is therefore presented here
rather than in the results section of this document.

**Results of Pilot Testing**—The computation of the percentage of
correct answers on the pre-test and post-test indicated that the
self-paced beginning private subjects gave correct answers to 19% of
the pre-test and 92% of the post-test; while the forced-paced
beginning answered 18% and 91%.

The computation of the percentage of correct answers on the pre-
test and post-test indicated that the self-paced adult beginning
private gave correct answers to 20% of the pre-test and 95% of the
post-test; while the forced-paced adult answered also 20% and 95%.

The computation of the percentage of correct answers on the pre-
test and post-test indicated that the self-paced sophomore voice
class gave correct answers to 23% of the pre-test and 90% of the
post-test; while the forced-paced voice class answered 23% and 95%.

The computation of the percentage of correct answers on the pre-
test and post-test indicated that the self-paced junior voice class
gave correct answers to 26% of the pre-test and 93% of the post-
test; while the forced-paced junior voice class answered 26% and 92%.

The computation of the percentage of correct answers on the pre-
test and post-test indicated that the junior private subjects
gave correct answers to 28% of the pre-test and 96% of the post-test;
while the forced-paced private answered 28% and 95%.

The computation of the percentage of correct answers on the
pre-test and post-test indicated that the self-paced senior private
advanced subjects gave correct answers to 27% of the pre-test and
98% of the post-test; while the forced-paced advanced answered 28%
and 98%.

While there was little difference in the percentage of correct
answers between the self and forced paced subjects, there was a
slight but noticeable difference between the percentage answered
correctly on the pre-test by beginning students as opposed to the
percentage answered correctly by advanced students. This was also
true, but to a lesser degree, on the post-test.

The percentage correct for each subject on the pre-test and post-
test of each unit is presented in Table 2.

Results: Percentage Increase--Computation of the difference
between the percentage of correct pre-test answers with the percentage
of post-test answers revealed that all subjects showed a total
increase in correct answers of between 67% and 74%. There was very
little difference between the percentage gains of the forced-paced
as opposed to the self-paced subjects. The percentage of increase
on the total tests was nearly the same irrespective of age or back-
ground experience.

The results of the computation of the percentage of increase
for each subject on each unit and the total test are presented
in Table 3.
TABLE 2

EFFECTIVENESS OF PROGRAM: PERCENT CORRECT
ON ALL SIX UNITS

<table>
<thead>
<tr>
<th>Unit</th>
<th>Self-paced group</th>
<th>Force-paced group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Subject</td>
<td>Subject</td>
</tr>
<tr>
<td></td>
<td>S1   S2   S3   S4</td>
<td>F1   F2   F3   F4</td>
</tr>
<tr>
<td>I</td>
<td>pre  14%  14%  20%  31%  20%  20%</td>
<td>post 100% 100% 97% 100% 100% 100%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>pre  25%  35%  22%  32%  42%  37%</td>
<td>post 100% 95% 90% 95% 100% 100%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>pre  12%  10%  20%  16%  29%  29%</td>
<td>post 100% 98% 81% 98% 100% 96%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>pre  35%  20%  36%  48%  36%  40%</td>
<td>post 96% 96% 92% 92% 100% 100%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>pre  17%  13%  17%  8%  15%  8%</td>
<td>post 66% 86% 88% 75% 82% 91%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VI</td>
<td>pre  20%  32%  28%  32%  32%  36%</td>
<td>post 90% 96% 96% 100% 96% 100%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>pre  19%  20%  23%  26%  28%  27%</td>
<td>post 92% 95% 90% 93% 96% 98%</td>
</tr>
</tbody>
</table>

*S1=Subject 1 of Self-paced group
F1=Subject 1 of Forced-paced group
### TABLE 3

**EFFECTIVENESS OF PROGRAM: PERCENT INCREASE PRE-TEST TO POST-TEST ON EACH UNIT**

<table>
<thead>
<tr>
<th></th>
<th>Beginning private</th>
<th>Voice class</th>
<th>Advanced private</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>high</td>
<td>adult</td>
<td>soph</td>
</tr>
<tr>
<td>S1 F1</td>
<td>86% 89%</td>
<td>86% 63%</td>
<td>77% 78%</td>
</tr>
<tr>
<td>S2 F2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S3 F3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S4 F4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S5 F5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S6 F6</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Unit I**: 86% 89% 86% 63% 77% 78% 69% 92% 80% 78% 83% 69%
- **Unit II**: 75% 65% 60% 68% 78% 78% 63% 37% 58% 58% 63% 58%
- **Unit III**: 88% 64% 78% 81% 61% 78% 82% 84% 71% 63% 67% 62%
- **Unit IV**: 60% 76% 76% 72% 56% 52% 44% 68% 64% 60% 60% 68%
- **Unit V**: 49% 68% 73% 77% 71% 75% 67% 62% 67% 77% 83% 87%
- **Unit VI**: 70% 76% 64% 80% 68% 66% 68% 52% 64% 64% 66% 76%
- **Total**: 72% 73% 75% 74% 67% 72% 67% 66% 68% 67% 71% 70%

**Results:** Unit Effectiveness—Computation of the mean percentage correct revealed that there was little difference between the pre-test scores of the self-paced and forced-paced groups on all units, or the post-test scores of the two groups on Units I, II, IV, and VI. While 96% of the Unit III post-test items were answered correctly by the self-paced group, 90% were answered correctly by the forced-paced
group. Conversely 81% of the items were answered correctly on the
Unit V post-test by the self-paced group while 89% were answered
correctly by the forced-paced group. Lowest pre-test percentage
scores were recorded by both groups on Units III and V (19% and 13%).
Post-test scores on all units except Unit V were above 90%. On the
Unit V post-test the self-paced group answered 81% correctly and 89%
were answered correctly by the forced-paced group.

Percentage of increase computations revealed that the forced-
paced group had slightly larger gains on all units except units II
and III. The total percentage increase was largest for Unit I (81%).
The 63% increases for Units II and IV were the smallest pre-test to
post-test gains.

Mean percentages correct and mean percentage of increase for
both groups on all units is presented in Table 4.

Results: Differences between Groups—There was no significant
difference between the pre-test mean scores, the post-test mean scores,
or the mean gains of each group. The results of the computation of
the mean scores are presented in Table 5.

Reactions of Subjects—All of the forced-paced and four of the
self-paced subjects found the program a highly motivating, enjoyable
and effective way to learn. One beginner and one advanced private
subject of the self-paced group found the program a motivating, en-
joyable and effective complement to other learning. Units I and VI
were most preferred by five subjects each and Unit III was preferred
by two subjects. Eight subjects least preferred Unit V, three least
liked Unit III, and three least preferred Unit II.
TABLE 4
EFFECTIVENESS OF EACH UNIT:
MEAN PERCENT CORRECT AND MEAN PERCENT INCREASE

<table>
<thead>
<tr>
<th></th>
<th>Self-paced group</th>
<th>Forced-paced group</th>
<th>Total group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mean percent</td>
<td>mean percent</td>
<td>mean percent</td>
</tr>
<tr>
<td></td>
<td>correct increase</td>
<td>correct increase</td>
<td>correct increase</td>
</tr>
<tr>
<td>Unit I</td>
<td>80%</td>
<td>82%</td>
<td>81%</td>
</tr>
<tr>
<td></td>
<td>pre 20%</td>
<td>20%</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td>post 99%</td>
<td>97%</td>
<td>98%</td>
</tr>
<tr>
<td>Unit II</td>
<td>66%</td>
<td>60%</td>
<td>63%</td>
</tr>
<tr>
<td></td>
<td>pre 32%</td>
<td>36%</td>
<td>34%</td>
</tr>
<tr>
<td></td>
<td>post 97%</td>
<td>96%</td>
<td>96%</td>
</tr>
<tr>
<td>Unit III</td>
<td>75%</td>
<td>72%</td>
<td>73%</td>
</tr>
<tr>
<td></td>
<td>pre 19%</td>
<td>18%</td>
<td>19%</td>
</tr>
<tr>
<td></td>
<td>post 96%</td>
<td>99%</td>
<td>93%</td>
</tr>
<tr>
<td>Unit IV</td>
<td>60%</td>
<td>66%</td>
<td>63%</td>
</tr>
<tr>
<td></td>
<td>pre 36%</td>
<td>31%</td>
<td>33%</td>
</tr>
<tr>
<td></td>
<td>post 96%</td>
<td>97%</td>
<td>96%</td>
</tr>
<tr>
<td>Unit V</td>
<td>68%</td>
<td>74%</td>
<td>71%</td>
</tr>
<tr>
<td></td>
<td>pre 13%</td>
<td>12%</td>
<td>12%</td>
</tr>
<tr>
<td></td>
<td>post 81%</td>
<td>89%</td>
<td>85%</td>
</tr>
<tr>
<td>Unit VI</td>
<td>67%</td>
<td>69%</td>
<td>68%</td>
</tr>
<tr>
<td></td>
<td>pre 30%</td>
<td>29%</td>
<td>30%</td>
</tr>
<tr>
<td></td>
<td>post 96%</td>
<td>97%</td>
<td>97%</td>
</tr>
</tbody>
</table>
TABLE 5
COMPARISON OF FORCED-PACED GROUP AND SELF-PACED GROUP
ON PRE-TEST AND POST-TEST

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Pre-test Mean</th>
<th>Post-test Mean</th>
<th>Mean Gain</th>
<th>Standard Dev.</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forced-paced</td>
<td>6</td>
<td>60.53</td>
<td>70.33</td>
<td>9.22</td>
<td>6.04</td>
<td>.00</td>
<td>ns</td>
</tr>
<tr>
<td>Self-paced</td>
<td>6</td>
<td>60.83</td>
<td>69.93</td>
<td>8.51</td>
<td>6.18</td>
<td>.25</td>
<td>ns</td>
</tr>
</tbody>
</table>

Comments and suggestions revealed that when Unit II and III were least preferred it was because more illustrations were needed. Unit V was least preferred because it was overly detailed and complex. Students liked review tests but thought a review at the end of Unit VI was unnecessary.

Tabulations of the reactions of subjects is presented in Table 6.

Time to Complete the Program—All six of the self-paced group and five of the forced paced group indicated that 12-16 hours was required to complete the program. One of the forced-paced group spent less than 12 hours completing the program.

Interpretation of Results—Results were interpreted only as indicators for needed revision rather than as patterns from which to draw inferences. The results were very helpful in giving direction to the revisions and preparation of draft four and the final revision of the pre-test and post-test.

Younger less experienced subjects answered fewer pre-test items correctly (18%) than did advanced subjects, indicating that the pre-
# Table 6

Reactions of Pilot Group Subjects to Programed Materials

<table>
<thead>
<tr>
<th>Questions and Subject Responses</th>
<th>Forced-paced Group</th>
<th>Self-paced Group</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Attitude statements</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. extremely positive</td>
<td>4</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>2. positive</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>3. neutral</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4. negative</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5. extremely negative</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

| **B. Preferred technique (Unit)** |                    |                 |       |
| 1. small step linear (I)        | 2                  | 3               | 5     |
| 2. modified linear (II)         | 0                  | 0               | 0     |
| 3. linearized branching (III)   | 1                  | 1               | 2     |
| 4. large step linear (IV)       | 0                  | 0               | 0     |
| 5. eclectic (V)                 | 0                  | 0               | 0     |
| 6. mathetic (VI)                | 3                  | 2               | 5     |

| **C. Least preferred technique** |                    |                 |       |
| 1. small step linear (I)        | 0                  | 0               | 0     |
| 2. modified linear (II)         | 2                  | 1               | 3     |
| 3. linearized branching (III)   | 1                  | 0               | 1     |
| 4. large step linear (IV)       | 0                  | 0               | 0     |
| 5. eclectic (V)                 | 3                  | 5               | 8     |
| 6. mathetic (VI)                | 0                  | 0               | 0     |

Forced-paced group N = 6
Self-paced group N = 6
Total pilot group N = 12

*The questionnaire used for obtaining this data appears in Appendix J.*
test seemed to differentiate between ability levels. Post-test percentages seemed to indicate that the program brought subjects toward a more uniform level of achievement because the mean percentage for beginners on the post-test was 93% and that of advanced subjects was 97%. Percentage of increase for beginners was therefore, understandably higher (74%) than that for advanced subjects (69%).

The calculation of both percentage correct and percentage of increase showed that all subjects learned as a result of the program. Some units were, however, less effective than others. While percentage of increase was similar, both the pre-test and post-test percentage correct for all subjects on Unit V was considerably lower than for other units. Unit III pre-test scores were low but the post-test scores and percentage of increase were high. The fact that the subject matter of both Units III and V was more complex and detailed may account for low pre-test scores but lower post-test scores on Unit V indicated that it was the least effective unit.

There was little difference between the self-paced and forced-paced groups as measured by pre-test scores, post-test scores, or percentage of gain.

All but one subject spent 12-16 hours to complete the program. The single subject who spent less than 12 hours to complete the program answered considerably fewer items on both the pre-test and post-test than did the other subjects. His percentage of increase was, however, comparable. This would seem to indicate that time spent on the program could affect final achievement level.
Program revisions: Preparation of Draft Four—Because the program was somewhat less effective with beginners and younger students, several revisions were made to simplify language and to make explanations clearer. Unit I was left unchanged. Numerous illustrations and X-R (experiment-respond) sequences were added to Unit II, since both were recommended by most students.

Since there was consistent error by all subjects on several items of the Unit III post-test, the frame sequences for these items were revised and more illustrations were added. Unit IV was slightly abbreviated since pre-test answers indicated that some of the information was already known by many of the subjects.

Unit V received an extensive revision since it was the least effective and least preferred. While some frame sequences which had especially large steps were lengthened, several entire sequences were eliminated along with corresponding test frames. The last section which gave an explanation of the physiological aspects of correct register adjustment were eliminated. These items were most frequently missed on the post-test and were thought to be "too complex" or "too detailed" by many of the pilot group.

In Unit VI the extensive section which reviewed concepts from previous chapters which related to resonance and diction was replaced with more information concerning basic rules of resonance. And the final review at the end of the unit was deleted.

All frames which corresponded to post-test items which showed consistent error were evaluated and revised. When over 40% of the subjects answered a pre-test item correctly, the test item was con-
sidered non-discriminating and the corresponding frame sequences were either eliminated or replaced with another frame sequence and test item. Findings of this testing and the opinionnaire not only supplied additional information for the third complete revision but indicated that the program could profitably be field tested with subjects with varied backgrounds using either forced or self pacing.

Sample pages of the final version of the program are presented in appendix E.

Test Revision—Six items were revised so that a more specific answer was required and ten items (three questions) were eliminated from the pre-test and post-test. The items which were revised are given asterisks in the tests included in Appendixes G and H, pages 166 to 194. Items eliminated are found in Appendix H, page 194. As a result of program deletion and item evaluation the final post-test included the same two hundred and fifty items as the pre-test but in randomized order.

Program Evaluation

Field Testing

Subjects—The forty-eight subjects used for final testing of the program were in four groups including:

Group A—Twelve beginning private non-college students including three junior high school students, six high school students, and three adults studying private voice for the first time.
Group B—Twelve voice class students including sophomores and juniors enrolled in several small midwestern colleges.

Group C—Twelve voice class students including sophomores and juniors enrolled in several small midwestern colleges.

Group D—Twelve private college age voice students in advanced stages of vocal training who were studying singing at three colleges in Iowa.

Subject Assignment Procedures—The first twelve beginning students who signed up at two Iowa colleges for special summer voice training for non-college students were selected for Group A. The first twelve students to sign up for intermediate voice class at three midwest colleges were selected to comprise Group C. And the first twelve advanced students who signed up to study privately were selected for Group D. Group B was assigned later. Since this group could be selected from a larger population of students who were enrolled in voice classes in several midwest colleges, subjects for Group B were selected if they matched subjects in Group C in class in college, cumulative grade point average, amount of previous study, and sex. The subjects of Group B were drawn from a group of 21 students who took the pre-test and answered the questionnaire and data sheet.

Treatment and Testing Procedures—The twelve beginning private non-college students (Group A), the twelve college voice class students
(Group C), and the twelve advanced college private students (Group D) were administered the pre-test during the second week of a fifteen week school term. Following completion of the pre-test they were given the programed textbook and requested to complete the program at their own pace. They were asked to return the textbook one week prior to the week scheduled for course examinations.

Subjects in Group B were also given the pre-test and the textbook during the second week of the term, but were requested to complete and return the textbook within three weeks. One week following completion of the program all of the groups were allowed two hours in which to complete the post-test and to fill in an opinionnaire concerning their attitude toward the program.  

Although students continued class or studio study, all work on the program, except testing, was carried on independently outside of class. Class and studio teachers agreed to emphasize repertoire development, language studies interpretation, and styles rather than factual information regarding voice production until after the program was completed.

Procedures for Gathering and Evaluating Results—The pre-tests and post-tests were scored and the test scores, student data sheets, and opinionnaire responses were key punched on to computer cards. The data obtained from the pre-test and post-test scores were analyzed by computing the percentage of correct items, percentage of increase from pre-test to post-test, mean scores, mean gains, range, and standard deviations.

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181 See Appendix K.
The significance of the differences between pre-test and post-test scores on each unit and the entire test was tested by applying the t test for small groups.

To measure the differences between the three experience level groups (Group A, C, and D), a comparison of the pre-test mean scores and a comparison of the post-test mean scores was made using a one-way analysis of variance and applying the F and t tests. This was done by comparing the mean scores of Group A with that of Group C, those of Group A with Group D, and those of Group C with Group D.

To test for significant variance between the three experience level groups, between the pre-test and post-test mean scores, and interaction between the groups and test scores, a two-way analysis of variance was employed and the F test of significance applied. The three experience level groups (A, C, and D) and the pre-test and post-test scores were used in the three by two mixed design.

To measure the difference between the mean scores of the forced-paced voice class (Group B) and the self-paced voice class (Group C) a t test was employed.

Responses to the opinionnaire regarding attitude and time required to complete the program were tabulated and are presented with other results in the following chapter.
CHAPTER IV

RESULTS

Introduction

This chapter presents the results of the fourth revision of the programmed textbook on the fundamentals of voice production in singing. Data was derived from tests, opinionnaires, questionnaires, and the program itself. Results of the questions and hypotheses are presented in the following sections: Effectiveness, Pre-test and Post-test Differences, Differences between Groups, Differences between Pacing Modes, Reactions of Students, and Time for Completion.

Effectiveness

The effectiveness of the program and the program techniques employed in the six units was determined by computing the percent of students who answered a certain percentage of the items correctly on the post-test and by computing the percent of increase in correct answers from the pre-test to the post-test.

Unit I (Small Step Linear): Percent Correct

Post-test percentage scores of the four groups revealed that 92% of the beginning private subjects answered 96% of the items correctly; 92% of voice class I answered 94% of the items correctly; 92% of voice
class II answered 90% of the items correctly; and 92% of the advanced private subjects answered 91% correctly.

It will be seen that 91% of the items on the Introduction to Singing (Unit I) were answered by 67% of the beginning private students; by 100% of voice class I students; by 92% of voice class II students; and by 100% of the advanced private students.

In the total group, 90% of the subjects answered 91% of the post-test items correctly and correct answers for 91% of the items were supplied by 90% of the subjects.

Subject and item percentages for Unit I are presented in Table 7.

**TABLE 7**

**EFFECTIVENESS OF THE PROGRAM, 90/90 CRITERION:**
**POST-TEST SCORES, UNIT I—35 ITEMS**

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Percent of Subjects</th>
<th>Number of Subjects</th>
<th>Percent of Items</th>
<th>Number of Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>A—Beginning</td>
<td>12</td>
<td>92%*</td>
<td>11</td>
<td>86%*</td>
<td>30</td>
</tr>
<tr>
<td>Private</td>
<td></td>
<td>67</td>
<td>8</td>
<td>91%*</td>
<td>32</td>
</tr>
<tr>
<td>B—Voice</td>
<td>12</td>
<td>92%*</td>
<td>11</td>
<td>94</td>
<td>33</td>
</tr>
<tr>
<td>Class I</td>
<td></td>
<td>100</td>
<td>12</td>
<td>91%*</td>
<td>32</td>
</tr>
<tr>
<td>C—Voice</td>
<td>12</td>
<td>92%*</td>
<td>11</td>
<td>90</td>
<td>32</td>
</tr>
<tr>
<td>Class II</td>
<td></td>
<td>92</td>
<td>11</td>
<td>91%*</td>
<td>32</td>
</tr>
<tr>
<td>D—Advanced</td>
<td>12</td>
<td>92%*</td>
<td>11</td>
<td>91</td>
<td>32</td>
</tr>
<tr>
<td>Private</td>
<td></td>
<td>100</td>
<td>12</td>
<td>91%*</td>
<td>32</td>
</tr>
<tr>
<td>(Combined Groups)</td>
<td>48</td>
<td>90%</td>
<td>43</td>
<td>91</td>
<td>32</td>
</tr>
</tbody>
</table>

*92% is reported because 11 of 12 students is 92% and 91% is reported because 32 correct out of 35 is 91% correct.*
Unit II (Modified Linear): Percent Correct

Unit II post-test percentage scores showed that 92% of the beginning private students made correct responses to 73% of the items; 92% of voice class I responded correctly to 85% of the items; 92% of voice class II made correct responses on 90% of the items; and 92% of the advanced private students responded correctly to 95% of the items.

Of the forty item post-test 90% of the items were answered correctly by 50% of the beginning private students; by 83% of voice class I; by 100% of voice class II; and by 92% of the advanced private students.

The combined group total revealed that 90% of the subjects answered 85% of the items correctly and 90% of the items were answered correctly by 91% of the subjects.

The percentages for subjects and items on Unit II are presented in Table 8.

Unit III (Linearized Branching): Percent Correct

The computation of post-test percentage scores for Unit III indicated that 92% of the beginning private students answered 65% of the items correctly; 92% of voice class I answered 75% of the items correctly; 92% of voice class II gave correct answers on 80% of the items; and 92% of the advanced private group answered 93% of the items correctly.

The computation of post-test percentage scores indicated that 91% of the items were answered correctly by 25% of the beginning private subjects; 42% of voice class I and II; and 92% of the advanced private
TABLE 8
EFFECTIVENESS OF THE PROGRAM, 90/90 CRITERION:
POST-TEST SCORES, UNIT II—40 ITEMS

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Percent of Subjects</th>
<th>Number of Subjects</th>
<th>Percent of Items</th>
<th>Number of Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>A—Beginning</td>
<td>12</td>
<td>92%*</td>
<td>11</td>
<td>73</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50</td>
<td>6</td>
<td>90%</td>
<td>36</td>
</tr>
<tr>
<td>B—Voice</td>
<td>12</td>
<td>92%*</td>
<td>11</td>
<td>85</td>
<td>34</td>
</tr>
<tr>
<td>Class I</td>
<td></td>
<td>83</td>
<td>10</td>
<td>90%</td>
<td>36</td>
</tr>
<tr>
<td>C—Voice</td>
<td>12</td>
<td>92%*</td>
<td>11</td>
<td>90</td>
<td>36</td>
</tr>
<tr>
<td>Class II</td>
<td></td>
<td>100</td>
<td>12</td>
<td>90%</td>
<td>36</td>
</tr>
<tr>
<td>D—Advanced</td>
<td>12</td>
<td>92%*</td>
<td>11</td>
<td>95</td>
<td>38</td>
</tr>
<tr>
<td></td>
<td></td>
<td>92</td>
<td>11</td>
<td>90%</td>
<td>36</td>
</tr>
<tr>
<td>(Combined</td>
<td>48</td>
<td>90%</td>
<td>43</td>
<td>85</td>
<td>34</td>
</tr>
<tr>
<td>Groups)</td>
<td></td>
<td>91</td>
<td>39</td>
<td>90%</td>
<td>36</td>
</tr>
</tbody>
</table>

*92% is reported because 11 of 12 students is 92%.

Subjects.

Percentages for the total group indicated that 90% of the subjects gave correct responses to 75% of the items on the post-test and 91% of the items were answered correctly by 65% of the subjects.

The percentages for subjects and items on Unit III are presented in Table 9.

Unit IV (Large Step Linear): Percent Correct

The computation of percentage scores for all four groups on Unit IV showed that 92% of the beginning group answered 88% of the items correctly; 92% of voice class answered 84% of the items
TABLE 9
EFFECTIVENESS OF THE PROGRAM, 90/90 CRITERION:
POST-TEST SCORES, UNIT III—55 ITEMS

| Group       | N | Subjects | | | Items Answered Correctly |
|-------------|---|----------|----------------|--------------------------|
|             |   | Percent of | Number of | Percent of | Number of |
|             |   | Subjects   | Subjects  | Items      | Items     |
| A—Beginning | 12| 92%*      | 11        | 65         | 36        |
| Private     | 12| 25        | 3         | 91%*       | 50        |
| B—Voice     | 12| 92%*      | 11        | 75         | 41        |
| Class I     | 12| 42        | 5         | 91%*       | 50        |
| C—Voice     | 12| 92%*      | 11        | 80         | 44        |
| Class II    | 12| 42        | 5         | 91%*       | 50        |
| D—Advanced  | 12| 92%*      | 11        | 93         | 51        |
| Private     | 12| 92        | 11        | 91%*       | 50        |
| (Combined Groups) | 48| 90%       | 43        | 75         | 41        |

*92% is reported because 11 of 12 students is 92% and 91% is reported because 50 correct out of 55 is 91% correct.

Correctly; 92% of voice class II answered 80% of the items correctly; and 92% of the advanced private group answered 88% of the items correctly.

It can be seen that 92% of the items were answered correctly by 83% of all four groups.

In the total group, 90% of the subjects answered 88% of the items correctly and 92% of the items were answered correctly by 83% of the subjects.

Subject and item percentages for Unit IV are presented in Table 10.
TABLE 10
EFFECTIVENESS OF THE PROGRAM, 90/90 CRITERION:
POST-TEST SCORES, UNIT IV—25 ITEMS

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Percent Subjects</th>
<th>Number Subjects</th>
<th>Percent Items</th>
<th>Number Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>A—Beginning</td>
<td></td>
<td>92%*</td>
<td>11</td>
<td>88</td>
<td>22</td>
</tr>
<tr>
<td>Private</td>
<td>12</td>
<td>83</td>
<td>10</td>
<td>92%*</td>
<td>23</td>
</tr>
<tr>
<td>B—Voice</td>
<td></td>
<td>92%*</td>
<td>11</td>
<td>84</td>
<td>21</td>
</tr>
<tr>
<td>Class I</td>
<td>12</td>
<td>83</td>
<td>10</td>
<td>92%*</td>
<td>23</td>
</tr>
<tr>
<td>C—Voice</td>
<td></td>
<td>92%*</td>
<td>11</td>
<td>80</td>
<td>20</td>
</tr>
<tr>
<td>Class II</td>
<td>12</td>
<td>83</td>
<td>10</td>
<td>92%*</td>
<td>23</td>
</tr>
<tr>
<td>D—Advanced</td>
<td></td>
<td>92%*</td>
<td>11</td>
<td>88</td>
<td>22</td>
</tr>
<tr>
<td>Private</td>
<td>12</td>
<td>83</td>
<td>10</td>
<td>92%*</td>
<td>23</td>
</tr>
<tr>
<td>(Combined Groups)</td>
<td>48</td>
<td>90%</td>
<td>43</td>
<td>88</td>
<td>22</td>
</tr>
</tbody>
</table>

*92% is reported because 11 of 12 students is 92% and 92% is reported because 23 correct out of 25 is 92% correct.

Unit V (Eclectic): Percent Correct

Unit V post-test percentage scores showed that 92% of the beginning private students made correct responses on 67% of the items; 92% of voice class I responded correctly to 78% of the items; 92% of voice class II made correct responses on 71% of the items; and 92% of the advanced private students responded correctly to 80% of the items.

On the forty item post-test no beginning private student answered 91% of the items. The two voice classes and the advanced private
students answered 91% of the items 25% of the time.

Percentage totals for the combined groups showed that 90% of the students answered 69% of the items correctly and 91% of the items were answered correctly by 19% of the students.

The percentages and items on Unit V are presented in Table 11.

TABLE 11
EFFECTIVENESS OF THE PROGRAM, 90/90 CRITERION:
POST-TEST SCORES, UNIT V--45 ITEMS

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Percent of Subjects</th>
<th>Number of Subjects</th>
<th>Percent of Items</th>
<th>Number of Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>A—Beginning</td>
<td>12</td>
<td>92%*</td>
<td>11</td>
<td>67</td>
<td>30</td>
</tr>
<tr>
<td>Private</td>
<td>12</td>
<td>0</td>
<td>0</td>
<td>91%*</td>
<td>41</td>
</tr>
<tr>
<td>B—Voice</td>
<td>12</td>
<td>92%*</td>
<td>11</td>
<td>78</td>
<td>35</td>
</tr>
<tr>
<td>Class I</td>
<td>12</td>
<td>91%*</td>
<td>3</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>C—Voice</td>
<td>12</td>
<td>92%*</td>
<td>11</td>
<td>71</td>
<td>32</td>
</tr>
<tr>
<td>Class II</td>
<td>12</td>
<td>91%*</td>
<td>3</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>D—Advanced</td>
<td>12</td>
<td>92%*</td>
<td>11</td>
<td>80</td>
<td>36</td>
</tr>
<tr>
<td>Private</td>
<td>12</td>
<td>91%*</td>
<td>3</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>(Combined</td>
<td>48</td>
<td>90%</td>
<td>43</td>
<td>69</td>
<td>31</td>
</tr>
<tr>
<td>Groups)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*92% is reported because 11 of 12 students is 92% and 91% is reported because 41 correct out of 45 is 91% correct.

Unit VI (Mathetic): Percent Correct

The computation of post-test percentage scores for Unit VI indicated that 92% of the beginning private students answered 80 of
the items correctly; 92% of voice class I answered 84% of the items correctly; 92% of voice class II gave correct answers on 84% of the items; and 92% of the advanced private group answered 92% of the items correctly.

The computation of post-test percentage scores indicated that 90% of the items were answered correctly by 50% of the beginning private subjects; 75% of voice class I; 83% of voice class II; and 100% of the advanced private subjects.

Percentages for the total group indicated that 90% of the subjects gave correct responses to 84% of the items on the post-test and 90% of the items were answered correctly by 79% of the subjects.

The percentages for subjects and items on Unit Vi are presented in Table 12.

**Total Test: Percent Correct**

The computation of the percentage scores obtained on the post-test by all four groups indicated that 92% of the beginning private subjects answered 79% of the items correctly; 92% of the subjects in voice class I answered 86% of the items correctly; 92% of the voice class II subjects answered 85% of the items correctly; and 92% of the advanced private subjects answered 93% correctly.

It can be seen that 90% of the items were answered correctly by 17% of the beginning private subjects; 58% of voice class I and II; and 100% of the advanced private subjects.

The computation of the combined group total of the entire post-test indicated that 90% of the subjects answered 82% of the items correctly and 90% of the items were answered correctly by 58% of the
TABLE 12
EFFECTIVENESS OF THE PROGRAM, 90/90 CRITERION:
POST-TEST SCORES, UNIT VI—50 ITEMS

<table>
<thead>
<tr>
<th>Group</th>
<th>Subjects</th>
<th>Items Answered Correctly</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Percent of Subjects</td>
<td>Number of Subjects</td>
</tr>
<tr>
<td>A—Beginning</td>
<td>92%*</td>
<td>11</td>
</tr>
<tr>
<td>Private</td>
<td>50%</td>
<td>6</td>
</tr>
<tr>
<td>B—Voice</td>
<td>92%*</td>
<td>11</td>
</tr>
<tr>
<td>Class I</td>
<td>75%</td>
<td>9</td>
</tr>
<tr>
<td>C—Voice</td>
<td>92%*</td>
<td>11</td>
</tr>
<tr>
<td>Class II</td>
<td>83%</td>
<td>11</td>
</tr>
<tr>
<td>D—Advanced</td>
<td>92%*</td>
<td>11</td>
</tr>
<tr>
<td>Private</td>
<td>100%</td>
<td>12</td>
</tr>
<tr>
<td>(Combined Groups)</td>
<td>90%</td>
<td>43</td>
</tr>
</tbody>
</table>

*92% is presented instead of 90% because 11 of 12 students is 92%. subjects.

The percentages for the four groups on the two hundred fifty item post-test are presented in Table 13.

Pre-test and Post-test: Mean Scores and Percent Correct

The computation of the pre-test mean scores and the mean percentages correct revealed that the beginning private subjects (Group A) gave correct answers for 42 of the 250 possible items or 17%; voice class I (Group B) answered 61 items or 24% correctly; voice class II (Group C) answered 61 items or 24% correctly; and the advanced private subjects (Group D) answered 74 items or 30% correctly.
TABLE 13
EFFECTIVENESS OF THE PROGRAM, 90/90 CRITERION POST-TEST SCORES, TOTAL—250 ITEMS

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Percent of Subjects</th>
<th>Number of Subjects</th>
<th>Percent of Items</th>
<th>Number of Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>A—Beginning</td>
<td>11</td>
<td>92%*</td>
<td>11</td>
<td>79%</td>
<td>198</td>
</tr>
<tr>
<td>Private</td>
<td>12</td>
<td>17%</td>
<td>2</td>
<td>90%</td>
<td>225</td>
</tr>
<tr>
<td>B—Voice</td>
<td>11</td>
<td>92%*</td>
<td>11</td>
<td>86%</td>
<td>215</td>
</tr>
<tr>
<td>Class I</td>
<td>12</td>
<td>58%</td>
<td>7</td>
<td>90%</td>
<td>225</td>
</tr>
<tr>
<td>C—Voice</td>
<td>11</td>
<td>92%*</td>
<td>11</td>
<td>85%</td>
<td>212</td>
</tr>
<tr>
<td>Class II</td>
<td>12</td>
<td>58%</td>
<td>7</td>
<td>90%</td>
<td>225</td>
</tr>
<tr>
<td>D—Advanced</td>
<td>12</td>
<td>92%*</td>
<td>11</td>
<td>93%</td>
<td>232</td>
</tr>
<tr>
<td>Private</td>
<td>12</td>
<td>100%</td>
<td>12</td>
<td>90%</td>
<td>225</td>
</tr>
<tr>
<td>(Combined</td>
<td>48</td>
<td>90%*</td>
<td>43</td>
<td>82%</td>
<td>206</td>
</tr>
<tr>
<td>Groups)</td>
<td></td>
<td>58%</td>
<td>28</td>
<td>90%</td>
<td>225</td>
</tr>
</tbody>
</table>

*92% is presented instead of 90% because 11 of 12 students is 92%.

The computation of the post-test mean scores and mean percentage correct indicated that 212 or 85% of the items were answered correctly by Group A; 227 or 91% by Group B; 228 or 91% by Group C; and 239 or 96% of the items were answered correctly by Group D.

Pre-test mean scores and the mean percentages correct for the total group indicated that 17% of the items were answered correctly on Unit I; 38% on Unit II; 19% on Unit III; 36% on Unit IV; 13% on Unit V; 26% on Unit VI; and 59 or 24% of the 250 items were answered correctly on the entire test.

Post-test mean scores and the mean percentage correct for the
total group indicated that 34 or 96% of the items were answered correctly on Unit I; 95% on Unit II; 87% on Unit III; 96% on Unit IV; 82% on Unit V; 92% on Unit VI; and 220 items or 91% of the 250 items were answered correctly on the entire test.

The mean scores and mean percentage correct for the four groups on each unit are presented in Table 14.

**Unit I: Percent of Increase**

Computation of the difference between the percent of correct answers on the pre-test and the percent of correct answers on the post-test reveals that the beginning private group scores increased by 80%; the voice class I scores increased by 77%; the voice class II scores increased by 80%; and the advanced private group scores increased by 77%. There was a 79% mean increase for the combined groups.

The percent of increase from the pre-test to the post-test is presented in Table 15.

**Unit II: Percent of Increase**

A comparison of the percent of correct pre-test answers with the percentage of post-test correct answers revealed that there was an increase of 60% for the beginning private students; 59% for the voice class I; 50% for voice class II; 55% for the advanced private students; and a 57% increase for the total group.

The percentage of increase in correct answers from the pre-test to the post-test is presented in Table 16.

**Unit III: Percent of Increase**

Computation of the difference between the percent of correct answers on the pre-test and the percent of correct answers on the
TABLE 14
CORRECT ITEMS AND PERCENT CORRECT
FOR FOUR GROUPS ON ALL SIX UNITS

<table>
<thead>
<tr>
<th></th>
<th>Group A Mean</th>
<th>Group B Mean</th>
<th>Group C Mean</th>
<th>Group D Mean</th>
<th>Combined Group Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>pre</td>
<td>post</td>
<td>pre</td>
<td>post</td>
<td>pre</td>
</tr>
<tr>
<td>Unit I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(35 possible)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>items correct</td>
<td>5</td>
<td>33</td>
<td>7</td>
<td>34</td>
<td>6</td>
</tr>
<tr>
<td>% correct</td>
<td>14%</td>
<td>94%</td>
<td>20%</td>
<td>97%</td>
<td>17%</td>
</tr>
<tr>
<td>Unit II</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(40 possible)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>items correct</td>
<td>11</td>
<td>35</td>
<td>15</td>
<td>38</td>
<td>18</td>
</tr>
<tr>
<td>% correct</td>
<td>28%</td>
<td>88%</td>
<td>38%</td>
<td>95%</td>
<td>45%</td>
</tr>
<tr>
<td>Unit III</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(55 possible)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>items correct</td>
<td>6</td>
<td>44</td>
<td>9</td>
<td>47</td>
<td>11</td>
</tr>
<tr>
<td>% correct</td>
<td>11%</td>
<td>80%</td>
<td>16%</td>
<td>35%</td>
<td>20%</td>
</tr>
<tr>
<td>Unit IV</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(25 possible)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>items correct</td>
<td>7</td>
<td>24</td>
<td>9</td>
<td>24</td>
<td>8</td>
</tr>
<tr>
<td>% correct</td>
<td>28%</td>
<td>96%</td>
<td>36%</td>
<td>96%</td>
<td>32%</td>
</tr>
<tr>
<td>Unit V</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(45 possible)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>items correct</td>
<td>4</td>
<td>32</td>
<td>7</td>
<td>38</td>
<td>6</td>
</tr>
<tr>
<td>% correct</td>
<td>9%</td>
<td>71%</td>
<td>16%</td>
<td>84%</td>
<td>13%</td>
</tr>
<tr>
<td>Unit VI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(50 possible)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>items correct</td>
<td>10</td>
<td>43</td>
<td>15</td>
<td>45</td>
<td>12</td>
</tr>
<tr>
<td>% correct</td>
<td>20%</td>
<td>86%</td>
<td>30%</td>
<td>90%</td>
<td>24%</td>
</tr>
<tr>
<td>Test Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(250 possible)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>items correct</td>
<td>42</td>
<td>212</td>
<td>61</td>
<td>227</td>
<td>61</td>
</tr>
<tr>
<td>% correct</td>
<td>17%</td>
<td>85%</td>
<td>24%</td>
<td>91%</td>
<td>24%</td>
</tr>
</tbody>
</table>
**TABLE 15**

PERCENT INCREASE OF CORRECT ANSWERS
PRE-TEST TO POST-TEST: UNIT I

<table>
<thead>
<tr>
<th>Group</th>
<th>Percent Correct Pre-Test</th>
<th>Percent Correct Post-test</th>
<th>Percent of Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>A—Beginning Private</td>
<td>14%</td>
<td>94%</td>
<td>80%</td>
</tr>
<tr>
<td>B—Voice Class I</td>
<td>20%</td>
<td>97%</td>
<td>77%</td>
</tr>
<tr>
<td>C—Voice Class II</td>
<td>17%</td>
<td>97%</td>
<td>80%</td>
</tr>
<tr>
<td>D—Advanced Private</td>
<td>23%</td>
<td>100%</td>
<td>77%</td>
</tr>
<tr>
<td>Mean (Combined Groups)</td>
<td>17%</td>
<td>96%</td>
<td>79%</td>
</tr>
</tbody>
</table>

**TABLE 16**

PERCENT INCREASE OF CORRECT ANSWERS
PRE-TEST TO POST-TEST: UNIT II

<table>
<thead>
<tr>
<th>Group</th>
<th>Percent Correct Pre-Test</th>
<th>Percent Correct Post-test</th>
<th>Percent of Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>A—Beginning Private</td>
<td>28%</td>
<td>88%</td>
<td>60%</td>
</tr>
<tr>
<td>B—Voice Class I</td>
<td>38%</td>
<td>95%</td>
<td>59%</td>
</tr>
<tr>
<td>C—Voice Class II</td>
<td>45%</td>
<td>95%</td>
<td>50%</td>
</tr>
<tr>
<td>D—Advanced Private</td>
<td>43%</td>
<td>98%</td>
<td>55%</td>
</tr>
<tr>
<td>Mean (Combined Groups)</td>
<td>39%</td>
<td>95%</td>
<td>57%</td>
</tr>
</tbody>
</table>
post-test reveals that the beginning private group scores increased by 68%; the voice class I scores increased by 69%; the voice class II scores increased by 67%; and the advanced private group scores increased by 67%. There was a 68% mean increase for the combined groups.

The percent of increase from the pre-test to the post-test is presented in Table 17.

**TABLE 17**

PERCENT INCREASE OF CORRECT ANSWERS  
PRE-TEST TO POST-TEST: UNIT III

<table>
<thead>
<tr>
<th>Group</th>
<th>Percent Correct Pre-Test</th>
<th>Percent Correct Post-Test</th>
<th>Percent of Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>A—Beginning</td>
<td>11%</td>
<td>80%</td>
<td>68%</td>
</tr>
<tr>
<td>Private</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B—Voice</td>
<td>16%</td>
<td>85%</td>
<td>69%</td>
</tr>
<tr>
<td>Class I</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C—Voice</td>
<td>20%</td>
<td>87%</td>
<td>67%</td>
</tr>
<tr>
<td>Class II</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D—Advanced</td>
<td>29%</td>
<td>96%</td>
<td>67%</td>
</tr>
<tr>
<td>Private</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean (Combined Groups)</td>
<td>19%</td>
<td>87%</td>
<td>68%</td>
</tr>
</tbody>
</table>

Unit IV: Percent of Increase

A comparison of the percent of correct pre-test answers with the percentage of post-test correct answers revealed that there was an increase of 67% for the beginning private students; 60% for the voice class I; 63% for voice class II; 48% for the advanced private
students; and a 60% increase for the total group.

The percentage of increase in correct answers from the pre-test to the post-test is presented in Table 18.

**TABLE 18**
PERCENT INCREASE OF CORRECT ANSWERS
PRE-TEST TO POST-TEST: UNIT IV

<table>
<thead>
<tr>
<th>Group</th>
<th>Percent Correct Pre-Test</th>
<th>Percent Correct Post-Test</th>
<th>Percent of Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>A—Beginning</td>
<td>28%</td>
<td>96%</td>
<td>67%</td>
</tr>
<tr>
<td>Private</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B—Voice</td>
<td>36%</td>
<td>96%</td>
<td>63%</td>
</tr>
<tr>
<td>Class I</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C—Voice</td>
<td>32%</td>
<td>96%</td>
<td>63%</td>
</tr>
<tr>
<td>Class II</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D—Advanced</td>
<td>44%</td>
<td>92%</td>
<td>48%</td>
</tr>
<tr>
<td>Private</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>36%</td>
<td>94%</td>
<td>60%</td>
</tr>
<tr>
<td>(Combined</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Groups)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Unit V: Percent of Increase

Computation of the difference between the percent of correct answers on the pre-test and the percent of correct answers on the post-test reveals that the beginning private group scores increased by 63%; the voice class I scores increased by 67%; the voice class II scores increased by 69%; and the advanced private group scores increased by 73%. There was a 60% mean increase for the combined groups.
The percent of increase from the pre-test to the post-test is presented in Table 19.

**TABLE 19**

PERCENT INCREASE OF CORRECT ANSWERS
PRE-TEST TO POST-TEST: UNIT V

<table>
<thead>
<tr>
<th>Group</th>
<th>Percent Correct Pre-Test</th>
<th>Percent Correct Post-Test</th>
<th>Percent of Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>A—Beginning</td>
<td>Private</td>
<td>9%</td>
<td>71%</td>
</tr>
<tr>
<td>B—Voice</td>
<td>Class I</td>
<td>16%</td>
<td>84%</td>
</tr>
<tr>
<td>C—Voice</td>
<td>Class II</td>
<td>13%</td>
<td>82%</td>
</tr>
<tr>
<td>D—Advanced</td>
<td>Private</td>
<td>16%</td>
<td>89%</td>
</tr>
<tr>
<td>Mean</td>
<td>(Combined Groups)</td>
<td>13%</td>
<td>82%</td>
</tr>
</tbody>
</table>

**Unit VI: Percent of Increase**

A comparison of the percent of correct pre-test answers with the percentage of post-test correct answers revealed that there was an increase of 66% for the beginning private students; 60% for the voice class I; 70% for voice class II; 68% for the advanced private students; and a 66% increase for the total group.

The percentage of increase in correct answers from the pre-test to the post-test is presented in Table 20.
### TABLE 20

PERCENT INCREASE OF CORRECT ANSWERS  
PRE-TEST TO POST-TEST: UNIT VI

<table>
<thead>
<tr>
<th>Group</th>
<th>Percent Correct</th>
<th>Percent Correct</th>
<th>Percent of Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-Test</td>
<td>Post-Test</td>
<td></td>
</tr>
<tr>
<td>A—Beginning</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private</td>
<td>20%</td>
<td>86%</td>
<td>66%</td>
</tr>
<tr>
<td>B—Voice</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class I</td>
<td>30%</td>
<td>90%</td>
<td>60%</td>
</tr>
<tr>
<td>C—Voice</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class II</td>
<td>24%</td>
<td>94%</td>
<td>70%</td>
</tr>
<tr>
<td>D—Advanced</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private</td>
<td>30%</td>
<td>98%</td>
<td>68%</td>
</tr>
<tr>
<td>Mean (Combined</td>
<td>26%</td>
<td>92%</td>
<td>66%</td>
</tr>
<tr>
<td>Groups)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Total Program: Percent of Increase**

A comparison of the difference between the percent correct on the pre-test and the percent correct on the post-test for the combined groups showed that there was a 79% increase of correct answers on Unit I; 57% increase on Unit II; a 68% increase on Unit III; a 60% increase on Unit IV; a 69% increase on Unit V; a 66% increase on Unit VI; and a 67% increase in correct answers from the pre-test to the post-test for the entire test.

The percentage of increase for combined groups on each unit and
the total test is presented in Table 21.

TABLE 21
PERCENT OF INCREASE FOR COMBINED GROUPS

<table>
<thead>
<tr>
<th>Unit</th>
<th>Percent Correct Pre-Test Mean</th>
<th>Percent Correct Post-Test Mean</th>
<th>Percent of Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>I—Introduction</td>
<td>17%</td>
<td>96%</td>
<td>79%</td>
</tr>
<tr>
<td>II—Posture</td>
<td>59%</td>
<td>95%</td>
<td>57%</td>
</tr>
<tr>
<td>III—Breathing</td>
<td>19%</td>
<td>87%</td>
<td>68%</td>
</tr>
<tr>
<td>IV—Acoustics</td>
<td>36%</td>
<td>94%</td>
<td>60%</td>
</tr>
<tr>
<td>V—Phonation</td>
<td>13%</td>
<td>82%</td>
<td>69%</td>
</tr>
<tr>
<td>VI—Resonation &amp; Diction</td>
<td>26%</td>
<td>92%</td>
<td>66%</td>
</tr>
<tr>
<td>Test Total</td>
<td>24%</td>
<td>91%</td>
<td>67%</td>
</tr>
</tbody>
</table>

N = 48

Pre-Test and Post-Test Differences

Unit I; Small Step Linear

It was hypothesized that there was no significant difference between the per-test and post-test scores on Unit I utilizing small step linear technique for the following four groups:
the beginning private voice students (Group A), intermediate level students in voice class I (Group B), intermediate level students in voice class II (Group C), and advanced private voice students (Group D).

The results of the computation of the difference between the mean scores of the pre-test and post-test are presented in Table 22.

**TABLE 22**

**COMPARISON OF THE PRE-TEST AND POST-TEST MEANS, STANDARD DEVIATIONS, AND RANGES FOR THE FOUR GROUPS ON UNIT I: SMALL STEP LINEAR (35 ITEMS)**

<table>
<thead>
<tr>
<th>Group</th>
<th>Pre-Test Mean</th>
<th>Post-Test Mean</th>
<th>Gain Mean</th>
<th>Pre-Test Range</th>
<th>Post-Test Range</th>
<th>S.D. Pre-Test</th>
<th>S.D. Post-Test</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beg. Private</td>
<td>4.5</td>
<td>33.0</td>
<td>28.5</td>
<td>0-10</td>
<td>30-35</td>
<td>2.5</td>
<td>2.1</td>
<td>28.16*</td>
</tr>
<tr>
<td>Voice Class I</td>
<td>6.9</td>
<td>34.2</td>
<td>27.3</td>
<td>1-14</td>
<td>32-35</td>
<td>3.4</td>
<td>1.0</td>
<td>24.89*</td>
</tr>
<tr>
<td>Voice Class II</td>
<td>5.7</td>
<td>33.5</td>
<td>27.8</td>
<td>0-15</td>
<td>24-35</td>
<td>4.2</td>
<td>3.0</td>
<td>17.73*</td>
</tr>
<tr>
<td>Adv. Private</td>
<td>7.9</td>
<td>34.5</td>
<td>26.6</td>
<td>2-12</td>
<td>32-35</td>
<td>3.0</td>
<td>0.8</td>
<td>28.22*</td>
</tr>
</tbody>
</table>

*t value needed for significance at the .01 level with 11 df = 3.106

These results show that there was a highly significant difference at the one percent level between the Unit I pre-test and post-test mean scores for the following groups: Beginning private, voice class I, voice class II, and advanced private. The gain scores for each of the four groups were statistically significant. The null hypothesis was rejected.
Unit II: Modified Linear

It was hypothesized that there was no significant difference between the pre-test and post-test scores on Unit II utilizing a modified linear technique for the following four groups: beginning private, voice class I, voice class II, and advanced private.

The results of the computation of the difference between the mean scores are presented in Table 23.

<table>
<thead>
<tr>
<th></th>
<th>Pre-Test Mean</th>
<th>Post-Test Mean</th>
<th>Gain</th>
<th>Pre-Test Range</th>
<th>Post-Test Range</th>
<th>S.D.</th>
<th>S.D. t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beg. Private</td>
<td>10.5</td>
<td>34.9</td>
<td>24.4</td>
<td>2-18</td>
<td>29-40</td>
<td>4.8</td>
<td>4.2</td>
</tr>
<tr>
<td>Voice Class I</td>
<td>14.7</td>
<td>38.0</td>
<td>23.2</td>
<td>8-24</td>
<td>30-40</td>
<td>5.0</td>
<td>2.1</td>
</tr>
<tr>
<td>Voice Class II</td>
<td>17.5</td>
<td>38.0</td>
<td>20.5</td>
<td>9-25</td>
<td>36-40</td>
<td>4.7</td>
<td>1.4</td>
</tr>
<tr>
<td>Adv. Private</td>
<td>16.6</td>
<td>39.1</td>
<td>22.5</td>
<td>13-22</td>
<td>35-40</td>
<td>2.8</td>
<td>1.4</td>
</tr>
</tbody>
</table>

*Significant at the .01 level.

These results show that there was a highly significant difference at the one percent level between the Unit II pre-test and post-test mean scores for the following groups: beginning private, voice class I, voice class II, and advanced private. The gain scores for each of the four groups were statistically significant. The null hypothesis was rejected.
Unit III: (Linearized Branching)

It was hypothesized that there was no significant difference between the pre-test and post-test scores on Unit III utilizing linearized branching for the following four groups of vocal students: beginning private, voice class I, voice class II, and advanced private.

The results of the computation of the difference between the mean scores are presented in Table 24.

<table>
<thead>
<tr>
<th></th>
<th>Pre-Test Mean</th>
<th>Post-Test Mean</th>
<th>Pre-Test Gain</th>
<th>Post-Test Range</th>
<th>Pre-Test Range</th>
<th>Post-Test S.D.</th>
<th>Post-Test S.D.</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beg. Private</td>
<td>6.3</td>
<td>44.2</td>
<td>37.9</td>
<td>1-14</td>
<td>36-50</td>
<td>3.9</td>
<td>4.7</td>
<td>20.29*</td>
</tr>
<tr>
<td>Voice Class I</td>
<td>9.4</td>
<td>47.0</td>
<td>37.6</td>
<td>1-21</td>
<td>36-53</td>
<td>6.4</td>
<td>5.5</td>
<td>14.63*</td>
</tr>
<tr>
<td>Voice Class II</td>
<td>10.5</td>
<td>48.3</td>
<td>37.7</td>
<td>2-29</td>
<td>40-54</td>
<td>6.8</td>
<td>3.9</td>
<td>15.77*</td>
</tr>
<tr>
<td>Adv. Private</td>
<td>15.5</td>
<td>52.6</td>
<td>37.0</td>
<td>10-21</td>
<td>47-55</td>
<td>2.7</td>
<td>2.1</td>
<td>35.55*</td>
</tr>
</tbody>
</table>

*Significant at the .01 level.

These results show that there was a highly significant difference at the one percent level between the Unit III pre-test and post-test mean scores for the following groups: beginning private, voice class I, voice class II, and advanced private. The gain scores for each of the four groups were statistically significant. The null hypothesis was rejected.
Unit IV: Large Step Linear

It was hypothesized that there was no significant difference between the pre-test and post-test scores on Unit IV utilizing a large step linear technique for the following groups: beginning private, voice class I, voice Class II, and advanced private.

The results of the computation of the difference between the mean scores are presented in Table 25.

**TABLE 25**

COMPARISON OF THE PRE-TEST AND POST-TEST MEANS, STANDARD DEVIATION, AND RANGES FOR THE FOUR GROUPS ON UNIT IV: LARGE STEP LINEAR (25 ITEMS)

<table>
<thead>
<tr>
<th>Group</th>
<th>Pre-Test Mean</th>
<th>Post-Test Mean</th>
<th>Gain</th>
<th>Pre-Test Range</th>
<th>Post-Test Range</th>
<th>Pre-Test S.D.</th>
<th>Post-Test S.D.</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beg. Private</td>
<td>6.5</td>
<td>23.5</td>
<td>17.0</td>
<td>5-10</td>
<td>22-25</td>
<td>1.6</td>
<td>1.1</td>
<td>28.24*</td>
</tr>
<tr>
<td>Voice Class I</td>
<td>8.7</td>
<td>23.8</td>
<td>15.0</td>
<td>6-10</td>
<td>21-25</td>
<td>1.4</td>
<td>1.4</td>
<td>24.52*</td>
</tr>
<tr>
<td>Voice Class II</td>
<td>8.2</td>
<td>23.8</td>
<td>15.5</td>
<td>5-12</td>
<td>20-25</td>
<td>2.3</td>
<td>1.8</td>
<td>17.23*</td>
</tr>
<tr>
<td>Adv. Private</td>
<td>11.1</td>
<td>23.2</td>
<td>12.0</td>
<td>7-15</td>
<td>12-25</td>
<td>2.1</td>
<td>3.5</td>
<td>9.67*</td>
</tr>
</tbody>
</table>

*Significant at the .01 level.

These results show that there was a highly significant difference at the one percent level between the Unit IV pre-test and post-test mean scores for the following groups: beginning private, voice class I, voice class II, and advanced private. The gain scores for each of the four groups were statistically significant. The null hypothesis was rejected.
Unit V: Eclectic

It was hypothesized that there was no significant difference between the pre-test and post-test scores on Unit V utilizing an eclectic program technique for the following groups of subjects: beginning private, voice class I, voice class II, and advanced private.

The results of the computation of the difference between the mean scores are presented in Table 26.

TABLE 26

COMPARISON OF THE PRE-TEST AND POST-TEST MEANS, STANDARD DEVIATION, AND RANGES FOR THE FOUR GROUPS ON UNIT V: ECLECTIC (45 ITEMS)

<table>
<thead>
<tr>
<th>Group</th>
<th>Pre-Test Mean</th>
<th>Post-Test Mean</th>
<th>Mean Gain</th>
<th>Pre-Test Range</th>
<th>Post-Test Range</th>
<th>Pre-Test S.D.</th>
<th>Post-Test S.D.</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beg. Private</td>
<td>3.8</td>
<td>32.4</td>
<td>28.5</td>
<td>0-8</td>
<td>25-40</td>
<td>1.9</td>
<td>3.8</td>
<td>22.01*</td>
</tr>
<tr>
<td>Voice Class I</td>
<td>6.7</td>
<td>38.0</td>
<td>31.2</td>
<td>4-12</td>
<td>33-43</td>
<td>2.0</td>
<td>2.8</td>
<td>29.29*</td>
</tr>
<tr>
<td>Voice Class II</td>
<td>6.0</td>
<td>37.3</td>
<td>31.2</td>
<td>4-10</td>
<td>31-43</td>
<td>1.7</td>
<td>3.6</td>
<td>25.67*</td>
</tr>
<tr>
<td>Adv. Private</td>
<td>7.3</td>
<td>39.5</td>
<td>32.2</td>
<td>4-12</td>
<td>35-44</td>
<td>2.5</td>
<td>2.5</td>
<td>29.14*</td>
</tr>
</tbody>
</table>

*Significant at the .01 level.

These results show that there was a highly significant difference at the one percent level between the Unit V pre-test and post-test mean scores for the following groups: beginning private, voice class I, voice class II, and advanced private. The gain scores for each of the four groups were statistically significant. The null hypothesis was rejected.
Unit VI: Mathetic

It was hypothesized that there was no significant difference between the pre-test and post-test scores on Unit VI utilizing mathetic programming techniques for the following groups: beginning private, voice class I, voice class II, and advanced private.

The results of the computation of the difference between the mean scores are presented in Table 27.

TABLE 27

COMPARISON OF THE PRE-TEST AND POST-TEST MEANS, STANDARD DEVIATION, AND RANGES FOR THE FOUR GROUPS ON UNIT VI: MATHETIC (50 ITEMS)

<table>
<thead>
<tr>
<th>Group</th>
<th>Pre-Test Mean</th>
<th>Post-Test Mean</th>
<th>Pre-Test Gain</th>
<th>Post-Test Range</th>
<th>Pre-Test S.D.</th>
<th>Post-Test S.D.</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beg. Private</td>
<td>9.7</td>
<td>43.4</td>
<td>33.6</td>
<td>6-14</td>
<td>2.1</td>
<td>3.3</td>
<td>28.12*</td>
</tr>
<tr>
<td>Voice Class I</td>
<td>15.3</td>
<td>45.8</td>
<td>30.5</td>
<td>11-20</td>
<td>2.7</td>
<td>2.5</td>
<td>27.00*</td>
</tr>
<tr>
<td>Voice Class II</td>
<td>12.3</td>
<td>46.7</td>
<td>34.4</td>
<td>8-18</td>
<td>2.7</td>
<td>3.2</td>
<td>26.72*</td>
</tr>
<tr>
<td>Adv. Private</td>
<td>15.0</td>
<td>48.7</td>
<td>33.6</td>
<td>10-20</td>
<td>2.9</td>
<td>2.1</td>
<td>30.28*</td>
</tr>
</tbody>
</table>

*Significant at the .01 level.

These results show that there was a highly significant difference at the one percent level between the Unit VI pre-test and post-test mean scores for the following groups: beginning private, voice class I, voice class II, and advanced private. The gain scores for each of the four groups were statistically significant. The null hypothesis was rejected.
Pre-test and Post-test Differences: Total Test

It was hypothesized that there was no significant difference between the pre-test and post-test scores of the total test on the program for the following experience level groups: beginning private, voice class I, voice class II, and advanced private.

The results of the computation of the difference between the mean scores are presented in Table 28.

<table>
<thead>
<tr>
<th>Group</th>
<th>Pre-Test Mean</th>
<th>Post-Test Mean</th>
<th>Mean Gain</th>
<th>Pre-Test Range</th>
<th>Post-Test Range</th>
<th>S.D.</th>
<th>S.D.</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beg. Private</td>
<td>41.5</td>
<td>211.6</td>
<td>170.1</td>
<td>22-72</td>
<td>183-235</td>
<td>13.9</td>
<td>14.2</td>
<td>29.58*</td>
</tr>
<tr>
<td>Voice Class I</td>
<td>61.1</td>
<td>227.0</td>
<td>165.5</td>
<td>47-94</td>
<td>213-230</td>
<td>13.2</td>
<td>9.1</td>
<td>35.69*</td>
</tr>
<tr>
<td>Voice Class II</td>
<td>61.3</td>
<td>227.9</td>
<td>166.5</td>
<td>50-93</td>
<td>192-247</td>
<td>12.2</td>
<td>14.3</td>
<td>30.64*</td>
</tr>
<tr>
<td>Adv. Private</td>
<td>73.7</td>
<td>239.0</td>
<td>165.3</td>
<td>55-89</td>
<td>225-248</td>
<td>9.5</td>
<td>6.5</td>
<td>49.72*</td>
</tr>
</tbody>
</table>

*Significant at the .01 level.

These results show that there was a highly significant difference at the one percent level between the total pre-test and post-test mean scores for the following groups: beginning private, voice class I, voice class II, and advanced private. The gain scores for each of the four groups were statistically significant. The null hypothesis was rejected.
Differences Between Groups

Pre-Test

It was hypothesized that there would be no significant difference between the pre-test scores of the three different experience level groups; beginning private (Group A), intermediate voice class (Group C), and advanced private (Group D).

Differences between the mean scores of the three groups is presented in Table 29.

<table>
<thead>
<tr>
<th>Group 1</th>
<th>Group 2</th>
<th>Pre-test M1</th>
<th>Pre-test M2</th>
<th>F</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>A—Beginning Private</td>
<td>C—Intermediate Voice Class</td>
<td>41.50</td>
<td>61.33</td>
<td>13.70*</td>
<td>3.70*</td>
</tr>
<tr>
<td>A—Beginning Private</td>
<td>D—Advanced Private</td>
<td>41.50</td>
<td>73.75</td>
<td>43.73*</td>
<td>6.61*</td>
</tr>
<tr>
<td>C—Intermediate Voice Class</td>
<td>D—Advanced Private</td>
<td>61.33</td>
<td>73.75</td>
<td>7.71</td>
<td>2.77ns</td>
</tr>
</tbody>
</table>

Beginning Private N = 12
Intermediate Voice Class N = 12
Advanced Private N = 12
ns = non-significant

*Significant at the .01 level

The difference between the pre-test mean scores was found to be significant at the .01 level for beginning private and intermediate voice class groups, and for the beginning private and advanced private group subjects. The null hypothesis was rejected for these
groups. The variance between groups as measured by the F test was also found to be significant for the beginning private and intermediate voice class, and for the beginning private and advanced private groups.

The difference between the pre-test scores was shown to be non-significant for the intermediate voice class and advanced private subjects. The null hypothesis was accepted for these groups. There was also no significant variance between these groups as measured by the F test.

**Post-test**

It was hypothesized that there would be no significant difference between the post-test mean scores of the three different experience level groups; beginning private (Group A), intermediate voice class (Group C), and advanced private (Group D).

The results of the comparison of the post-test mean scores are presented in Table 30.

The difference between the post-test mean scores was found to be significant at the .01 level for the beginning private and advanced private groups. The null hypothesis was rejected for these groups. There was also a significant variance between these two groups as measured by the F test.

The difference between the post-test mean score was shown to be non-significant when the beginning private and intermediate voice class scores were compared, and when the intermediate voice class and advanced private group scores were compared. The null
hypothesis was accepted for these groups. The variance between these groups as measured by the F test was also found to be non-significant.

**TABLE 30**

**COMPARISON OF THE POST-TEST MEAN SCORES**

<table>
<thead>
<tr>
<th>Group 1</th>
<th>Group 2</th>
<th>Post-test M1</th>
<th>Post-test M2</th>
<th>F</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>A—Beginning Private</td>
<td>C—Intermediate Voice Class</td>
<td>211.66</td>
<td>227.91</td>
<td>7.78</td>
<td>2.79ns</td>
</tr>
<tr>
<td>A—Beginning Private</td>
<td>D—Advanced Private</td>
<td>211.66</td>
<td>239.08</td>
<td>36.94*</td>
<td>6.07*</td>
</tr>
<tr>
<td>C—Intermediate Voice Class</td>
<td>D—Advanced Private</td>
<td>227.91</td>
<td>239.08</td>
<td>6.04</td>
<td>2.45ns</td>
</tr>
</tbody>
</table>

Beginning Private N = 12
Intermediate Voice Class N = 12
Advanced Private N = 12 ns — non-significant

*Significant at the .01 level

**Percentage of Gain**

It was hypothesized that there would be no significant difference between the percentage of gain for the three groups; beginning private, intermediate voice class, and advanced private.

The results of the computation of the differences between the percentage of gain scores are presented in Table 31.

The difference between the percentage of gain and the variance, as measured by the F test was found to be non-significant for all groups. The null hypothesis was accepted.
TABLE 31

COMPARISON OF THE PERCENT OF GAIN BETWEEN GROUPS

<table>
<thead>
<tr>
<th>Group 1</th>
<th>Group 2</th>
<th>Percent gain</th>
<th>Percent gain</th>
<th>F</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>A—Beginning</td>
<td>C—Intermediate</td>
<td>68.06</td>
<td>66.63</td>
<td>0.45</td>
<td>0.67ns</td>
</tr>
<tr>
<td>Private</td>
<td>Voice Class</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A—Beginning</td>
<td>D—Advanced</td>
<td>68.06</td>
<td>66.13</td>
<td>0.97</td>
<td>0.98ns</td>
</tr>
<tr>
<td>Private</td>
<td>Voice Class</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C—Intermediate</td>
<td>D—Advanced</td>
<td>66.63</td>
<td>66.13</td>
<td>0.05</td>
<td>0.24ns</td>
</tr>
<tr>
<td>Voice Class</td>
<td>Voice Class</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Beginning Private  N = 12
Intermediate Voice Class  N = 12
Advanced Private  N = 12

ns = non-significant

Interrelationship of Groups: Pre-Test and Post-Test Scores

It was hypothesized that variance between groups would have no significant effect upon the amount learned as measured by pre-test to post-test variance.

The results of the analysis of variance computation are presented in Table 32.

No significant relationship was found between group variance and the amount learned as measured by pre-test to post-test variance. The null hypothesis was accepted.

The findings of the analysis of variance related to variance between groups and pre-test to post-test variance supports findings previously reported. The variance between groups and the variance between the pre-test to post-test scores were both found to be significant at the .01 level as measured by the F test.
TABLE 32

GROUP VARIANCE, PRE-TEST AND POST-TEST VARIANCE,
AND INTERACTION OF GROUP AND TEST VARIANCES

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>ms</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variance between groups</td>
<td>11,694</td>
<td>2</td>
<td>5,847</td>
<td>26.94*</td>
</tr>
<tr>
<td>Variance between pre-test and post-test</td>
<td>509,208</td>
<td>1</td>
<td>509,208</td>
<td>17.13*</td>
</tr>
<tr>
<td>Group variance&lt;test variance</td>
<td>49</td>
<td>24</td>
<td>24.5</td>
<td>.001ns</td>
</tr>
</tbody>
</table>

Beginning Private N = 12
Intermediate Voice Class N = 12
Advanced Private N = 12
ns = no significant difference

*Significant at the .01 level

Effects of Pacing Mode

Comparing Groups: Pre-Test and Post-Test Scores

It was hypothesized that there would be no significant difference between the pre-test and post-test scores of the forced-paced intermediate voice class (Group B) and the self-paced intermediate voice class (Group C).

The results of computing the mean scores, standard deviation, and mean gain for Group B and C on the pre-test and post-test are presented in Table 33.

The difference between the pre-test and post-test scores for Group B and C were both found to be non-significant. The null hypothesis was accepted.
It was hypothesized that there would be no significant difference between the amount of gain (mean gain) between the pre-test and post-test for the forced-paced group (B) and the self-paced group (C).

The results of the computation of the mean gains for both groups appears in Table 33.

The difference between the mean gain was found to be non-significant. The null hypothesis was acceptable.

**TABLE 33**

COMPARISON OF THE FORCED-PACED GROUP (B) AND SELF-PACED GROUP (C) ON THE PRE-TEST AND THE POST-TEST

<table>
<thead>
<tr>
<th></th>
<th>Group B</th>
<th>Group C</th>
<th>Group B</th>
<th>Group C</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Mean</td>
<td>S. D.</td>
<td>S. D.</td>
<td></td>
</tr>
<tr>
<td>Pre-Test</td>
<td>61.16</td>
<td>61.33</td>
<td>12.68</td>
<td>11.70</td>
<td>.03ns</td>
</tr>
<tr>
<td>Post-Test</td>
<td>227.08</td>
<td>227.91</td>
<td>8.76</td>
<td>13.71</td>
<td>.16ns</td>
</tr>
<tr>
<td>Mean Gain</td>
<td>165.90</td>
<td>166.51</td>
<td>3.56</td>
<td>5.23</td>
<td>.13ns</td>
</tr>
</tbody>
</table>

Group B N = 12
Group C N = 12 ns = no significant difference

Reactions of Subjects

Attitude Statement

In response to opinionnaire question A which asked, "Which of the statements below best describes your reaction to the program on the fundamentals of singing?", forty-one of the forty-eight subjects indicated that their attitude was "extremely positive: Found the program a highly motivating, enjoyable and effective way to learn"; six subjects were "positive: Found the program a motivating, enjoyable
and effective complement to other learning”; and one subject was “neither negative or positive”. Of the seven subjects who selected statements which were not extremely positive, five were beginning private students. The tabulation of subject responses is presented in Table 34.

**Student Evaluation of Programming Techniques**

The most preferred units were Unit I (small step linear) which was selected by twenty-three of the forty-eight subjects, and Unit VI (mathetic) which was selected by sixteen subjects. Five subjects preferred Unit IV (large step linear) and four subjects preferred Unit II (modified linear).

Thirty subjects least preferred Unit V, six indicated Unit III, four indicated Unit IV, three indicated Unit II, two indicated Unit VI, and one subject least preferred Unit I. Two subjects gave no response.

The tabulation of subject responses to questions B and C is presented in Table 34.

**Usefulness of the program as an Adjunctive Learning Aid**

Thirty-seven of the forty-eight subjects thought the program was a very effective adjunctive aid and preferred it to usual learning guides such as books and lectures”, nine subjects thought the program was “an effective way to learn the fundamentals of singing without taking class time”, and two subjects thought that the program “compared favorably with other learning aids”.

The tabulation of subject responses to question D are presented in Table 34.
<table>
<thead>
<tr>
<th>Questions and Subject Responses</th>
<th>Ber.</th>
<th>VC I</th>
<th>VC II</th>
<th>Priv</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Attitude statements</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. extremely positive</td>
<td>6</td>
<td>12</td>
<td>11</td>
<td>12</td>
<td>41</td>
</tr>
<tr>
<td>2. positive</td>
<td>5</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>3. neutral</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>4. negative</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5. extremely negative</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>B. Preferred technique (unit)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. small step linear (I)</td>
<td>6</td>
<td>7</td>
<td>5</td>
<td>5</td>
<td>23</td>
</tr>
<tr>
<td>2. modified linear (II)</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>3. linearized branching (III)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4. large step linear (IV)</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>5. eclectic (V)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6. mathetic (VI)</td>
<td>2</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>C. Least preferred technique (unit)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. small step linear (I)</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>2. modified linear (II)</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>3. linearized branching (III)</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>4. large step linear (IV)</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5. eclectic (V)</td>
<td>7</td>
<td>10</td>
<td>8</td>
<td>5</td>
<td>30</td>
</tr>
<tr>
<td>6. mathetic (VI)</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>D. Usefulness as learning aid</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. very effective—preferred to other aids</td>
<td>9</td>
<td>8</td>
<td>9</td>
<td>11</td>
<td>37</td>
</tr>
<tr>
<td>2. compliments other aids</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>3. compares with other aids</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>4. prefer other aids</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5. ineffective</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6. detracts</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Time to Complete the Program

Twelve to sixteen hours was required to complete the program by thirty-seven of the forty-eight subjects. Six subjects needed six to twelve hours and five subjects needed sixteen to twenty hours to complete the program. Those who used less time to complete the program were nearly equally distributed between the various groups, but the largest number of subjects who required between sixteen and twenty hours to complete the program were the younger members of the beginning private group.

The tabulations of the time required to complete the program are presented in Table 35.

<table>
<thead>
<tr>
<th>Time Required to Complete the Program</th>
<th>Group A</th>
<th>Group B</th>
<th>Group C</th>
<th>Group D</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-12 hours</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>12-16 hours</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>10</td>
<td>37</td>
</tr>
<tr>
<td>16-20 hours</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>5</td>
</tr>
</tbody>
</table>
CHAPTER V

SUMMARY AND CONCLUSIONS

Summary

Purposes

The major purposes of this study were to construct a programmed textbook on the fundamentals of voice production in singing and to test the effectiveness of the program, as a learning aid for voice classes and various age private students of singing.

Since the program was of considerable length and used different programing techniques in six different units, sub-purposes included determining the effectiveness of various programing formats within a multiple technique design; the effect that differences in the experience level of the subjects had upon the effectiveness of the program; the effect that pacing mode had upon the effectiveness of the program; student reactions to the program, the programed textbook design, and the various programing techniques employed in each unit of the program; and the relationship between the amount of time required to complete the program and program effectiveness.

Subjects

The forty-eight subjects used for final testing of the program were in four groups including: twelve beginning private non-college students including three junior high school students, six high school
students, and three adults studying private voice for the first time (Group A), twelve voice class students including sophomores and juniors enrolled in midwestern colleges (Group B), twelve voice class students including sophomores and juniors enrolled in midwestern colleges (Group C), and twelve private college age voice students in advanced stages of vocal training who were studying singing at three colleges in Iowa (Group D).

All but Group B were selected of the first twelve students to register. Group B subjects were selected from a larger population of voice class students so that each member could be matched to subjects in Group C as to class in college, cumulative grade point average, amount of private study, and sex.

Procedures

Preparation for construction of the program included determining the feasibility, nature, and scope of the program by reviewing literature, research, and books on voice and interviewing experts in the field of voice and programmed instruction; gathering broad program, student learning outcome, behavioral, and performance level objectives for the program from private voice teachers, voice class teachers, and professional publications; gathering content suggestions by consulting subject matter experts and books on voice; building a rough draft, tentative outline, and numerous samples of various alternative programming formats and techniques; and presenting these to students and teachers of singing who were asked to articulate vocal concepts in their own terms, to indicate which parts of the information reviewed they knew or taught, what information they desired to learn or teach, and which information
they found to be important enough to be programed.

In the construction phase a content sequence outline was built, the nature of the target population was determined, a criterion test was constructed, the most appropriate program design was determined, and the first draft of the program was constructed.

The extensive process of revision-testing prior to final testing included a first major revision following editing and critique of the program by experts, a second major revision including eight revisions made following the presentation of the program, frame by frame, to eight individual students, a third major revision based on answers to a frame analysis sheets and the criterion test gathered from a class of eight beginning voice students, and the final fourth revision based on the computation and interpretation of data gathered from results of the pilot testing of six self-paced and six forced-paced subjects showing percentage of increase, percentage correct on each unit (programing technique), differences between groups, reaction of subjects, and time to completion.

For final testing the subjects were selected; all were given the pre-test and post-test, the three different experience level groups (A, C, and D) went through the program at their own pace during an entire semester (self-paced), and Group B was forced-paced to complete the program in three weeks. Data from data sheets, an opinionnaire, pre-test, and post-test were collected and analyzed.

Results

In Chapter I of this study five questions were raised concerning
program content, program effectiveness, student reactions, and time to complete the program. Hypothesis were stated which were designed to point out differences between the test scores, differences between the three experience level groups, and to what extent pacing mode had an effect on the effectiveness of the program. The answers to these questions and restatement of the hypothesis constitute the summary of the results of this study.

1. What was the most appropriate content, sequence, length, program format, and program technique for a program on the fundamentals of voice production in singing?

The content included in the program and believed to be appropriate for this study included six units; I. Characteristics of the good singer's voice, II. Posture, III. Breathing, IV. Acoustical aspects of singing, V. Phonation, and VI. Resonation and diction. The logical sequence traditionally associated with the subject was maintained, with the inclusion of review devices that supplied a type of cyclic recurrences of each unit topic and praxeonomic preview devices that gave minimal pre-training.

Because there was a desire to construct a program for an entire semester course and because of the research interest of testing a program of extensive length, enough material was programmed to require between ten and twenty hours of study ancillary to other instruction.

A four track page-to-page programmed textbook format using either or both overt and covert responses was deemed most feasible and appropriate. A multiple technique design was used so that Unit I employed small step linear techniques almost exclusively; Unit II
employed modified linear; Unit III employed linearized branching; Unit IV employed large step linear; Unit V employed eclectic techniques; and Unit VI employed mathetic approaches. This design made it possible to put into effect several recommendations suggested by research and preferred by students; 1) gradually longer delays in feedback, 2) increasingly fewer prompts and cues, and 3) increasingly longer step-size. Error rate during the program was expected to increase as the techniques employed utilized error responses.

A system of typographical cueing was developed using underlining, capitalization, letter, and spacing cues. Other visual cues such as color coding of the overview, outline, review, and test frames, colored illustrations, algorithms, and figures were systematically interspersed for interest and clarification.

2. What is the effectiveness of the program and the six units employing different programming techniques when compared with the 90/90 ideal?

Unit I (small step linear)—In the total group, 90% of the subjects answered 91% of the post-test items correctly and correct answers for 91% of the items were supplied by 90% of the subjects. The 90/90 ideal was reached by all groups except the beginning private group where 92% of the subjects answered 86% of the items. This unit was most effective for the forced-paced group where 92% of the subjects answered 94% of the items correctly. Review supplied in later units, novelty, and better construction may in part account for the overall effectiveness of this unit.

Unit II (modified linear)—For the combined group, 90% of the
subjects answered 85% of the items correctly and 90% of the items were answered correctly by 91% of the subjects. The 90/90 ideal was reached by the self-paced voice class and easily by the advanced private group where 92% of the subjects answered 95% of the items correctly. Beginning private students did considerably less well, answering only 73% of the post-test items.

**Unit III (linearized branching)**—The total group recorded a 90/75 level even though the advanced private group reached 92/93. The major cause for bringing the total percentages below 90/90 were the scores of the beginning private subjects, where 92% of the subjects answered 65% of the items correctly. Test items on complex physiological concepts related to breathing contributed markedly to the lower scores of the younger group.

**Unit IV (large step linear)**—The percentages for all the groups were nearly identical, with 90% of the total group answering 88% of the post-test items correctly and 92% of the items answered correctly by 83% of the subjects.

**Unit V (eclectic)**—For the combined group, 90% of the subjects answered 69% of the items and 91% of the items were answered correctly by 19% of the subjects. The length and complexity of the information in this unit as well as a less regularized approach may account for lower scores on this unit. Beginning private students found this unit especially difficult and less effective. There were no subjects in this group who answered 91% of the items, for example.

**Unit VI (mathetic)**—The advanced private group reached 92/92 but lower levels by the other experience level groups brought the total group percentages to 90/84, slightly below the 90/90 ideal. The
absence of cues, reviews, or review tests may, in part, account for the slightly lower scores.

**Total program**—The percentages for the entire post-tests by all groups showed that 90% of the subjects were able to answer 84% of the items and 90% of the items were answered correctly by 79% of the subjects. These percentages are very high considering how close they come to the high ideal of 90/90. Advanced subjects easily surpassed the 90/90 ideal with a 92/93 total percentage level. Voice classes would have reached the ideal except for the lower scores on Unit V. Even the 92/79 level of the beginning private subjects is well above levels deemed as indication of effectiveness by programmers.

3. What did the percentage correct on the post-test and the percentage of gain between the pre-test and the post-test indicate concerning the effectiveness of the program for the four groups: self-paced beginning private, forced-paced intermediate voice class, self-paced intermediate voice class, and self-paced advanced private?

The beginning private group answered 17% of the items correctly on the pre-test and 85% correctly on the post-test for a mean percentage increase of 68%. Percentage gain for both voice classes was 67% because they completed 24% on the pre-test and 91% on the post-test. The advanced group improved by 66% from 30% correct on the pre-test to a 96% average on the post-test.

Calculation of the percentage of increase for combined group revealed a 79% increase for Unit I; 57% for Unit II; 68% for Unit III; 60% for Unit IV; 69% for Unit V; and 66% for Unit VI, with a test total of 67% average increase. High pre-test scores for Units II and
IV brought increases down, while highest increases occurred with Unit I, the most effective unit as measured by 90/90 ideal, and Unit V, the least effective unit as measured by the 90/90 ideal.

4. What was the student reaction and attitude toward the program and each of the programming techniques (units) as measured by an opinionnaire?

Only one subject of the forty-eight subjects indicated on an opinionnaire that he had neither a negative or a positive attitude toward the program. Forty-one subjects "found the program a highly motivating, enjoyable, and effective way to learn", and six subjects "found the program a motivating, enjoyable and effective complement to other learning".

Most preferred units were Unit I: small step linear (23 of 48 subjects) and Unit VI: mathetic (16 subjects). Five subjects preferred Unit IV: large step linear, and four subjects preferred Unit II: modified linear.

Thirty subjects least preferred Unit V, six indicated Unit III, four indicated Unit IV, three indicated Unit II, two indicated Unit VI, and one subject least preferred Unit I. Two subjects gave no response.

Thirty-seven of the forty-eight subjects thought the program was a "very effective adjunctive aid and preferred it to usual learning guides such as books and lectures", nine subjects thought the program was "an effective way to learn the fundamentals of singing without taking class time", and two subjects thought that the program "compared favorably with other learning aids".
5. What was the relationship between the amount of time required to complete the program and the effectiveness of the program?

Thirty-seven of the forty-eight subjects needed from twelve to sixteen hours to complete the program. Those who needed less than twelve hours (6 subjects) were nearly equally distributed between the various groups, but the largest number of subjects who required over sixteen hours to complete the program were younger members of the beginning private group. Spending more or less time on the program made little appreciable difference on post-test scores.

There was a significant difference at the .01 level as measured by \( t \) test between the pre-test and post-test scores on every unit for all four groups: the beginning private voice students (Group A), intermediate level students in voice class I (Group B), intermediate level students in voice class II (Group C), and advanced private voice students (Group D). The null hypotheses of no significant difference between pre-test and post-test scores were rejected.

To measure the difference between the three experience level groups (Group A, C, and D) a comparison of the pre-test mean scores and a comparison of the post-test mean scores was made using a one way analysis of variance and applying the \( F \) and \( t \) tests. A significant difference at the .01 level was found when comparing the pre-test scores of the beginning private students (Group A) with the other experience level groups (Group C and D). The difference found between intermediate voice class and advanced private pre-test scores was non-significant.

Difference was also significant when comparing the
post-test scores of the beginning private group with the advanced private group, but the difference between the beginning group and the intermediate voice class group was found to be non-significant. The difference between the percentages of gain for the three experience level groups was also found to be non-significant.

To test for significance between the three experience level groups, between the pre-test and post-test mean scores, and interaction between the groups and test scores, a two-way analysis of variance was employed and the F test of significance applied. No significant relationship was found between group variance and the amount learned as measured by pre-test to post-test variance. The variance between groups and the variance between the pre-test to post-test scores were both found to be significant at the .01 level as measured by the F test.

The difference between the pre-test scores, the post-test scores, and the amount of gain for the forced-paced voice class (Group B) and the self-paced voice class (Group C) were all found to be non-significant.

Conclusions

In consideration of the foregoing results and the purposes and limitations of the study, the following conclusions are suggested:

1. A body of information concerning the fundamentals of voice production in singing can be identified, programmed, and effectively used as an ancillary aid by beginning, intermediate, and advanced students of singing who are studying privately or in voice classes.
2. The program was more effective with college age subjects than high school and junior high school subjects. Of the junior and senior college students in the advanced private group, 92% of the subjects were able to answer 93% of the two-hundred fifty item post-test. In the two college voice classes 92% of the subjects answered 86% (voice class I) and 85% (voice class II) correctly for the total test, but on several units of the test both voice class groups surpassed the 90/90 ideal.

3. All experience level groups (beginning, intermediate, and advanced) learned at a similar rate from the program as indicated by the pre-test to post-test increases of between 66% and 68%.

4. The amount of time required to complete the program was quite similar for all subjects (sixteen to twenty hours) and when slightly longer or shorter time was required for completion there was little noticeable effect upon learning.

5. Units employing small or large step linear or mathetic techniques were preferred and more effective than modified linear, linearized branching, and eclectic techniques by the subjects of this study.

6. The program developed for this study was equally as effective for intermediate voice class subjects whether they were forced-paced or self-paced.

7. Student reactions to The Fundamentals of Voice Production in Singing was overwhelmingly positive and enthusiastic, with nearly all students preferring the programed textbooks to other textbooks and considering the program an extremely effective adjunctive aid.

See Appendix L.
Implications

In view of the purposes of the study, the findings suggested the following implications:

1. Results of effectiveness and reactions of students suggested that programed materials of the type developed for this study could be useful both for teachers of voice classes, choruses, and private students who desire a systematic means of presenting the fundamentals of voice production without taking time from lessons, rehearsals, and classes, and also for individuals who wish to learn about singing by means of a self-instructional programed textbook.

2. While a program such as the type developed for this study would be especially effective and useful for voice class students and as a complement to studio lessons for the private student, junior high school, high school, and adult beginners also learned so effectively and reacted so positively to a program on the fundamentals of voice production in singing that with slight alterations a program of this type could also be very useful for the beginning non-college student.

3. The uniformity in amount learned from the program, irrespective of individual and experience level differences, pointed out the usefulness of the program to lead students to more uniform levels of performance and to lessen individual learner differences.

4. Programs of considerable length can be effective when varied programing techniques and review devices are used.

5. The use of different programing techniques for different units can be effective, but when too many techniques are interspersed
in a given unit, such as was the case in the least effective unit (Unit V: eclectic) of the program developed for this study, effectiveness diminished sharply.

6. Since there was no difference in the effectiveness of the program whether subjects were forced-paced or self-paced, teachers using the program could choose at which pace they preferred their students to progress through the program.

7. The highly positive reactions of students to the program suggested that use of a program as an adjunct to usual voice teaching could be a motivating way to supply students with an organized presentation of facts about the voice.

Recommendations for Further Research

The following recommendations for future research are suggested on the basis of the findings and limitations of the present study:

1. A study in which the program was expanded to include information concerning coordination of the fundamental functions, interpretation in singing, and which would include specified exercises, song selections, and taped or recorded examples.

2. Further revision of Unit V, simplification of the language of the program, and the inclusion of skip branches for use by younger students could be tested with subjects of younger age.

3. More testing of the program with larger populations would make the findings concerning effectiveness more generalizable.
4. Additional research which tests the effectiveness of longer programs.

5. Additional research dealing with the construction and testing of programs using several different programing techniques.

6. Additional research on the effects of forced-pacing versus self-pacing of long programs.

7. A study which explores the effectiveness of the material used in this program plus more visual illustrations when programmed for computerized teaching machine.
APPENDIX A

OBJECTIVES SHEET
OBJECTIVES FOR THE TEACHING OF THE
BASIC FUNDAMENTALS OF SINGING

You were selected as an authority on the fundamentals of voice production in singing. You were also selected because your teaching reveals that you have already formulated your own broad program objectives and have definite ideas about the student learning outcome you hope for, what you expect students to be able to do as the result of your teaching (behavioral objectives), and what kind of learning tasks you think your students should be exposed to.

Please state your objectives under the following headings:

1. Broad program objectives

2. Student learning outcome objectives (what students should know).

3. Behavioral objectives (what students should be able to do).

4. Performance level objectives (what kind of decisions, responses, learning approaches, and attitudes students should develop).
APPENDIX B

OBJECTIVES-TECHNIQUE SHEET
<table>
<thead>
<tr>
<th>OBJECTIVES</th>
<th>PROGRAM CONTENT AND TECHNIQUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Broad Program Objectives----------</td>
<td>A. Content Sequence</td>
</tr>
<tr>
<td>B. Student Learning Outcome---------</td>
<td>B. Criterion Test (test frames)</td>
</tr>
<tr>
<td>C. Behavior Objectives---------------</td>
<td>C. Design (what student will do)</td>
</tr>
<tr>
<td>D. Performance Level Objectives------</td>
<td>D. Frame Structure</td>
</tr>
</tbody>
</table>

**Information Sources:**
APPENDIX C

CONTENT SUGGESTIONS SHEET
CONTENT SUGGESTIONS FOR A PROGRAM ON

THE FUNDAMENTALS OF VOICE PRODUCTION IN SINGING

1. In addition to developing correct posture, which other fundamental functions of singing should a singer understand and develop? (Please list as many basic functions or basic principles as you can below).

2. Which terms or concepts related to each fundamental function you listed must a singer know and understand?

<table>
<thead>
<tr>
<th>TERMS</th>
<th>CONCEPTS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX D

CONTENT SEQUENCE OUTLINE
Unit IV---Acoustics of Singing

Large Step Linear--------------------------------------Discusses the basic
multiple response nature of sound, the
with overviews, components necessary for
outlines, and producing voice, sound, and
reviews properties of tone, frequency, and

Unit V---Phonation

Eclectic----------------------------------------------- Defines phonation, intro-
linear, branching, duces the relationships
c and mathetic, baboon between sound and
frames, multiple language, the
choice branching, expressive, expressive,
paragraph to retro-
gressive chaining, skip expressive, expressive,
branching, R-R (read a expressive, expressive,
paragraph then respond) expressive, expressive,
with extensive overviews, expressive, expressive,
mastery goal outlines, expressive, expressive,
X-R, I-R, and X frames, expressive, expressive,
and reviews expressive, expressive,

Unit VI---Resonation and Diction

Mathetic----------------------------------------------- Defines resonation and
diction and presents
modified large step linear information and techniques,
T-R (test respond sequences dealing with acoustics,
using pre-tests) interim and phonetic phenomena
review test, algorithms, relating to cavities of
overviews, outlines, resonance and the
multiple choice decision articulators to improve
sequences, skip branches voice quality and

Unit VII---Coordination*

Linear and Skip Branching Linear--------------------- Relates and reviews
washback, review, and material of previous
test frames units.

*Eliminated in revision three
CONTENT SEQUENCE OUTLINE AND PROGRAM FORMAT

Programming Technique

Paragraph-----------------Instructions-------------------Explains the nature and format of the program and gives instructions on how to proceed and how to use specific learning aids.

Unit I---An Introduction to Singing and Voice Production

Linear--------------------------------------------------------Defines singing, its interrelated psychological, acoustical, and physiological aspects, the five fundamental functions, and and twelve characteristics desirable in the singing voice.

Linear---------------------------Linear---------------------------with color-coded overviews, outlines, reviews, and a unit review test

Unit II---Posture

Modified Linear--------------------------------------------------Instructions for correct discrimination frame sequences, X-R (experiment and respond) frames, I-R (illustration-response) frames, X (experiment-no response) frames, multiple answers with overviews, outlines, reviews, and unit review test

Unit III---Breathing

Linearized Branching-------------------------------------------Presents correct and incorrect breathing types, phases of breathing, basic nomenclature, musculature, and correct muscular function for appropriate muscular counteraction, breath support, and breath control
Unit IV---Acoustics of Singing

Large Step Linear----------------------------------------------Discusses the basic nature of sound, the components necessary for producing vocal sound, and properties of tone, feedback, and tone sensation memory.

   multiple response
   with overviews, outlines, and reviews

Unit V---Phonation

Eclectic-----------------------------------------------------Defines phonation, discusses the function of laryngeal muscles, explains proper laryngeal attack, control, and efficiency and techniques relating to range and register.

   linear, branching, baboon frames, multiple choice branching, paragraph to retrogressive chaining, skip branching, R-R (read a paragraph then respond) with extensive overviews, mastery goal outlines, X-R, I-R, and X frames, and reviews

Unit VI---Resonation and Diction

Mathetic---------------------------------------------------Defines resonation and diction and presents information and techniques dealing with acoustical and phonetic phenomena relating to cavities of resonance and the articulators to improve voice quality and intelligibility.

   modified large step linear T-R (test respond sequences using pre-tests) interim review test, algorithms, overviews, outlines, multiple choice decision sequences, skip branches

Unit VII---Coordination*

Linear and Skip Branching Linear------------------------Relates and reviews material of previous units.

   washback, review, and test frames

*Eliminated in revision three
APPENDIX E

SAMPLE PAGES

A Self-Instructional Program On The Fundamentals of Voice Production in Singing
PLEASE NOTE:

This is not original copy.
Print on pages 160-163-A
is very light and indistinct.
Filmed as received.

UNIVERSITY MICROFILMS.
The components of complex sound form a spectrum, such as light passing through a prism breaks up into many colors. The sonograph made the graph on the left which shows time from left to right, and the pitches (basic pitch and overtones) from bottom to top. The blackness indicates greater strength (loudness) of the overtones. (areas of greater strength are called for.)

Do you think the overtones you see in the illustration above the basic pitch can be heard? (yes/no)

I-R
(Use illustration on left and if necessary names in capitals and underlined in R-R paragraph back one page)

At the top of your "Adam's apple" you should be able to find a V shaped separation where it protrudes the most. You will be resting your fingers on the front and top of the _______ cartilage. It is more difficult to feel the ring shaped _______ cartilage since it is _______ and fits _______ the gristle-like cartilage of the "Adam's apple". It is _______ impossible to feel the two ladle shaped _______ cartilages because they are located internally and at the _______ of the voice box (larynx).
Control

Resonance Impedence

When tone is allowed to pass through the resonance cavities and directly out the mouth without being in one way or another impeded, the result is air escape and "spreading". This term is based on what the overtone spectrum looks like with such production. No clear formants emerge. Instead overtones are spread all over. A tone without adequate back pressure against the vocal folds often is unstable, because the entire load of controlling air escape is placed upon the larynx itself. You should give the tone time to rebound ("bounce around") in the resonance cavities before it escapes. Greater impedance stabilizes the laryngeal output and gives the tone a ringing, "humming" vital intensity. Proper impedance:

- a. gives the feeling that the tone rebounds, arches over, and then out;
- b. gives the feeling the tone goes directly from larynx out the mouth;
- c. gives the feeling that the tone is kept inside.

Pleuotzlar breathing causes TENSION and CONTRACTION, and its INEFFICIENT, and too SLOW for ringing. It also DIMINISHES breath CAPACITY and results in an appearance.
Following the reading of each statement indicate:
1. an important statement about resonation or diction
2. the statement may relate to other aspects of singing or music but is not basic to an understanding of resonation and diction
3. the statement is false or incorrect.

After completing each page find the answers on the back.

dryness
not fast enough
not quiet enough

If you keep an open channel in your mouth, provided your nose is not "sniffed", the speed and neatness of your diction can and should be developed for nasal breathing too.
You were just asked to decipher cause and effect relationships which should have helped you to see how important resonance and diction are in the singing process. Some of the statements may also have suggested approaches in your mind. In the next few frames you will be confronted with more statements by authorities on singing. You will be asked to weight the value of the statement and test its validity. In other words some statements will be important information about resonance and diction, some will be "nice" statements out not directly related to resonance and diction, and others will have been "tampered with" rendering them fake or incorrect. In the last case attempts will be made so the statement would be correct if the opposite were true. More instructions on the back.

With an understanding of the advantages and limitations of both \[MATH\] and nasal inhalation a singer can and must make choices regarding their use. Using one technique exclusively would be unwise. Using mouth breathing exclusively, for example, often causes \[MATH\]. Similarly, nasal breathing is often not \[MATH\] enough or \[MATH\] enough.
You can even try this by lifting your arm at a right angle to your body. While muscles must "hold" the arm up, you can gradually relax the muscles which are not specialized for holding the arm up. Fortunately the balance of the postural framework seldom requires this kind of holding action.
The shift is slightly lower for basses and moves slightly higher for sopranos. Female voices often sense the need for adjustment near D⁴ or E⁴ and also D⁵ or E⁵. Men occasionally notice an adjustment near or above E⁵ because the falsetto can not usually be brought lower down.
X-R
Touch the tips of your fingers in front of you at waist level as if making a half circle around and about 6 inches away from your body. Maintain an expansive feeling as if your fingers wish to be pulled apart, then try:

A. clamping one hand gently in the other slightly above waist level (keep hands away from body)
B. dropping and relaxing one hand to the side (often the other is placed on the piano or used to gesture)
C. drop both hands to your sides (thus reaching gently on the first joint of the first two fingers)

Which do you prefer? __________

Concentrate

on

Pull

The change in quality between the various upper register types is most marked between the types which use the entire thin EDGE of the vocal folds, and DAMPING which uses just a small portion of the vocal folds. Nonetheless, the similarity between the light mechanism falsetto types of the upper register is much greater than between the upper and lower registers. Some teachers of singing, recalling techniques used by the early Italian masters and based on recent knowledge, believe that it is especially useful for "strengthening" the laryngeal mechanism (especially the arytenoid and thyroarytenoids) as a result of developing the supported falsetto. They also hold that the falsetto should be extended downward to fuse the registers. Thus, the falsetto must also be developed.
Pre-Test on Concepts of Resonation and Diction

1. A basic consideration in developing good resonance and diction is the proper production of word sounds. It is not surprising then, that a basic singer's manual on the English language defines ______________ in one word—"words".

2. The usual division of words into syllables is often different from the division of syllables in song. __________

3. A hyphen (-) generally indicates a rest or slight interruption in the music. __________

4. Speech sounds are usually divided into those articulated by "narrowing the breath channel enough to cause audible friction" and those in which the mouth is not blocked enough to cause friction. These are definitions of the __________ and the __________.

Muscles do not work in two directions. The e-a muscle can not pull a bone back and forth. This requires two opposite muscles, since a single muscle lengthens and loosens when relaxed and thickens and shortens when __________.

This training high and expensive chorus position of the words and movements of the voice is a very important task. As a result, the basic principles are at the heart of the __________.
As you progress through this unit in the programed textbook, write the answer you believe to be correct behind the corresponding number listed below. Be sure to give an answer even if you are unsure or must guess.

Your answers and any comment about each frame, outline, review, and illustration will be very helpful in the process of revising the program to make it a more effective learning aid. You do not need to comment on every frame, but when a frame is difficult to understand, confusing, too lone, seems too redundant, uses poor grammar, or any other deficiency, please write your comment as briefly as possible. If more room is needed, write the number of the frame with comment on the back.

<table>
<thead>
<tr>
<th>Frame</th>
<th>Answer</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overview</td>
<td>III-A</td>
<td>----------</td>
</tr>
<tr>
<td>Outline</td>
<td>III-A</td>
<td>----------</td>
</tr>
<tr>
<td>1.</td>
<td>exhalation, inhalation</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>inhalation, exhalation</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>exhalation</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>inhalation</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>suspending</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>recovery</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>inhalation, suspension-exhalation, recuperation</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>suspension</td>
<td>unclear, don't understand, review good</td>
</tr>
<tr>
<td>9.</td>
<td>like 7</td>
<td>maybe could cut (same as 7) terms list on answer good</td>
</tr>
<tr>
<td>10.</td>
<td>slower, noisier</td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>faster, slower mouth, nose</td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>mouth, nose</td>
<td>interesting! answer printed fuzzy</td>
</tr>
<tr>
<td>13.</td>
<td>4. &quot;ah&quot; or 2. &quot;o&quot;</td>
<td>good explanation in answer</td>
</tr>
<tr>
<td>14.</td>
<td>1, 3</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX G

PRE-TEST
Test on Unit I—An Introduction to Singing
and Voice Production

1. Most books and teachers of singing include chapters or direct attention to the
five fundamental physical accoustical functions that a singer must develop and
coordinate in singing.
List the five fundamental functions (list in the usual order of emergence
beginning with the term applied to developing expansive, erect body position):
I. 1. __________________________
   2. __________________________
   3. __________________________
   4. __________________________
   5. __________________________

II. Give a definition of singing: Singing is the __________________________

III. The word "voice" seems to have three different meanings because it can be defined
    as 1) a physical mechanism for producing vocal tone, 2) a sound one hears, and
    3) a recognizable aspect of a personality. These three aspects of voice are
    interrelated in a study of singing are called the 1) __________________ aspect,
    2) __________________ aspect, and 3) __________________ aspect.

IV. Define vibrato: Vibrato is a regulated fluctuation of ___________________
     and usually at the rate of about __________ pulsations per second.

V. List two forms of inadequate or incorrect vibrato:
   V. 1. __________________________
      2. __________________________

VI. Voices possessed by fine singers have numerous characteristics which distinguish
    them from poorer voices. A singer who wishes to develop his voice should listen
to his own singing and attempt to find techniques to produce them with his
    own voice. List twelve characteristics of the good singers voice:
    The tone of the singers voices is.
    1. __________________________
    2. __________________________
    3. __________________________
    4. __________________________
    5. __________________________
    6. __________________________
    7. __________________________
    and has: 8. __________________________
     9. __________________________
     10. __________________________
     11. __________________________
     12. __________________________

(continue with part two on the next page)
I. Use 5 reasons for the importance of good posture: The most important reasons for developing correct posture is that only expansive, erect posture will supply an adequate framework for 1. and will result in the freedom from 2. necessary for proper phonation. In addition to improving the singer's attitude, good posture also improves his 3. ________ and increases the singer's 4. ________.

II. To assure proper skeletal positions and good postural balance, the singer should make an alignment check to be sure the four balance points of the body are aligned one above the other.

II. 1. ________ List the four balance points: 1. __________
    2. __________
    3. __________
    4. __________

III. All three classes or types of muscles which have been identified by physiologists are involved in singing. While most intricate muscular activities of breathing and phonation would involve adjunct or minimal 1. ________ muscles. Most posture musculature would be considered as gross 2. ________.

IV. Developing proper posture involves three postural techniques which, when correctly used, result in three postural sensations:

IV. A. 1. ________ Proper positioning of the four balance points of the body requires proper skeletal 1. ________ which results in a sensation of 2. ________ stability.

    B. Proper positioning of the 3 major parts of the trunk and action of 3 major muscle areas is involved in the postural technique called respiratory 1. ________ which results in sensation of expansive 2. ________.

    C. The postural sensation of flexible tonicity results when only as few muscles are tensed as possible, only muscles needed for a specific task are developed, and muscles working contrary to the singing act are involved. This muscle control technique is called muscle 1. ________.
Part III—Test on Unit III

XI. List the basic parts of the breathing mechanism illustrated on the right.

1. ____________intercostal
2. ____________intercostal
3. ______________transverse
4. ________________
5. ____________oblique
6. ____________oblique
7. ________________
8. ________________

Part III—Test on Unit II

Use the Illustration on the right.

IV. The illustrations of the right shows the 3 major muscle areas (red) and the 3 parts of the trunk involved in preparing the framework for respiration (green).

The 3 major postural muscles which stretch and suspend the respiratory framework are the 1. ________________, and 2. ________________, and 3. ________________ muscles.

These muscles are used by the singer to maximally expand the 1. ________________, erect the 2. ________________, and properly position the 3. ________________. All three of the above are parts of the trunk or ________________.

Place three arrow heads on the dark black lines to show the correct direction of the movements of respiratory expansion on the figure on the right.
Test on posture--continued

(Part III)

VI. The best foot position is illustrated by (A/B/C/D).

A. 
B. 
C.  
D. 

(arrows indicate direction of weight)

VII. Besides prevention of incorrect forward curviture of the backbone and protrusion of the buttocks, the correct action of the lower abdominal muscles is complimented by tilting the under, forward, and up.

VIII. The technical term for incorrect forward curviture of the middle of the backbone is ____________.

IX. The state of partial contraction of a muscle at rest but in readiness for action is called muscle ____________.

X. Ultimately good posture is natural and functions on an unconscious level because ____________.

XI. List the two most acceptable positions for the hands when singing: 1. ____________ 2. ____________

XII. Correct jaw position in singing is generally (1) (lower/higher) and farther (2) (forward/back) than with usual "lazy" posture.

XIII. It is advisable to raise the collarbone and clavicles in singing since this widens the neck and chest (true/false).

XIV. Ankles and knees should be locked so posture will remain erect. (true/false)

XV. To properly position the trunk; thighs and buttocks should be completely relaxed. (true/false)

XVI. Posture is initially more easily learned than other singing skills because it is more observable and subject to voluntary control. (true/false)
I. Breathing for singing requires more than simply taking in air and letting it out again. What are the four phases of breathing during singing? (Place in order of accuracy and give a short definition of each.)

   I. 1. __________
   2. __________
   3. __________
   4. __________

II. There are several special requirements of the singer when taking air in during the _______ phase of breathing. Complete the following:
   a. Breathing in should be done through _______.
   b. 1. __________
   2. __________
   3. __________
   4. __________
   c. Mouth shape affects the speed and sound of breathing in. Thus the singer should use the shape one uses to produce an __________ sound to assume that the breath will be both _______.

III. There are four major breathing types. Each is named for the musculature emphasized. The first type which uses the shoulders has been discredited for use during singing. Correct breathing for singing is a coordinated and integrated combination of the other three. List the four major breathing types on the left placing shoulder breathing first.

   I. 1. __________
   2. __________
   3. __________
   4. __________

IV. The moment before phonation when air is temporarily held in balanced muscular counteraction so that breath is neither moving in or out is called _______. During this phase the _______(pharynx) should be relaxed and open as well as the space between the vocal cords which is called the _______.

V. At least 5 physical and psychological actions may take place during the momentary period following phonation and preceding air intake called _______. Complete the following of the 5 r's a singer thinks during this phase of breathing.

   1. _______ by lowering tonus of all but postural muscles (avoids tiring)
   2. _______ exterior deoxygenated air (avoids "air jag" or "booging down")
   3. get ready for the next phase by anticipating its musical demands and thinking the initial _______.
   4. _______ by checking your posture and setting up the framework for _______.

(Please write answers on the lines provided to the left of each question for ease of correction)
VI. The three most common incorrect breathing types include an outmoded technic of holding the abdomen firm when taking air in, shoulder breathing, and breathing that is opposite, reverse, or backwards from correct breathing because the stomach area goes in when taking air in and out as air goes out. List the three incorrect breathing types on the left.

VII. The incorrect breathing types you just noted are incorrect methods of breathing in. There are also at least 5 incorrect methods of breath support which often involve excess tension of a given area when forcing air out. List three incorrect methods of breath support.

VIII. There are at least seven reasons why clavicular breathing is incorrect for singing. List three:

IX. Muscles of inhalation work to steady, oppose, and resist muscles of exhalation in breathing. This subtle muscular interaction has been called muscular antagonism or muscular

X. Two major breath techniques are largely responsible for developing two of the desirable characteristics of the singer's voice. The first is a term applied to the act of supplying steady breath pressure. The second relates to breath resistance. Give a complete definition for 1. and list one of several synonyms for 2.

1. Breath pressure = breath ______________ which is defined as ______________

2. Breath resistance = breath ______________: Another term used is breath ______________
Test on Unit Four from The Fundamentals of Voice Production in Singing.

1. Singers can be confused because they have two means of monitoring or "hearing" the tone they produce. The most obvious is the ear. What other means is there?

2. What happens to the mass and length of the vocal folds when changing to a higher pitch? The mass gets _________ and the length becomes _________.

3. In addition to the epiglottis there is another set of folds above the vocal folds which can close or cover them. These are called the ____________ folds.

4. List the scientific terms for the four physical properties of tone which we hear as length, pitch, quality, and loudness.
   1. _____________
   2. _____________
   3. _____________
   4. _____________

5. The psycho-acoustical means the singer has to monitor (hear and feel) the sound he produces is called _____________.

6. Several terms are used instead of vocal folds. Circle the terms which are NOT used simultaneously with folds. Vocal:
   bands  lips  shelves  wedges  nodes  pillars

7. Using the U.S.A. Standards Association approach, indicate which number would be used to show which octave the A above middle C would be in. A________

8. Four components are necessary to produce sound. Fill in the blanks using the four components of voice production.
   Besides the breath, which is called the _____________ and the larynx which is the _____________, there are the _______ and _______ which color and shape the sound into pleasing tone and recognizable words.

9. List the three basic resonators and three major articulators involved in singing.
   Resonators:  Articulators:
   1. _____________  1. _____________
   2. _____________  2. _____________
   3. _____________  3. _____________

10. Circle the two terms which have basically the same meaning as timbre:
    intensity  quality  tone  color  register  vibrato  overtones  tonus

11. The psycho-physical means the singer uses to recall physical sensations of tone so that he can produce the same kind of tone again is called _____________.

1. Define range in your own terms or using synonyms:
   range = ________

2. The most accepted theory of registration posits that there are ______ registers.

3. There are several ways to produce falsetto tone. These include damping, closed and open ________.

4. Complete the definition of phonation by filling in the blanks:
   Phonation is the act of ________ vocal tone as a result of ________ of the ________ ________.

5. Acceptable range for the good singer should include at least:
   ________________ tones
   12/ 13/ 15/ 17

6. Proper initiation of tone requires mental and muscular preparation as well as proper control of laryngeal musculature which bring the vocal folds together. Fill in the blanks of three of the five recommended technique listed. (Note: 3 of the 5 missing words begin with S):
   1. Perfect ________ (timing) of breath and laryngeal resistance.
   2. Correct ________ or position of the larynx.
   3. Using ________ and selected muscles, called ________
   4. Mental ________ of the tone to be produced.
   5. Adequate ________ (approximation) by crico-and inter-arytenoid muscles.

7. The lid like cartilage which folds down over the larynx to send food and other matter into the esophagus rather than passing into the lungs through the ________ is called the ________.

8. List the six major voice classifications from highest voice type down to lowest. Include usual range for each voice types:

<table>
<thead>
<tr>
<th></th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>__________</td>
</tr>
<tr>
<td>2</td>
<td>__________</td>
</tr>
<tr>
<td>3</td>
<td>__________</td>
</tr>
<tr>
<td>4</td>
<td>__________</td>
</tr>
<tr>
<td>5</td>
<td>__________</td>
</tr>
<tr>
<td>6</td>
<td>__________</td>
</tr>
</tbody>
</table>

9. Circle the four terms most appropriate to complete the sentence: Proper phonation requires that the registers be:
   eliminated extended modified de-emphasized balanced overlapped differentiated fused

10. The term used for initiation or onset of tone is ________. Correct tone is initiated by instantaneous and simultaneous counteraction of breath pressure and laryngeal resistance. List two incorrect types of resulting from to much resistance and when there is air escape before vibration of the larynx:
    1. ________ 2. ________
11. A specific term is applied to the portion of the singer's range which is produced with the most beauty and ease. It is also defined as the pitch region in which most of the notes of a song or rule lie. If this is high, the role or song is said to have a "high _____________."

12. There are many names given to the various recognizable changes in quality in the voice called registers. Some have names referring to the kind of mechanism adjustment used, some to where the tone seems to "come from", and others originated in a specific country or were named to indicate a register that was no "true voice." List four names given to registers:
1. ________________
2. ________________
3. ________________
4. ________________

13. List the three major cartilages and three major muscle sets of the larynx. Place them before the correct description given.

Cartilages:
1. _____________ = cartilage called the "adam's apple."
2. _____________ = ring shaped, below and inside the "adam's apple."
3. _____________ = two ladle shaped cartilages located internally and at the back of the voice box.

Muscle sets:
1. _____________ = the "vocal folds", long thin muscle attached to ladle shaped and "adam's apple" cartilages.
2. _____________ = attached to ring shaped and "adam's apple" cartilages, called the "stretcher."
3. _____________ = open the vocal folds, attached to ladle and ring shaped cartilages, (not the inter-_____)

14. Name the two types of range espained below:

__________ range = range ----- including every tone one can produce no matter what quality.

__________ range = range ----- including only tones which are musically and vocally practical for usual singing.
1. Delaying the final consonant so it becomes the initial consonant of the next word is called _________________ (French word).

2. The illustration on the right could be an acoustical picture of the concentration of overtones for a specific vowel. These "peaks" are called _______________.

3. Consonants should be sounded ____________ the musical beat and vowels should be ____________ the beat.

4. The term associated with the back pressure which results from adequate resonance control is called _______________.

5. Give a definition of resonation: __________________________________________________________.

6. Diction deals with producing and uttering word sounds. There are three words which describe more specific activities involved in diction. Give the correct term for each of the explanations below:

   * ________________ concerned with the action of the speech organs in joining speech sounds, especially in forming consonants.
   * ________________ deals with the sounds of words as given in the dictionary.
   * ________________ concerned with uttering of speech sounds, with emphasis upon vowels and syllables.

7. Complete the following "rules of resonance":
   a. The larger the resonator or resonance space ________________
   b. The softer the texture or surface of the cavity wall the more ________________
   c. Enlarging the orifice of a cavity causes it to resonate ________________
   d. When the neck of a resonator is lengthened it resonates ________________

8. The admixture of noise sounds and the fluctuation within a tone is sometimes called the 5th characteristic or property of tone. The term for this noise related aspect of tone is ________________.

9. Complete the following by giving the correct shape, position, or size:
   a. The palate should be ________________
   b. The tongue should be ________________
   c. The lips should be ________________

10. Give two terms which are used to describe voice quality. The first must be a "visual" image, the second "tactile":
    a. ________________    b. ________________
11. Fill in the vowel chart below. Be sure each is in the right position.

12. Fill in the parts of the consonant chart below which are empty.
   (You will need to use p, b, f, t, k, l):
13. It is advisable to make the sound of the consonant as different from that of a vowel as possible. This technique is called phoneme _________.

14. The "ring" in the voice comes with a strong concentration of overtones at about ________ cycles per second (cps).

15. When the articulators are flexible it is possible to make sudden position changes from vowel to consonant to vowel. This technique is referred to as making rapid articulatory _________.

16. The two arched "pillars" which are formed as a result of low laryngeal position and proper positioning of the palate are located _________.

17. When the singer strives to make the vowel sounds similar enough to produce a "vocal line" we say he ________izes the vowels.

18. The last part of a diphthong or compound vowel is called the _________.

19. When a vowel is not modified or affected by sounds around it, the vowel is called a stable or ________ vowel. The technique associated with maintaining the stability of the vowel is called vowel _________.

20. List two rules about consonants that relate to how long they should last and the frequency level.
   1. ______________________  2. ______________________

21. Consonant connection (on which syllable to place the consonant) is important in singing. Place arrow heads on the correct side of the lines below to indicate the correct direction for the following:
   a. m, n, and ng, when preceded by a vowel ( __________ ).
   b. initial l ( __________ ).
   c. v moving to lower pitch ( __________ ).
   d. w preceded by a consonant moving _________. ( __________ ).

22. Give two examples of the modification of usual speech sounds by singers. (choose from w, s, ay/e/, or Ee/i/):
   ________ becomes ________ in singing.
   ________ becomes ________ in singing.

23. Each consonant has a point of articulation (i.e. lips=labial) and a manner of articulation (i.e. f=fricative). The classes of consonants are based on points of articulation. Classes are listed below, points are lettered in the diagram. Fill in the remaining letters that correspond to each class of sound.

   1. c  alveolars
   2. b  dentals
   3. (labials
   4. (palatals
   5. (velars
   6. (uvulars
APPENDIX H

POST-TEST
I. Give a definition of singing: Singing is the

II. Voices possessed by fine singers have numerous characteristics which distinguish them from poorer voices. A singer who wishes to develop his voice should listen to his own singing and attempt to find techniques to produce them with his own voice.
List twelve characteristics of the good singer's voice:
The tone of the singer's voice is
1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.
12.
and has

III. Most books and teachers of singing include chapters, or direct attention, to the five fundamental physical-acoustical functions that a singer must develop and coordinate in singing.
List the five fundamental functions (list in the usual order of emergence beginning with the term applied to developing expansive, erect body position):
1.
2.
3.
4.
5.

IV. The word "voice" seems to have three different meanings because it can be defined as 1) a physical mechanism for producing vocal tone, 2) a sound one hears, and 3) a recognizable aspect of a personality. These three aspects of voice are interrelated in a study of singing and are called the 1). aspect, 2). aspect, and 3). aspect.

V. List two forms of inadequate or incorrect vibrato.
1.
2.

VI. Define vibrato: Vibrato is a regulated fluctuation of ______ and ______ usually at the rate of about ______ pulsations per second.
Test on Unit II—Posture

(Please write answers on the lines provided to the left of each question for ease of correction.)

I. Posture is initially more easily learned than other singing skills because it is more observable and subject to voluntary control. (true/false)

II. The state of partial contraction of a muscle at rest but in readiness for action is called muscle ________.

III. Ultimately good posture is natural and functions on an unconscious level because it has become a ________.

IV. Ankle and knees should be locked so posture will remain erect. (true/false)

V. To properly position the trunk, thighs and buttocks should be completely relaxed. (true/false)

VI. It is advisable to raise the collarbone and clavicles in singing since this widens the neck and chest. (true/false)

VII. List the two most acceptable positions for the hands when singing. 1. ________

VIII. Correct jaw position in singing is generally 1. (lower/higher) and farther 2. (forward/back) than with usual "lazy" posture.

IX. The technical term for incorrect forward curvature of the middle of the backbone is ________________.

X. Besides prevention of incorrect forward curvature of the backbone and protrusion of the buttocks, the correct action of the lower abdominal muscles is complimented by tilting the ________ under, forward, and up.

XI. The best foot position is illustrated by (A/B/C/D).

A.  
B.  
C.  
D.  

(arrows indicate direction of weight)
XII. To assure proper skeletal positions and good postural balance the singer should make an alignment check to be sure the four balance points of the body are aligned one above the other.

List the four balance points:
1. __________
2. __________
3. __________
4. __________

XIII. (Use the 5 reasons for the importance of good posture)
The most important reasons for developing correct posture is that only expansive, erect posture will supply an adequate framework for 1. ______ and will result in the freedom from 2. ______ necessary for proper phonation. In addition to improving the singer's attitude, good posture also improves his 3. ______ and increase the singer's 4. ______.

XIV. All three classes or types of muscles which have been identified by physiologists are involved in singing. While most intricate muscular activities of breathing and phonation would involve adjacent or minimal 1. ______ muscles, most postural musculature would be considered as gross 2. ______.

XV. Developing proper posture involves three postural technics which, when correctly used, result in three postural sensations.

A. Proper positioning of the four balance points of the body requires proper skeletal 1. ______ which results in a sensation of 2. ______ stability.

B. Proper positioning of the 3 major parts of the trunk and action of 3 major muscle areas is involved in the postural technic called respiratorv 1. ______ which results in the sensation of expansive 2. ______.

C. The postural sensation of flexible tonicity results when only as few muscles are tensed as possible, only muscles needed for a specific task are developed, and muscles working contrary to the singing act are involved. This muscle control technic is called muscle 1. ______.
PART III--Test on Unit II

Use the illustration on the right.

V. The illustration on the right shows the 3 major muscle areas (red), and the 3 major parts of the trunk involved in preparing the framework for respiration (green).

The 3 major postural muscles which stretch and suspend the respiratory framework are the 1._______________________, 2._______________________, and 3._______________________ muscles.

These muscles are used by the singer to maximize expand the 1.___________, erect the 2._____________, and properly position the 3._______________________.

All three of the above are parts of the trunk or_______________________.

Place three arrow heads on the dark black lines to show the correct direction of the movements of respiratory suspension on the figure on the right.
Test on Unit III—Breathing

(Please write answers on the lines provided to the left of each question for ease of correction.)

I. There are four major breathing types. Each is named for the musculature emphasized. The first type which uses the shoulders has been discredited for use during singing. Correct breathing for singing is a coordinated and integrated combination of the other three. List the four major breathing types on the left placing shoulder breathing first.

1. ____________
2. ____________
3. ____________
4. ____________

II. The three most common incorrect breathing types include an outdated technic of holding the abdomen firm when taking air in, shoulder breathing, and breathing that is opposite, reverse, or backwards from correct breathing because the stomach area goes in when taking air in and out as air goes out. List the three incorrect breathing types on the left.

1. ____________
2. ____________
3. ____________

III. The incorrect breathing types you just noted are incorrect methods of breathing in. There are also at least 5 incorrect methods of breath support which often involve excess tension of a given area when forcing air out. List three incorrect methods of breath support.

1. ________ tension
2. ________ tension
3. ________

IV. Breathing for singing requires more than simply taking in air and letting it out again. What are the four phases of breathing during singing? (Place in order of occurrence and give a short definition of each.)

1. ____________
2. ____________
3. ____________
4. ____________

V. There are several special requirements of the singer when taking air in during the ________ phase of breathing. Complete the following:

a. Breathing in should be done through ________.

b. 1. ________
  2. ________
  3. ________
  4. ________ in a comfortable and relaxed position.

c. 1. ________
  2. ________
  3. ________
  4. ________

d. Mouth shape affects the speed and sound of breathing in. Thus the singer should use the shape one uses to produce an ________ (neutral vowel) sound to assure that the breath will be both ________.
Test on Unit III—part II

VI. The moment before phonation when air is temporarily held in balanced muscular counteraction so that breath is neither moving in or out is called _______. During this phase the (pharynx) should be relaxed and open as well as the space between the vocal cords which is called the _______.

VII. At least 5 physical and psychological actions may take place during the momentary period following phonation and preceding air intake called _______. Complete the following of the 5 r's a singer thinks during this phase of breathing.
1. _______ by lowering tonus of all but postural muscles (avoids tiring)
2. _______ excess or deoxygenated air (avoids "air jog" or "bogging down")
3. get ready for the next phase by anticipating its musical demands and thinking the initial _______.
4. recover by checking your posture and setting up the framework for _______.

VIII. Two major breath technics are largely responsible for developing two of the desirable characteristics of the singer's voice. The first is a term applied to the act of supplying steady breath pressure. The second related to breath resistance. Give a complete definition for 1. and list one of several synonyms for 2.

1. breath pressure=breath _______. which is defined as _____________.
2. breath resistance=breath _______. another term used is breath _______.

IX. Muscles of inhalation work to steady, oppose, and resist muscles of exhalation in breathing. This subtle muscular interaction has been called muscular antagonism or muscular _______.

X. There are at least seven reasons why clavicular breathing is incorrect for singing. List three:
1. _______.
2. _______.
3. _______.
Part IIJ-Test on Unit III

XI. List the basic parts of the breathing mechanism illustrated on the right.

1. __________ intercostal
2. __________ intercostal
3. transverse
4. __________
5. __________ oblique
6. __________ oblique
7. __________
8. __________
Test on Unit Four from The Fundamentals of Voice Production in Singing

1. List the scientific terms for the four physical properties of tone which we hear as length, pitch, quality, and loudness:
   1. __________________________
   2. __________________________
   3. __________________________
   4. __________________________

2. Four components are necessary to produce sound. Fill in the blanks using the four components of voice production.
   Besides the breath, which is called the ____________, and the larynx which is the ____________, there are the ____________ and ____________, which color and shape the sound into pleasing tone and recognizable words.

3. Singers can be confused because they have two means of monitoring or "hearing" the tone they produce. The most obvious is the ear. What other means is there?
   __________________________

4. The psycho-physical means the singer uses to recall physical sensations of tone so that he can produce the same kind of tone again is called __________________________.

5. The psycho-acoustical means the singer has to monitor (hear and feel) the sound he produces is called __________________________.

6. Using the U.S.A. Standards Association approach, indicate which number would be used to show which octave the A above middle C would be in. A_____

7. What happens to the mass and length of the vocal folds when changing to a high-pitch? The mass gets ____________, and the length becomes ____________.

8. Circle the two terms which have basically the same meaning as timbre:
   intensity quality tone color register vibrato overtone tonus

9. Several terms are used instead of vocal folds. Circle the terms which are NOT used simultaneously with folds. Vocal:
   bands lips shelves wedges nodes pillars

10. In addition to the epiglottis there is another set of folds above the vocal folds which can close or cover them. These are called the ____________ fold.

11. List the three basic resonators and three major articulators involved in singing.

   Resonators:
   1. __________________________
   2. __________________________
   3. __________________________

   Articulators:
   1. __________________________
   2. __________________________
   3. __________________________
1. Complete the definition of phonation by filling in the blanks:

Phonation is the act of _______ vocal tone as a result of _______ of the _______ _______.

2. List the three major cartilages and three major muscle sets of the larynx. Place them before the correct description given.

Cartilages:
1. _______ set = cartilage called the "adam's apple"
2. _______ set = ring shaped, below and inside the "adam's apple"
3. _______ set = two ladle shaped cartilages located internally and at the back of the voice box.

Muscle sets:
1. _______ = the "vocal folds", long thin muscle attached to ladle shaped and "adam's apple" cartilages.
2. _______ = called the "stretcher", attached to ring shaped and "adam's apple" cartilages
3. _______ = open the vocal folds, attached to ladle and ring shaped cartilages, (not the inter-_______)

3. The terms used for initiation or onset of tone is _______.

Correct tone is initiated by instantaneous and simultaneous counteraction of breath pressure and laryngeal resistance. List two incorrect types of resulting from too much resistance and when there is air escape before vibration of the larynx: 1. _______ 2. _______.

4. Proper initiation of tone requires mental and muscular preparation as well as proper control of laryngeal musculature which bring the vocal folds together. Fill in the blanks of tone of the five recommended technique listed. (note: 3 of the 5 missing words begin with S):

1. Perfect _______ (timing) of breath and laryngeal resistance.
2. Correct _______ or position of the larynx.
3. Using fewest and selected muscles, called muscle _______.
4. Mental _______ of the tone to be produced.
5. Adequate _______ (approximation) by crico- and inter-arytenoid muscles.

5. List the six major voice classifications from highest voice type down to lowest. Include usual range for each voice types:

1. _______ _______ _______ _______ _______ _______.
2. _______ _______ _______ _______ _______ _______.
3. _______ _______ _______ _______ _______ _______.
4. _______ _______ _______ _______ _______ _______.
5. _______ _______ _______ _______ _______ _______.
6. _______ _______ _______ _______ _______ _______.

6. There are several ways to produce falsetto tone. These include damping, closed and open _______.

7. Circle the four terms most appropriate to complete the sentence: Proper phonation requires that the registers be: eliminated _______ extended _______ modified _______ differentiated _______ balanced _______ overlapped _______ fused _______.

8. List the six major voice classifications from highest voice type down to lowest. Include usual range for each voice types:

1. _______ _______ _______ _______ _______ _______.
2. _______ _______ _______ _______ _______ _______.
3. _______ _______ _______ _______ _______ _______.
4. _______ _______ _______ _______ _______ _______.
5. _______ _______ _______ _______ _______ _______.
6. _______ _______ _______ _______ _______ _______.

9. There are several ways to produce falsetto tone. These include damping, closed and open _______.

10. Circle the four terms most appropriate to complete the sentence: Proper phonation requires that the registers be: eliminated _______ extended _______ modified _______ differentiated _______ balanced _______ overlapped _______ fused _______.

11. List the six major voice classifications from highest voice type down to lowest. Include usual range for each voice types:

1. _______ _______ _______ _______ _______ _______.
2. _______ _______ _______ _______ _______ _______.
3. _______ _______ _______ _______ _______ _______.
4. _______ _______ _______ _______ _______ _______.
5. _______ _______ _______ _______ _______ _______.
6. _______ _______ _______ _______ _______ _______.
8. Define range in your own terms or using synonyms:

\[ \text{range} = \] 

9. Name the two types of range explained below:

\[ \text{range} = \text{range} ----\text{including every tone one can produce no matter what quality.} \]

\[ \text{range} = \text{range} ----\text{including only tones which are musically and vocally practical for usual singing.} \]

10. Acceptable range for the good singer should include at least: 

\[ \] tones.

12. There are many names given to the various recognizable changes in quality in the voice called registers. Some have names referring to the kind of mechanical and adjustment used, some to where the tone seems to "come from", and others originated in a specific country or were named to indicate a register that was not "true voice." List four names given to registers:

1. 
2. 
3. 
4. 

13. The most accepted theory of registration posits that there are ____________ registers.

14. A specific term is applied to the portion of the singer's range which is produced with the most beauty and ease. It is also defined as the pitch region in which most of the notes of a song or role lie. If this is high, the role or song is said to have a "high \[ \]".

15. The lid like cartilage which folds down over the larynx to send food and other matter into the esophagus rather than passing into the lungs through the \[ \] is called the \[ \].
1. Give a definition of resonance: ____________________________

2. Diction deals with producing and uttering word sounds. There are three words which describe more specific activities involved in diction. Give the correct term for each of the explanations below:
- ___________________________ concerned with the action of the speech organs in joining speech sounds, especially in forming consonants.
- ___________________________ deals with the sounds of words as given in the dictionary.
- ___________________________ concerned with uttering of speech sounds, with emphasis upon vowels and syllables.

3. Complete the following "rules of resonance":
   a. The larger the resonator or resonance space ____________________________
   b. The softer the texture or surface of the cavity wall the more ____________________________
   c. Enlarging the orifice of a cavity causes it to resonate ____________________________
   d. When the neck of a resonator is lengthened it resonates ____________________________

4. The admixture of noise sounds and the fluctuation within a tone is sometimes called the 5th characteristic or property of tone. The term for this noise related aspect of tone is ____________________________

5. Complete the following by giving the correct shape, position, or size:
   a. The palate should be ____________________________
   b. The tongue should be ____________________________
   c. The lips should be ____________________________

6. Give two terms which are used to describe voice quality. The first must be a "visual" image, the second "tactile":
   a. ____________________________ b. ____________________________

7. It is advisable to make the sound of the consonant as different from that of a vowel as possible. This technique is called phoneme ____________________________.

8. The "ring" in the voice comes with a strong concentration of overtones at about _______ cycles per second (cps).

9. When the articulators are flexible it is possible to make sudden position changes from vowel to consonant to vowel. This technique is referred to as making rapid articulatory ____________________________.

10. The two arched "pillars" which are formed as a result of low laryngeal position and proper positioning of the palate are located ____________________________.

11. When the singer strives to make the vowel sounds similar enough to produce a "vocal line" we say he ____________________________izes the vowels.
12. Delaying the final consonant so it becomes the initial consonant of the next word is called __________ (French word).

13. The illustration on the right could be an acoustical picture of the concentration of overtones for a specific vowel. These "peaks" are called __________.

14. Consonants should be sounded __________ the musical beat and vowels should be __________ the beat.

15. The term associated with the back pressure which results from adequate resonance control is called __________.

16. The last part of a diphthong or compound vowel is called the __________.

17. When a vowel is not modified or affected by sounds around it, the vowel is called a stable or __________ vowel. The technique associated with maintaining the stability of the vowel is called vowel __________.

18. List two rules about consonants that relate to how long they should last and the frequency level.
1. _____________
2. _____________

19. Consonant connection (on which syllable to place the consonant) is important in singing. Place arrow heads on the correct side of the lines below to indicate the correct direction for the following:
   a. m, n, and ng, when preceded by a vowel ( ___________ ).
   b. initial l ( ___________ ).
   c. v moving to lower pitch ( ___________ ).
   d. w preceded by a consonant moving ( ___________ ).

20. Give two examples of the modification of usual speech sounds by singers. (Choose from w, s, ay/e/, or Ee/i/):
   _______ becomes _________ in singing.
   _______ becomes _________ in singing.

21. Each consonant has a point of articulation (i.e. lips=labial) and a manner of articulation (i.e. f- fricative). The classes of consonants are based on points of articulation. Classes are listed below, points are lettered in the diagram. Fill in the remaining letters that correspond to each class of sound.

   1. c alveolars
   2. b dentals
   3. ________ abial
   4. ________ palatais
   5. ________ velars
   6. ________ uvulars
11. Fill in the vowel chart below. Be sure each is in the right position.

12. Fill in the parts of the consonant chart below which are empty. (You will need to use p, m, f, t, k, l):
Items eliminated from tests with final test revision.

Item 15 (Unit V) Label each of the parts of the vocal phonating mechanism in the illustration below.

Item 24 (Unit VI) The International Phonetic Association phonetic alphabet includes ________ symbols.

Item 25 (Unit VI) Give phonetic transcriptions for the following:
boy _____, shower _____, singing ________
fundamental ________, functions ________.
STUDENT DATA SHEET

Name: ________________________________

Skill Level Classification: (check one)

1 _______ high school beginning private (no previous voice study)
2 _______ adult beginning private
3 _______ college voice class I
4 _______ college voice class II
5 _______ intermediate college private (less than three terms of previous private or class study)
6 _______ advanced college private (three or more terms of previous study)

Grade Point Average Groups:

1 _______ 1.5-2.0 D- C
2 _______ 2.0-2.5 C- C+
3 _______ 2.5-3.0 C+ B
4 _______ 3.0-3.5 B- B+
5 _______ 3.5-4.0 A- A

Age Group:

1 _______ junior and senior high school
2 _______ adult (non-college)
3 _______ college freshman
4 _______ college sophomore
5 _______ college junior
6 _______ college senior

Do not fill in below this line

Group: student number appears behind appropriate group

1 Group A Beginning private (#1-12)
2 Group B Voice class I (#13-24)
3 Group C Voice class II (#25-36)
4 Group D Private voice (#37-48)
5 Forced paced from paired group (#51-62)
6 Self paced from paired group (#51-62)
## Data Sheet (for computer use)

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APPENDIX K

OPINIONNAIRE
OPINIONNAIRE

1. Which of the statements below best describes your reaction to the program on the fundamentals of singing?

1 _____ Extremely positive. Found the program a highly motivating, enjoyable and effective way to learn.
2 _____ Positive. Found the program a motivating, enjoyable and effective compliment to other learning.
3 _____ Neither negative or positive.
4 _____ Negative. Did not find the program an especially motivating, enjoyable, or effective means to learn.
5 _____ Extremely negative. Disliked the program and found it unmotivating and ineffective.

2. Excluding time required to take the pre and post-test how many hours did you spend completing the program?

1 _____ 6-12 hours
2 _____ 12-16 hours
3 _____ 16-20 hours

3. Place an M before the unit and programing approach you most preferred and L before your least preferred unit.

1 _____ Unit I  Introduction  (small step linear)
2 _____ Unit II  Posture  (modified linear)
3 _____ Unit III  Breathing  (linearized branching)
4 _____ Unit IV  Acoustic  (large step linear)
5 _____ Unit V  Phonation  (eclectic)
6 _____ Unit VI  Resonation and Diction  (mathetic)

4. Which of the following statements best describes how you view the program as an aid or adjunct to the study of voice?

1 _____ Very effective adjunctive aid. Prefer to usual learning guides such as books and lectures.
2 _____ An effective way to learn the fundamentals of singing without taking class time. Compliments other learning guides.
3 _____ Effective way to learn fundamentals. Compares favorably with other learning aids.
4 _____ Prefer other ways to learn fundamentals of singing such as books and lectures.
5 _____ The program is ineffective as an adjunctive aid.
6 _____ The program detracts from other voice study.
APPENDIX L

A SELF-INSTRUCTIONAL PROGRAM ON THE
FUNDAMENTALS OF VOICE PRODUCTION IN SINGING

An original copy of the 180 page copywritten program is available on loan from the School of Music, The Ohio State University, Columbus, Ohio.
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BIBLIOGRAPHY


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