Teaching Clarinet Fingerings with Teaching Machines

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Purpose of Study

THE PRINCIPAL PURPOSE of this study was to devise a means of conserving the classroom time of the instrumental music teacher. The author was interested in determining whether or not certain aspects of beginning clarinet playing could be taught on teaching machines just as effectively as they could be taught by the teacher in the normal class method of instruction. A teaching machine program was developed to teach beginning clarinet students clarinet fingerings and such factual knowledge as the names of the parts of the clarinet, the names of the various clarinet keys, and the names of the different ranges of the clarinet. The completed teaching machine program was used in conducting a controlled experiment with beginning clarinet students.

Teaching Machine Program

The teaching machine program which was developed used the branching technique of programing and the multiple choice mode of response to questions. These techniques were used so that none of the instructor's time would be used in correcting answer tapes, and because the multiple choice response program tends to be self-correcting. By self-correcting is meant that when an incorrect response is made, the student is corrected immediately so that he does not proceed without first having found out why he was wrong.

There were two objectives for the teaching machine program. The first was to teach clarinet fingerings, and the second was to teach some factual knowledge about the clarinet. The teaching of clarinet fingerings and the correct choice of fingerings when several were available, constituted the primary objective. The factual knowledge taught included such things as the pitch names of the clarinet keys, the parts of the clarinet, and the fact that the clarinet overblows an interval of a twelfth.

The teaching machine program did not teach such things as how the lips are held, how to breathe correctly, and what a good tone sounds like.

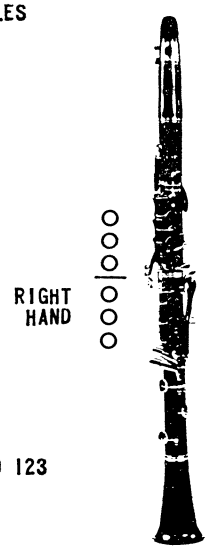
The clarinet fingerings were presented to the students by means of fingering diagrams. The fingering diagram was shown with a picture of a clarinet to indicate the relation of the circles and the fingerholes which they represent (Figure 1A). Then the diagram with dots for some of the circles, indicating that the fingers are covering the fingerholes represented by dots, was shown with a picture of that note being fingered on the clarinet (Figure 1B). The next step was the use of the diagram, photographs of the clarinet being played, the note being played indicated by pitch name and also given in music notation (Figure 1C).

After the students had become familiar with the fingering diagrams, the photographs of the clarinet gradually vanished. Then the students were

A

122

THE THREE CIRCLES BELOW THE LINE REPRESENT THE THREE FINGER-HOLES OF THE RIGHT HAND.



GO TO 123

B

136

COMPARE THE DIAGRAM AND THE PHOTOGRAPH AND THEN FINGER THE NOTE ON YOUR CLARINET.

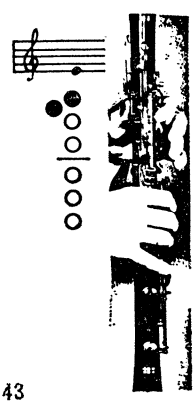
GO TO 137

C

145

CORRECT.

E, ON THE FIRST LINE, IS FINGERED WITH THE THUMB AND FIRST FINGER OF THE LEFT HAND, LIKE THIS.



GO TO 143

D

112

NOW THAT YOU KNOW HOW TO FINGER D,

HOW DO YOU THINK YOU WOULD FINGER E,

?

(113) (111)

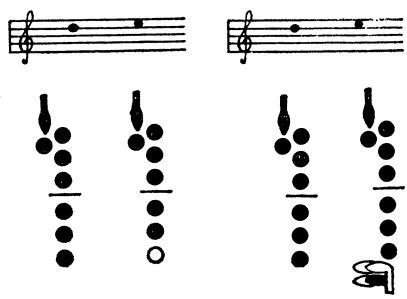


Figure 1. Four frames from program for teaching clarinet fingerings.

given the fingerings with the diagram and notation and pitch names (Figure 1D). When a new key or group of keys was used, a photograph was used to clarify the position of the keys in the diagram. After the students had learned the notes, they used them in a short exercise and then in some melodic material. For the final phase, the melodic material, the student had neither diagrams nor photographs, but he was given the option of reviewing any of the notes of which he was uncertain.

Experiment

The students used in the experiment were college students at Southern Illinois University who had had no previous experience playing clarinet. The students were randomly assigned to one of three groups by drawing each of their names from a hat. Group I was the control group and it consisted of seven members. Group II was an experimental group which used the teaching machine; it consisted of six members. The students of this group had a clarinet in their hands while using the teaching machine, but they could not play it as the mouthpiece had been removed. Group III was an experimental group which used the teaching machine; it consisted of five members. Each member of Group III had a clarinet with the mouthpiece on it while he was using the teaching machine. These students could play the clarinet while using the teaching machine. The comparison of the three groups can be made from Table 1.

The Instructional Program

The instructional period for the experiment was five and one-half weeks, which was one-half of a quarter of instruction. The instructional classroom periods were each of 50-minute duration.

On Mondays and Thursdays Groups I, II, and III met together as a combined group for their instruction. During these periods of the combined groups, the students played individually and in ensemble, and they learned such techniques as how to blow the clarinet, how to produce a good tone, how to tongue on the clarinet, and the correct clarinet embouchure.

Group I met with the instructor on Tuesdays and Wednesdays and received in class the instruction which

TABLE 1
CHARACTERISTICS OF GROUPS PARTICIPATING IN EXPERIMENTAL STUDY ON LEARNING CLARINET FINGERINGS

	Group I	*Group II*	*Group III*
No. of members	7	6	5
No. of men	6	3	3
No. of women	1	3	2
Music majors	5	6	5
Non-music students	2	0	0
Average age	20yr 7mo	19yr 9mo	19yr 1mo
Average school classification	2.00	1.83	1.40
Average SCAT* score	62.44	68.50	62.40
Average grade point**	3.444	3.900	3.374
Performing media:			
Piano	1	3	2
Voice	1	1	0
String instrs.	1	1	1
Brass instrs.	3	1	2
Woodwind instrs.	1	0	0

* Raw score on the Total Ability of the School and College Aptitude Test.
** Figured on a five-point scale.

the experimental groups were receiving on the teaching machine. On Tuesday and Wednesday, Group I learned the clarinet fingerings, the use of the fingering diagram, the names of the parts of the clarinet, and the fact that the clarinet overblows an interval of a twelfth.

Both experimental groups, Groups II and III, met with Group I, the control group, on Mondays and Thursdays, and received one-half of their instruction on these days. Groups II and III received the other half of their instruction on the teaching machine. Each of the members of both experimental groups arranged to take two lessons on the teaching machine between the Monday class meeting and the Thursday class meeting. The teaching machine lessons were arranged at the convenience of the students. In a few instances a lesson was not completed before the next class meeting. In these cases the students completed the incomplete lesson and the other lessons before the next class meeting. There was no restriction placed on the students in regard to the length of time they spent on a lesson. The students were also free to take two teaching machine lessons at one sitting, or to take one lesson one period and the other lesson at a different period. Some students began with two different periods and decided to change to one extended period. Some students started with an extended lesson period and others took each lesson at a different period.

From the teaching machine program the students learned what the control group learned at their Tuesday and Wednesday class meetings.

The Testing Program

Each of the students in the experiment, members of Groups I, II, and III, had a clarinet loaned to him for his personal use. The clarinets were all new Bundy Resonite B♭ Clarinets which were loaned for use in the experiment by the H & A Selmer Company of Elkhart, Indiana.

Each of the students in the experiment took three tests during the course of the experiment. Before any instruction was given each of the members of Groups I, II, and III was given a written examination. The test covered the fingerings of the clarinet and such factual knowledge as the names of the clarinet keys and the names of the registers of the clarinet. The student's score on this written examination was the number of correct answers. The highest possible score was 50.

At the completion of the instructional period all of the students took two examinations. One of these examinations was the same test which was used as a pretest. The student's final score on the written part of the testing program was his net gain on the posttest over the pretest.

The second part of the posttest was an examination on the students' ability to play the clarinet. For this test the students were required to play scales and a short sight reading exercise. This test was designed to determine whether or not the students could use the information and skills which they had learned in class or on the teaching machine, in playing the clarinet. The students were each graded on the number of wrong notes, the number of incorrect articulations, incorrect fingerings, tone quality, embouchure, tonguing, and intonation.

The student's performance was evaluated by a committee of three members. Robert Forman and Robert Resnick were members of the faculty of the Department of Music at Southern Illinois University, and William Tar-

water was a member of the University School faculty, College of Education, Southern Illinois University. Just prior to the examination, the three committee members were given the rating sheets and the instructions for marking the sheets and evaluating the learning that had resulted from the use of the several procedures. Dr. Forman, acting as chairman, informed the students of the material to be played and started each of them playing at the same tempo.

Each of the committee members had a separate rating sheet for each of the students. The committee members marked the errors directly on the rating sheet by means of a check mark or a cross. There were three objective aspects to the grading, and each committee member graded one of these. Thus, one member graded incorrect notes, another incorrect articulations, and the third graded incorrect fingerings. Fingerings were considered to be incorrect when the person played the correct note but chose the wrong fingering from among those available for that note. Incorrect notes were those notes of the wrong pitch or notes which the student failed to play. Articulation errors were marked when a student tongued when he should have slurred, or when he slurred where he should have tongued.

Each of the committee members was instructed to grade each student on the four subjective aspects of clarinet playing indicated on the rating sheets. The committee members marked the subjective aspects according to their personal judgment. The rating scale extended from one for excellent to ten for poor. Then the committee's ratings were averaged for each student on each of the four subjective aspects of clarinet playing. For each student, the committee ratings for tone, embouchure, tonguing, and intonation were averaged. These four averages were then used as the student's scores on the subjective part of the performance test.

The total score for the performance test was arrived at by combining all of the scores from the different parts of the test. The total score equaled the number of wrong notes plus the number of incorrect fingerings, plus the number of incorrect articulations, plus the average scores on tone, embouchure, tonguing, and intonation. On the performance test, a good score was a low score, while a poor score was a high score. The data for all tests are given in Table 2.

The Teaching Machine

The teaching machine used in the experiment was a machine designed by the Instructional Materials Department of Southern Illinois University for use in experimenting with pictorial branching type programing. Three Sarkes Tarvian Random Selector slide projectors were used. Each projector had a capacity of 50 two-by-two (2″ x 2″) slides, thus making the total capacity 150 slides. The Random Selector allowed any slide to be shown at any time. The three projectors were electrically connected by means of a relay rack. The relay rack permitted the subject to choose any of the slides in any of the machines, thus giving the programer the random choice of the 150 slides.

In operation the procedure was as follows: The student was told the slide number on which to start, say 101. Then the student cleared the relay rack by pressing the "clear" button. Next he entered 101 on the console by pressing button number one in the hundred column. To activate the projector the student pressed the "show" button, at which time slide

TABLE 2
RAW SCORES AND NET GAIN ON WRITTEN AND PERFORMANCE TESTS FOR STUDENTS IN THE CONTROL AND EXPERIMENTAL GROUPS

Student	*Group*	*Pretest (Written)*	*Postest (Written)*	*Net Gain (Written)*	*Performance Test*
1	I	0	43	43	79.3
2	I	6	43	37	67.7
3	I	1	40	39	127.5
4	I	0	17	17	111.2
5	I	1	45	44	124.3
6	I	7	39	32	102.3
7	I	2	28	26	96.7
8	II	2	33	31	103.3
9	II	0	27	27	149.2
10	II	3	30	27	129.3
11	II	2	26	24	115.3
12	II	1	35	34	125.3
13	II	5	44	39	80.0
14	III	4	29	25	108.7
15	III	6	36	30	38.3
16	III	2	43	41	117.3
17	III	0	35	35	134.2
18	III	2	35	35	87.2

number 101 was projected on the screen. At the end of information slides the student was directed to the next slide by the words GO TO, followed by the frame number. For the multiple choice questions, the student was given a number of possible answers. For each of these answers there was a slide number. The student chose the answer he thought was best and entered that slide number on the console. Figure 2 is a drawing of the teaching machine rooms.

Analysis and Results

The three groups of students involved in this study were compared with each other in regard to age, grade point average, School and College Aptitude Test scores, school classification, and scores on the pretest. The F-ratio was used as the statistical method of comparing the groups. An F-ratio was computed for each of the variables, and the ten percent level of confidence was used as the acceptance level. To

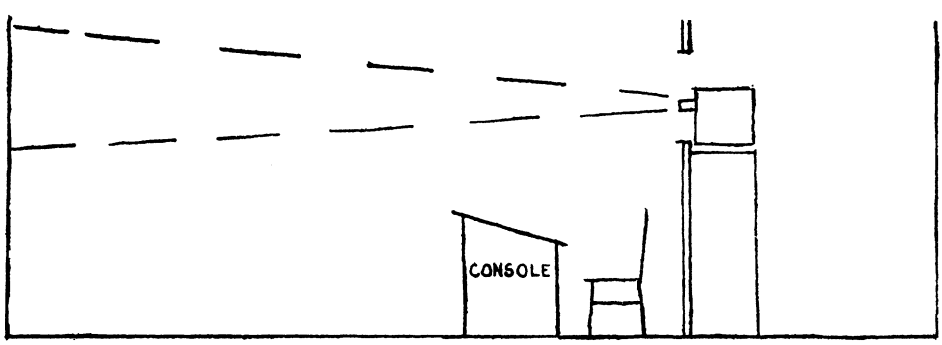


Figure 2. The Teaching Machine Room.

be significant, the computed F-ratio would have to be greater than $.10^{F}2, 15=2.70$.

The computed F-ratio for the students' ages was 1.92, for grade point it was .77, for the Total Ability of the School and College Aptitude Test it was .31, for school classification it was .45, and for the pretest it was .09. None of these F-ratios were greater than the 2.70; therefore, none of the variables were significantly different. Since Groups I, II, and III did not differ significantly in any of the areas, it was possible to use the F-ratio in analyzing the data from the written test and the performance test.

The experimental design used was a Type I Mixed Design (2:2 67-73). In this type of design the A effect is obtained while the B effect is counterbalanced, and the B effect is obtained while the A effect is counterbalanced. Because of this counterbalancing feature, the Type I Mixed Design gives a more precise F-ratio than does the simple randomized design.

The .01 level of confidence was used as the acceptance level, the .05 level of confidence was used as the rejection level, and an F-ratio between these two was to be considered inconclusive.

The data in this study were analyzed to test the following null hypotheses:

1. There is no significant difference among the means of the scores of Groups I, II, and III on the net gain for the written examination.
2. There is no significant difference among the means of the scores made on the performance test for Groups I, II, and III.
3. There is no significant difference among the means of the combined scores of the net gain on the written test and the performance test for Groups I, II, and III.

In the Type I Mixed Design, the test of AB interaction compares A_1B_1: A_1B_2:A_1B_3:A_2B_2: and A_2B_3. In this study, the F-ratio as determined by the AB interaction compared Groups I, II, and III on the net gain for the written test and on the performance test. The calculated AB interaction F-ratio was 1.04. An F-ratio greater than $.01^{F}2, 15=6.36$ would be significant, and an F-ratio between $.05^{F}2, 15=3.68$ and 6.36 would be inconclusive. The calculated F-ratio for the AB interaction was 1.04, which is not significant nor is it inconclusive; therefore, null hypotheses one and two were accepted.

In the Type I Mixed Design the test of B effects compared the totals of B_1:B_2: and B_3. In this study the F-ratio determined by the test of B effects compared Groups I, II, and III on the combined scores for each student for the net gain on the written test and the score on the performance test. The calculated B effects F-ratio was 60. For the test of B effects an F-ratio greater than $.01^{F}2, 15=6.36$ would be significant, and an F-ratio between $.05^{F}2, 15=3.68$ and 6.36 would be inconclusive. The calculated F-ratio for the test of B effects was .60, which is not significant, nor is it inconclusive. Therefore, null hypothesis number three was accepted.

In the Type I Mixed Design the test of A effects compares A_1 with A_2. In this study the F-ratio determined by the test of A effects compared the net gain on the written test with the score on the performance test. These two tests are not comparable, thus a significant F-ratio was expected. The F-ratio obtained for the test of A effects was 113.79. An F-ratio greater than $.01^{F}1, 15=8.68$ would be significant; therefore, the F-ratio of 113.79 is significant as was expected.

Conclusions

The results of this experiment indicate that the teaching machine instruction was as effective as the regular classroom instruction. This was true for the students of both experimental groups: those students who played the clarinet while using the teaching machine and those students who only held the clarinet while using the teaching machine.

The teaching machine program used in the experiment was effective in teaching the students clarinet fingerings and factual knowledge about the clarinet. This is evidenced by the fact that the students who used the teaching machine did as well, both in factual knowledge and in performance ability, as the students who took all of their instruction in the classroom. The success of the teaching machine program indicates that the pictorial presentation, the fingering diagram and photographs, was an effective means of teaching the students clarinet fingerings.

The fact that there was no significant difference among the three groups indicates that the students in the experimental groups learned how to play the clarinet with only one-half as much time in class as the control group spent in class. In this experiment, one-half of the teacher's classroom time with the students was saved, without any significant loss for the students in either performance ability on the clarinet or factual knowledge about the clarinet.[1]

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References

1. Crowder, Norman A. "Automatic Tutoring by Means of Intrinsic Programming," *Automatic Teaching: The State of the Art* (New York: John Wiley and Sons, Inc., 1959), pp. 109-16.

2. Lindquist, E. F. *Design and Analysis of Experiments in Psychology and Education* (Boston: Houghton Mifflin Co., 1953).

3. Lumsdaine, A. A., and Robert Glaser. *Teaching Machines and Programmed Learning, A Source Book* (Washington, D. C.: National Education Association, 1960).

4. Skinner, B. F. "Teaching Machines," *Science,* CXXVII (October, 1958), 969-77.

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[1] This paper was read at the meeting of the American Educational Research Association in Chicago, February 13, 1963.