

PRECISION TEACHING IN A UNIVERSITY CENTER¹

Charles T. Merbitz, Ph.D. and Charles P. Olander, Ph.D.
Jacksonville State University

The Center for Individualized Instruction was an Advanced Institutional Development Program (AIDP) grant-funded unit whose function was to use the best of modern instructional technology to develop and offer some exemplary individualized courses at Jacksonville State University.

The general method of teaching used at the Center grew from the work of B. F. Skinner (1968) and the application of operant conditioning to teaching. Human behavior was seen as a lawful function of its environment, and the problem of teaching was to control relevant aspects of the teaching environment so that the appropriate behaviors were learned in the quickest, most efficient and humane manner. Courses were generally organized in the Personalized System of Instruction (PSI) method (Keller, 1968) using self-pacing and repeated testing over a given unit of material until mastery was demonstrated. Other undergraduate students served as proctors who provided immediate feedback on exams, personal attention, and discussion of missed test items.

Microprocessors were used in some courses to provide computer-assisted instruction (CAI), academic exercises, and tests. The computers precisely timed the student activities and kept permanent records of performance.

Measurement of academic activity at the Center relied on the work of Pennypacker, Koenig, and Lindsley (1972), White and Haring (1976) and their associates. Tests and exercises were timed, although there was no time limit, and frequency of correct and incorrect responses per minute were plotted on Daily Standard Behavior Charts. The Charts provided graphic assessment of the position and daily progress of each student.

All of these elements functioned within an ongoing flow of educational activity as a system which provided and fed-back the data needed to improve. Following are expanded discussions of the components of the system, and examples of some of the data generated.

SYSTEM DESCRIPTION

Course Management. Courses housed at the Center used the basic PSI model (see also Ruskin, 1977; Sherman, 1977; Taveggia, 1977). Each course was divided into a set of well-defined units presented sequentially, some with review units. Generally a standard textbook formed the central curriculum element for Center courses. Combinations of slide/tape,

¹Preparation of this article was supported in part by Grant #G-00-76-02485. The authors gratefully acknowledge the help of R. Yaracs, who did much of the APPILOT programming, and of J. Schwarz who patiently typed and re-typed the manuscript.

video/tape, audio/tape, small discussions, live laboratory exercises, CAI exercises, workbooks, and lectures provided supplemental information. Both commercial and locally produced materials were used. A syllabus or course policy statement outlined the procedures for each course. Courses presenting a great diversity of elements also provided extensive study guides with flow diagrams to direct students into the activity appropriate for their level of attainment at that time.

The students began by studying the material for Unit One. When ready, students presented themselves individually for testing on Unit One. Immediately following the test, the students met with advanced-student advisors for discussion of the concepts presented in the focusing on the concepts missed.

Mastery criteria were specific to each course and were defined as percent correct (usually 80-90 percent). If students demonstrated mastery of the material, they proceeded to the next unit; if not, they restudied and later took another test. Some courses arranged for multiple forms of each test, while others selected a new stratified random sample of items for each test.

The elements of this arrangement worked together as a system. Study guides and the curriculum presentations provided the concepts to be learned. The self-pacing feature permitted the well-intentioned students who had minor gaps in a unit's background to spend the extra time needed to adequately prepare for that unit's test. The mastery requirement insured that the students had learned the crucial material in that unit before proceeding to the next. The unlimited retest component made each test a motivational tool, as well as an evaluation instrument. When a unit test was failed, the potential reinforcer of a good grade was still available, since only the highest unit tests counted for grades. The student advisors individually discussed the tests with the students, giving immediate feedback and covering the points that were not mastered. As peers, the advisors explained concepts in the student's language and interacted with the students in a friendly and personal way.

Microprocessors. Six Apple II² microprocessors with floppy disks used the BASIC or APPILLOT II³ language to present test items interactively for three courses using the "concealed multiple choice" (Bowles, 1977), or the fill in the blank format. In concealed multiple choice, a question was presented followed by the first randomized foil, to which the student responded with a yes or no, corresponding to true and false. The next foil was then presented and answered. The student was given feedback as to which responses were correct. The microprocessor randomized the selection of items and foils, and recorded the number of correct and incorrect responses, the test time and the latency of each

²Apple II is a trademark of the Apple Computer Co., Cupertino, Calif.

³APPILLOT copyright 1978 by Silas B. Warner available from MUSE, 7112 Darlington Dr., Baltimore, MD 21234.

response. Percent correct was also calculated. The information was permanently stored for subsequent analysis.

Precision Measures. Student performance on tests was measured in two (2) ways: (1) frequency of correct and incorrect responses per minute, and (2) percent of correct responses. The frequency measure was used to monitor and improve student performance and learning, while the percent measure indicated current performance in relation to the mastery criterion.

Although there was no time limit, the tests were timed. The advisors plotted frequency correct and incorrect as well as the record floor on Daily Standard Behavior Charts (Pennypacker, Koenig, Lindsley, 1972; White & Haring, 1977). The resulting graphic display took the advisor about 20 seconds per test to plot because the "Frequency Finder" method was used instead of a table or manually dividing count by time.

After a few tests in a given unit, any student's Chart could be inspected and tentative celeration lines drawn through the frequencies--correct and incorrect. Projecting celeration lines indicated immediately whether the student was making rapid enough progress. A change in the student's behavior was seen as either frequency change or a change in celeration (slope), and provided an estimate of the extent to which the teaching environment controlled the behavior. Thus, each unit formed a set of repeated measures that allowed experimental tactics to be evaluated. Chart 1 shows one student's performance and learning on chapter tests in a Human Physiology course in Fall, 1979. Frequencies plotted between the day lines indicated more than one test taken per day. As shown in Chart 1, the instructor intervened with a discussion of efficient study techniques and student progress on day #38. Notice that in the first 35 days of the semester, (before the intervention) she completed only 1 chapter. Following the intervention, she completed the remaining 9 chapters in only 64 days.

While statistical measures for the above elements were possible (see Pennypacker, Koenig, Lindsley, 1972; White & Haring, 1977; Koenig, 1972; Pennypacker, 1976a, 1976b), visual assessment was generally used for its speed and ease. Also, since these measures were absolute, direct, independent, and continuous, other advantages accrued. Since frequency was an absolute and direct measure like the meter, as opposed to an indirect or statistical measure dependent on the observed variability of the sample at hand, Charts from all courses at the Center (or anywhere else) could be directly compared. As frequency (as opposed to percentage) was an independent measure, there was no necessary linkage between frequency correct and frequency incorrect. Thus, intervention could be directed at reducing one or increasing the other, depending on circumstances. As frequency was continuous, the minimum change in a student's performance that could be measured was not determined by the number of test items, as were percents, but depended on the accuracy of the clock used. (For a more complete discussion of these points, see also Pennypacker, 1976a, 1976b)

CALENDAR WEEKS

26 Aug 79
 DAY MO YR

23 Sep 79
 DAY MO YR

21 Oct 79
 DAY MO YR

18 Nov 79
 DAY MO YR

16 Dec 79
 DAY MO YR

13 Jan 80
 DAY MO YR

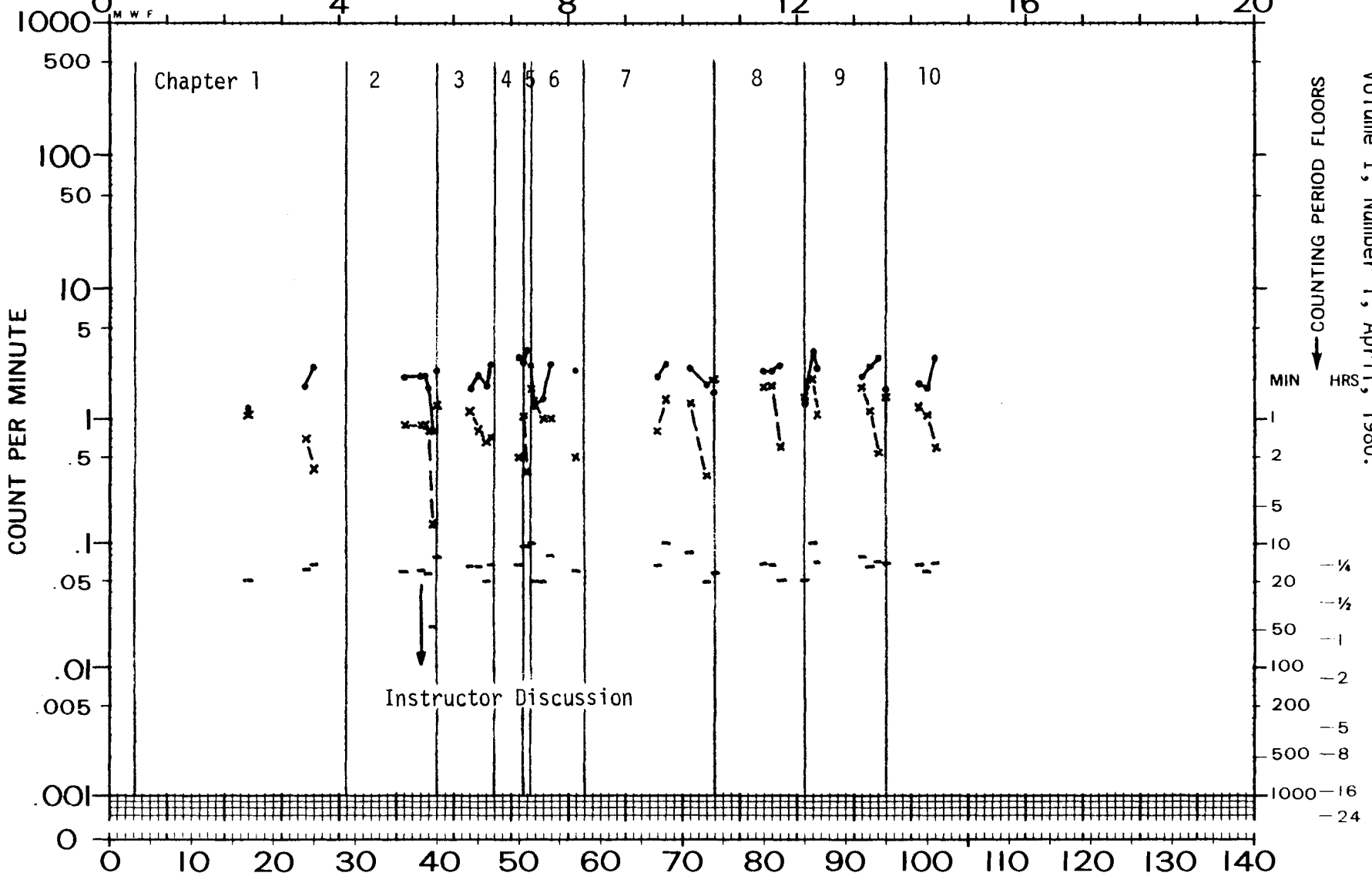


Chart 1. One Student's Performance and Learning on Chapter Tests in a Human Physiology course

Merbitz, Charles T. and Olander, Charles P. Precision Teaching
 in a University Center. *Journal of Precision Teaching*,
 Volume I, Number 1, April, 1980.

OLANDER									ANSWERS
SUPERVISOR	ADVISER	MANAGER				BEHAVIOR	AGE	LABEL	COUNTED
DEPOSITOR	AGENCY		AM	CPU	CTM	CHARTER			TEST QUESTIONS
			TIMER	COUNTER					

Operating Statistics. The Center had a full time staff of two, an instructor for each course, and a fluctuating staff of student advisors working for credit, money, or recommendations. Twelve (12) sections of 8 courses were physically housed in a 1400 sq. ft. facility open from 8-4:30 weekdays (see Table 1). Chart 2 shows the total number of tests taken per day by all students in all courses and by 42 students enrolled in Biology 102 (16 units) during the first 5 weeks in 1980.

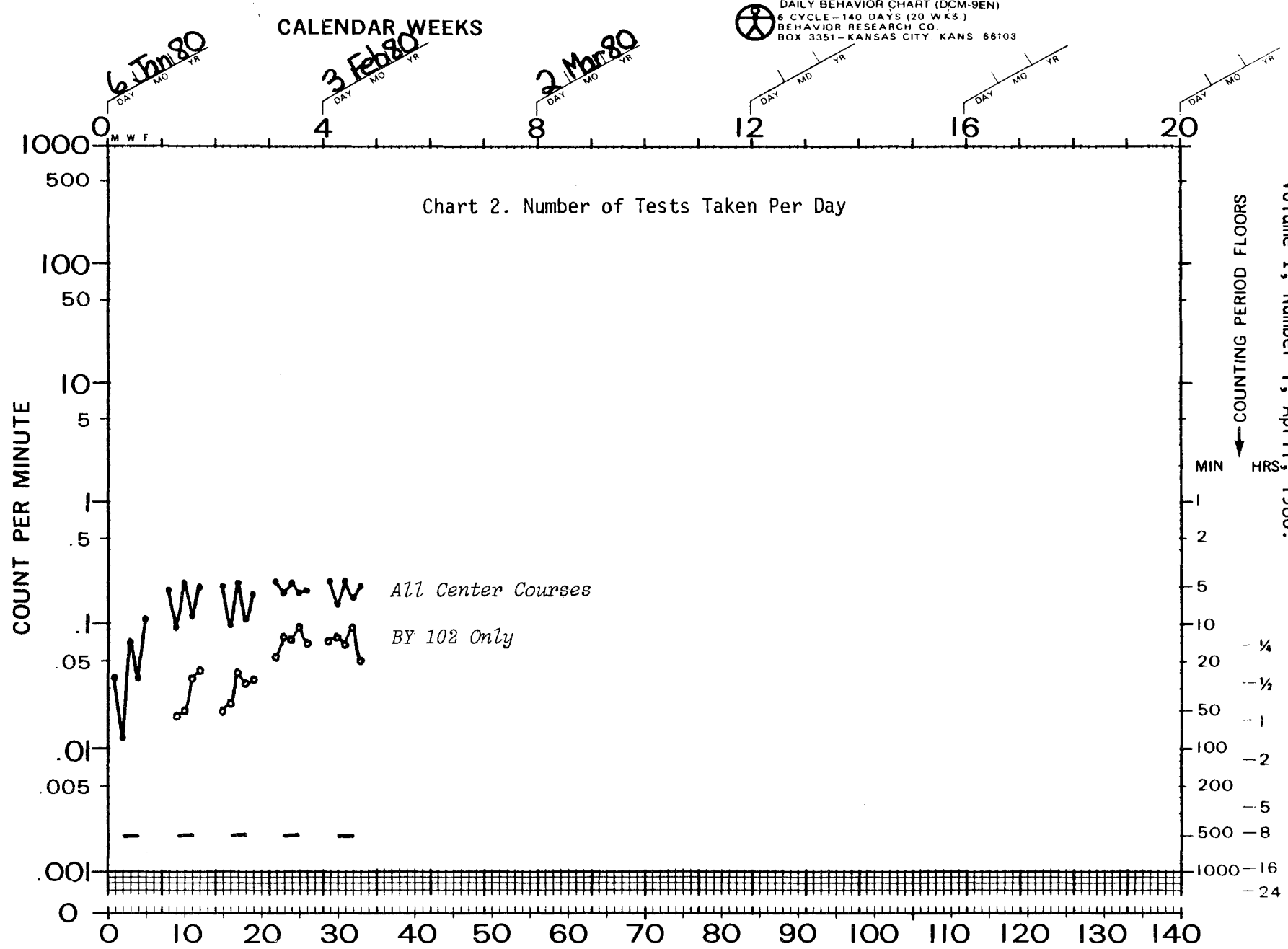
Table 1
Enrollments for 2 Years and Spring Semester, 1980, for Courses Housed at the Center for Individualized Instruction

Courses	1978	1979	Spring, 1980
Academic Survival Skills	14	30	24
Reinforcing Quantitative Skills	30	34	49
General Biology	--	--	42
Human Physiology	--	35	35
History	--	22	34
College Algebra	24	24	32
Statistics	--	18	24
Analysis of Child Behavior	--	--	25
	68	163	265

RESEARCH

The system described was self-improving in the long term, as it provided a basis for instructors to test their notions of how students learn. Work under way in one semester included an attempt to use the power of Charted direct measures to investigate the use of sophisticated logical strategies and an effort to measure the effect of feedback-timing on performance and retention in multiple-choice testing.

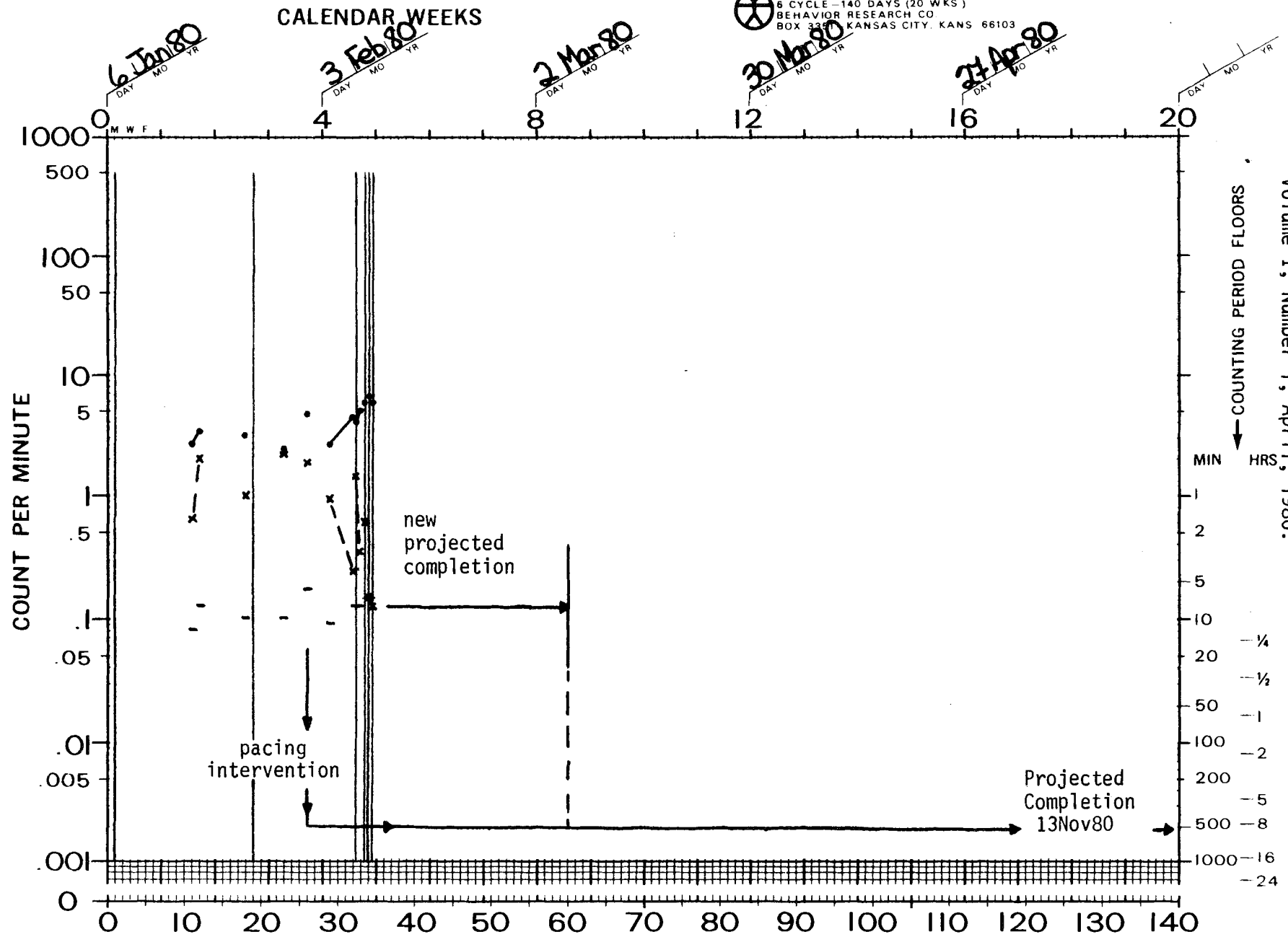
Another investigation involved the use of a prediction of the course completion date as a pacing device. While the program used a computer, it was a straightforward conversion of an operation that can be done simply on the Chart. The student accessed an on-line computer program. The machine calculated the average number of days the students had spent per unit passed, multiplied this by the number of units in the course, and projected the calendar date for completion of that course. The program was initiated at selected points in the semester in various courses. The effect of this pacing device on actual completion date, units completed per day per week and units attempted per day per week were assessed and reported in Merbitz, Olander and McDade (1980). Chart 3 shows the effects of the pacing device on one student enrolled in Biology 102. On day #26, the student was exposed to the pacing program and participated in a discussion with her instructor. At that time, the projected course completion



Merbitz, Charles T. and Olander, Charles P. Precision Teaching in a University Center. *Journal of Precision Teaching*, Volume I, Number 1, April 1980.

23

MARBITZ			SUCCESSIVE CALENDAR DAYS				ALL CENTER STUDENTS		TAKE TESTS	
SUPERVISOR	ADVISER	MANAGER					BEHAVIOR	AGE	LABEL	COUNTED
DEPOSITOR	AGENCY		TIMER	COUNTER		CHARTER				



Merbitz, Charles T. and Olander, Charles P. Precision Teaching in a University Center. *Journal of Precision Teaching*, Volume I, Number 1, April, 1980.

24

Chart 3. The Effects of a Pacing Device on Projected Course Completion

CPO			BAT			BY 102		ANSWERS
SUPERVISOR	ADVISER	MANAGER	BEHAVIOR	AGE	LABEL	COUNTED		
DEPOSITOR	AGENCY	TIMER	COUNTER	CHARTER	TEST QUESTIONS			

date was Nov. 13, 1980, or 312 days into the semester. After the intervention the student rapidly completed 6 additional units such that her projected completion date became March 6, 1980, or only 60 days after the beginning of the semester.

OUTCOMES

Using these technologies has improved the product, behavior change of students, while making the courses effective and accountable. The effectiveness of the courses was demonstrated by the change in student behavior recorded from the beginning to the end of each unit and the number of units completed. Since costs to run a course can be found, a cost efficiency and effectiveness calculation based on student behavior change can be generated for fiscal and performance accountability (see Sexton, Merbitz, & Pennypacker, 1974).

Another effect of the system was to foster true equality of educational opportunity, in that the data permitted the student's work to be viewed objectively, separating it from any implied assessment of the student's worth or potential as a human being. In addition, since less skilled students entering the system were required to remedy deficiencies and reach a defined level of competence before progressing, they were not passed along with a low grade and an inferior superstructure of skills resting on a poor foundation. The repeated measures and teaching opportunities made sure that students spent the time needed and got the attention necessary for maximum progress.

The Charted performance data freed the instructors to teach by putting them in the position of managing learning, while the individualized nature of the system gave the instructors the power, flexibility, time and feedback needed to experimentally determine the appropriate conditions of learning for each student. The data also made it possible for students to find out which tactics were effective, and made it the student's responsibility to actually use those tactics. The union of the instructor and student in learning meant that instructors could do their best, most creative teaching with every student.

As a grant-funded organization, the Center is not available to instructors from other institutions. However, the Center staff is willing to share curricular materials and programs developed here and to encourage application of these technologies elsewhere.

REFERENCES

- Bowles, K. L. Microcomputer-based mass education. *Journal of Personalized Instruction*, 1978, 3(3), 151-156.
- Keller, F. S. "Goodbye Teacher . . ." *Journal of Applied Behavior Analysis*, 1968, 1(1), 78-89.
- Koenig, Carl H. *Charting the future course of behavior*. Kansas City: Precision Media, 1972.
- Merbitz, C. T., Olander, C. P., & McDade, C. *Prediction of completion dates as a PSI pacing device*. Poster presentation, Association for Behavioral Analysis, Dearborn, MI, May, 1980.

- Pennypacker, H. S. The role of direct measurement in the evolution of a complex education system. L. E. Fraley and E. A. Vargas (Eds.), *Proceedings of the third national conference on behavior research and technology in higher education*. Gainesville, FL: Society for Behavioral Technology and Engineering, 1976a, 259-266.
- Pennypacker, H. S. Measurement, accountability, and the economics of a complex instructional system. L. E. Fraley and E. A. Vargas (Eds.), *Proceedings of the third national conference on behavior research and technology in higher education*. Gainesville, FL: Society for Behavioral Technology and Engineering, 1976b, 311-320.
- Pennypacker, H. S., Koenig, C. H., & Lindsley, O. R. *Handbook of the Standard Behavior Chart*. Kansas City: Precision Media, 1972.
- Ruskin, R. S. The personalized system of instruction. *Educational Technology*, 1977, 9, 5.
- Sexton, J., Merbitz, C. T., & Pennypacker, H. S. Accountability: Cost efficiency and effectiveness measures in behavioral college teaching. *Behavior Research and Technology in Higher Education*, 1975, 463-473.
- Sherman, J. G. Individualized Instruction is not enough. *Educational Technology*, 1977, 17(9), 56-60.
- Skinner, B. F. *The technology of teaching*. Englewood Cliffs, N.J.: Prentice-Hall, Inc, 1968.
- Tavoggia, T. C. Goodbye teacher, goodbye classroom, hello learning: A radical appraisal of teaching-learning linkages at the college level. *Journal of Personalized Instruction*, 1977, 2(2), 119-122.
- White, O. R., & Haring, N. W. *Exceptional teaching*. Columbus: Charles E. Merrill, 1976.

Charles T. Merbitz is the Director of the Center for Individualized Instruction and Charles P. Olander is Associate Professor of Biology at Jacksonville State University, Jacksonville, Alabama 36265.