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ABSTRACT

An experimental first year course in accounting was offered which utilized the concept of individualized instruction. The students were mostly sophomores at the University of Massachusetts. Two teaching assistants and the instructor provided the 60 member sample population with two types of assignment sheets, one relating to the textbook, one relating to the teacher-authored programed materials. All students were advised to take self-quizzes at the end of programed lessons. A student who did not achieve mastery on the self-quiz was advised to study the alternative assignment material. Deadlines were utilized. A final examination and a treatment-interaction analysis evaluated the one semester experiment. The median score (78 percent) earned on the final exam was equal to the 85th percentile of the departmental examination. The treatment-interaction analysis, using grade point average as the independent variable, showed uniformly higher scores in the experimental group. The study dramatically confirmed the need for individualization of time to complete the course although the amount of flexibility needed to be increased by one or more orders of magnitude. (WCM)

A PRIMITIVE INDIVIDUALIZATION OF TIME AND METHOD IN A BEGINNING ACCOUNTING COURSE

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In the writer's view, the most critical of all educational variables is that of individual differences. There are many dimensions along which it would seem desirable to individualize instruction. It is well established that under current educational practices individual students require vastly differing time to attain the same educational objective.[1] This is probably because the nonoptimality of any other input tends to increase the time necessary to succeed. It was in response to these individual needs that the writer and two teaching assistants carried out the instructional procedures here reported.

Subjects

The students involved were mostly sophomores at the University of Massachusetts. They were enrolled for the first course in accounting. This requirement is normally the first course our faculty teaches to students in the School of Business Administration. In addition, many others, predominantly upperclassmen, elect this course. Students were assigned to the experiment by computer. The numbers assigned corresponded to three normal sections. There were 107 so-assigned. This total includes students who pre-registered but did not return to the University and those who did not attend a single class before transferring to other sections. Our records of participation identify 77

students who took our first "progress quiz". Most students took it on the third class day. There were still further transfers. 72 students attempted the second progress quiz, but only 60 ever passed its mastery requirement.[2] Some made as many as four attempts, but some tried only once. This number (60) will be considered the sample size of the experiment. Our only available information on the impact of these shifts is the cumulative grade point average (g.p.a.) data (at entry). The range for students who exited without passing (or without attempting) the second progress check was 1.5 to 2.9 (A=4) with a median of 2.2. The median g.p.a. for the sixty who remained was also 2.2 (range: 1.20 to 3.70). The large range is to be expected due to the larger sample size (60 versus 47).

Setting and procedure

Three adjacent rooms were regularly available for the use of instructors and students. On each day we posted a notice of the activity planned for each of the three rooms. One room was always scheduled for a conventional lecture-discussion activity in which students could ask questions, check their success with homework problem assignments and/or witness a demonstration or review. The other two rooms were used for the taking of progress quizzes and/or for consultation with the instructors - or simply for study with such help as the student requested. The following diagram summarizes a self-instructional system which could also be used. The system has been described in detail elsewhere.[3]

(Please insert EXHIBIT A)

There are multiple versions of the progress quizzes. The criterion is a high level of mastery -- specifically defined for each quiz. Consequently, we accepted no work which we felt other teachers would grade less than "B". The mathematical nature of the subject makes any other approach irrational.

Alternatives. All students were provided with two types of assignment sheets, one relating to the textbook, one relating to the teacher-authored programmed materials. All students were advised to assess their study efforts by taking the self-quizzes at the end of the programmed lessons. Both solutions and suggested mastery criteria were provided for this formative evaluation. A student who did not achieve mastery on the self-quiz was advised to review or to study the alternative assignment material.

The two sets of assignments were not mutually exclusive. On occasion, when a portion of the programmed lesson was judged to have no textbook counterpart, it was assigned along with the text. Students were advised that if they could succeed on the basis of the textbook presentation they would probably save time. The commitment was not, of course, exclusively to either set of assignments.

Contingencies. The system (with program required) had been used several times. Always before, progress had not been monitored, but passes had been required. It was observed that the provisions for make-ups tended to be neglected in the early weeks, that those who did keep up were most successful. Nearly all students would slack off at the points where hour-exams were scheduled

in their other courses.

To try to encourage better use of time we introduced deadlines, but made the passing of only two progress checks required. Students were allowed one week after the scheduled time for taking a quiz to earn an "A" or "B" when a pass was not required. Two weeks were allowed in the two cases where a pass was mandatory. (Excused absence extended time, of course.) The cummulative nature of the course made it necessary to learn each lesson whether a deadline was met or not and we emphasized this from the outset. Further, the requirement of two specific passes made mastery important on prerequisites.

Arrangements. Two manila folders were maintained for each student. One, kept in the instructor's office, accumulated both the successful and unsuccessful progress checks after the student had reviewed them in class. The student was entitled to review these files at any time, but he was not allowed to take quizzes away from class. He might, however, devote an entire class period to studying an unsuccessful one and to securing such explanations as were needed. Three graders were able to process the papers for this group and two other sections in which the program was being used at other times (approximately fifty more papers at the outset). The second set of folders, alphabetized in a cardboard file, were carried to class with corrected quizzes and any other materials being distributed. We tried to arrive as soon as the prior class broke, and this kept waiting lines short as students, immediately upon arrival, helped themselves to the contents of their folders. For makeups, office hours and the

regular classes of the other two sections mentioned above were used - as these sections used the class hours of the experimental group. There were opportunities to get results and take progress quizzes six days per week.

Peer tutors. At the end of two weeks, all students who were maintaining the schedule - whether easily or by taking frequent makeups - were invited to set themselves up at the beginning of an hour to help answer questions about the corrections on papers then being returned. These tutors were assured that they need not serve every day and that they might discontinue their participation at any time. Eighteen out of twenty invitees accepted.

The motives for this step were threefold. First, we wanted to provide for some interaction which was less available than in a class. Second, we felt that some students who were having trouble might be more willing to ask for help from a fellow student. Third, we wished to reinforce the maintenance of a good rate of progress and to provide to the volunteers the widely acknowledged benefits of trying to teach.

Flexibility. The programmed lessons were scheduled for seven weeks. After that time the textbook was used by all students. However, three topics of a modular character were assigned flexibly. To students who matched the assignment sheet schedule throughout the period for which there were programmed lessons these topics occupied weeks eight and nine. There were multiple progress quizzes for these topics also. Arrangements had been made with the University Registrar to give "incomplete" grades, if necessary, to students who had not satisfied the progress quizzes for these topics by the time of the final examination. It was

therefore possible for other students to spend the eighth and ninth week of the course in continuing to study the programmed lessons or to do some modular assignments after spending the first part of this period on the last of the parallel assignments. One of the rooms was devoted to a class for students who were on these modular topics. However, as was necessary for students who did these lessons after classes ended, most students relied on self-instruction.

In the tenth week all students began study of further assignments in a conventional format. Students who had not completed the parallel assignments by this time were considered to have failed. However, if they had completed their study of all lessons they were permitted to continue to take makeups to complete the demonstration of mastery. Forty-four students satisfied at least the minimum rate of progress; that is, they began conventional instruction in the tenth week. They were divided into two groups. Assignments were common and both groups were exposed to both instructors. The third instructor was no longer involved.

Results

Performance evaluation was somewhat makeshift, yet the results seem clear and convincing. Fortunately, during the prior academic year the department had made a survey of performance on the topics which were given the experimental treatment. This was done by administering a four-part test to every student who attended the first class of every section of the second required course in accounting. Thus the test was unannounced, but its administration was within two weeks of the final examination in

the course being evaluated. The test, itself, was of uneven quality, but total and part scores were available, as well as grade point average information. 238 students had taken this test.

We used the department's test as part of our final examination. The median score (78%) earned this time was equal to the one at the 85th percentile of the departmental test. That is, about one student out of seven who were starting the second required course bettered our average. Testing the hypothesis that the scores of the experimental group were not significantly different from those earned on the initial administration by analysis of variance, we obtained an F of 19.2. This far exceeds F = 11.0 which indicates that a result would occur by chance once in a thousand times. We can reject the null hypothesis emphatically.

We also performed a treatment-interaction analysis, using g.p.a. as the independent variable. We computed regression lines relating test scores to g.p.a. for each group. When graphed, these lines are very nearly parallel. Students of comparable aptitude, as roughly measured by g.p.a., tended to have uniformly higher scores in the experimental group.

It is possible, of course, that some or all of this difference is due to the unannounced character of the first administration compared to the absence of surprise on the final. On the other hand, three students who took the test as a final examination were not eligible to pass the course. They had failed to meet the ten week deadline. Although they had not been attending class, they appeared for the final examination anyway. Also, one "A" student

was unable to take this final examination.

Criterion-related assessment. The above is a normative comparison. In criterion-referenced terms the original test results had been a disaster. Here in its entirety is one of the four parts of the test. (Please insert EXHIBIT B)

To the right of the double line is the fundamental accounting equation which is a definition of total owner's equity. The relationship is:

(total assets - total liabilities) = total owner's equity

The items on the left of Exhibit B are the elements of an equation which is a definition of net income.[4] The relationship is:

(total revenue - total expense) = net income

These concepts and principles occur early in any elementary textbook. Virtually the entire course is built upon these relationships. They are clearly prerequisites to the learning of topics which occur later than the third week of the course. No knowledge of accounting is necessary to recognize that the equations can never be affected in certain ways, e.g., changed on one side of the equal sign and not changed on the other, as illustrated on the right hand side of Number 1. (Total owner's equity should be minus.) One need not read the example in order to identify such "impossible answers."

In a sample of the test papers, a search was made for "impossible answers." Only two assumptions were made: that the student noted that a single amount was either stated or implied; and that the student could recognize that in none of the test items

was the firm transacting business with its owner (as it is in the sample event). (The assumptions eliminate as correct possibilities some combinations which maintain the equations.) When a student produced an "impossible answer" he was denying understanding of either a concept or a relationship. THE DEFECT IS INDEPENDENT OF WHETHER THE SPECIFIC EXAMPLE WAS FAMILIAR. Since a 100% correct response is the implied standard for the correctly learned concept, only random error need be allowed for in deciding that a student who gives impossible answers does not know these fundamentals.

Even making the absurdly generous assumption that two impossible answers out of eight were due to test error, one was forced to reject the hypothesis that fundamentals were understood in more than 80% of the cases! As determined from a 25% sample, the median proportion of "impossible answers" was a humiliating 50%.

On their final examination the absolute number of persons in the experimental group who achieved two or fewer impossible answers was equal to the number who had met this criterion when all students had been tested. 59% of all students tested met this criterion.[5] There had been a conscious effort to alter this particular feature of terminal behavior, but it had not involved the introduction of any similar examples or calling attention to this type of defect in the test context.

The first outcome had been diagnosed as failure to maintain behavior that had been at a high level early in the term. That is, instructional materials, most notably self-quizzes, had pro-

vided practice on the easy aspects of prior lessons, rather than on the members of concept-sets which were more often troublesome. Some frames, most of the self-quizzes and perhaps one-third of the progress quizzes had been modified in accordance with our interpretation. In addition, care was taken to call attention to internal contradictions in marking students' mistakes. "Equation must balance...," etc.

One other datum relating to this subtest is available. In order to explore the question of the impact of announced versus unannounced administration a colleague was kind enough to use this sub-test as part of his final examination in a subsequent semester. He had experienced above-average attrition (approximately 40%) in his sections. The median number of impossible answers on this administration was three. Among 51 students who took this final examination there were 20% fewer who equalled the modest two-or-fewer criterion for impossible answers. It would seem that one interpretation of this data is that by disguising the seriousness of defects in order not to discourage those at the lower end of the distribution one sacrifices a fraction of those who might have achieved competence. In an intensely cumulative course such as accounting, there seems little reason to prefer that sort of trade-off.

Choices. Twelve students studied the textbook rather than the program for at least two weeks. All others used the programmed lessons as their exclusive, or first, vehicle for preparation. The twelve were quite successful students, a large majority of whom had studied bookkeeping or accounting in some way before entering the

course. One or two students in this group had had no prior instruction, however. Perhaps the most striking feature of the approach of this group was that they virtually never chose to attend the class sessions which were held primarily for their benefit.[6] They seemed to know that this conventional activity was unnecessary.

We followed up with each of these students. Usually, their explanation for choosing the textbook was the time-saving advantage. However, without exception, each of these students had, at some point, found that he was unsuccessful in learning some topic from the textbook and had shifted to a programmed lesson. Invariably, the program enabled him to succeed. Five students reported that they then used the programmed lessons for the remainder of the topics. Seven students, however, used the programmed lessons only when they found that studying the text had not worked.

Attrition. Of course another significant result was the attrition.[7] Although we were not then familiar with the label, it is clear that there are many parallels between our practices and Keller-based instruction. One is the relatively high rate of dropouts. A related problem, and perhaps a cause , was the tendency for our make-up deadlines to be converted into the real schedule. Students often took their first quiz on the last day of the extra week (and had no second chance to earn a grade).

There was even attrition among those who took the final examination and were eligible for a pass. While most students finished satisfying the flexible requirements during the final exam period or during the days of registration in the new semes-

ter, a few students procrastinated and some had to make as many as six attempts to pass one of the required progress quizzes on the modular topics. In two cases it was necessary to notify students by postcard that they still had incomplete grades because of one or two progress quizzes not yet attempted. (Misunderstanding was claimed, but the precaution had been taken of having each student who had any flexible requirement yet unsatisfied sign an acknowledgment indicating that he had read and understood the rules for completing the course.)

Such a notification was made after a considerable time-lapse. This made the passing of the progress quizzes more of an obstacle than it otherwise would have been. One very good student, enmeshed in a new semester's obligations, did not persist sufficiently. Four other students failed to meet some of the flexible requirements. In one case, it is the writer's opinion that this was the correct result - that it was a defect in the system for this student to have been eligible to participate in the group-based instruction. In the other cases, the students allowed too much time to elapse between one unsatisfactory effort and the next attempt. Some students who were clearly less capable than those who gave up succeeded through prompt and persistent effort. The writer has retained this time-flexibility in subsequent semesters but has invoked rules about minimum demonstrations of continuing work.

Peer tutors. The peer tutors were unanimous in expressing satisfaction with the experience they had, but they commented that they were called on infrequently. We gathered no systematic in-

formation from non-tutors, but made some informal inquiries. No one indicated that a tutor had failed to help, but several students said they had more confidence in the teachers and chose to consult them when possible.

Conclusions and Recommendations

The need for individualization of time-to-complete was dramatically confirmed. It was obvious, nevertheless, that the amount of flexibility needed to be increased by one or more orders of magnitude. Given the semester constraint, the number of topics to be dealt with was absurdly ambitious for an average student. We had hoped that the experimental group would settle down into an accelerated group, one which matched the assignment sheet and one which utilized the flexible elements we had provided. In fact, the fastest student exceeded the suggested pace by one assignment only. More than half those who met the tenth-week deadline for starting group instruction had completed none of the flexible assignments. Furthermore, merely the random handicaps of a semester (illness, emotional crises, etc.) impact so significantly that even better grouping than we now know how to do is not likely to be adequate. The writer's impression is that, presently, the major source of variation is in the degree to which individuals match or miss our assumptions about their readiness.

The logical response would seem to be to regard the entire introductory course as a community project. Students could be allowed to group and re-group themselves according to the constraints of their aptitudes and current circumstances. The large number of teachers could be dealing with students at different

stages of progress and students could use these varied activities as resources. If he fails a criterion test a student would merely join a slower group. Certainly, an academic year is a minimum time over which to permit students to spread a study effort to achieve competence. The measurements taken in the experiment here reported do indicate that providing more time does increase the number of students who achieve a worthwhile level of mastery.

It is also clear that if the defective performance which was accepted on the ambitious number of topics is adequate, then competent performance on many fewer topics is as valuable. A pass might reasonably be awarded if half as many topics are mastered. If some prerequisite for another required course is missing it has been missing in the past.[8] Adjusting both time and the minimum criterion are necessary in order to rationalize our efforts.

FOOTNOTES

1. See, for example, Bloom, Benjamin, "Learning for Mastery", UCLA Evaluation Comment, May, 1968.

2. The writer would have liked to limit transfers to those required by schedule problems. Since we conscientiously offered conventional instruction and were quite sincere in our indifference to the student's choice of instructional materials, it would seem fair to have done so. However, there was administrative reluctance to abridge the normal availability of free section transfers.

3. Singer, Frank A., "A System Approach to Teaching the Accounting Process", The Accounting Review, April 1970, pp. 351-364.

4. Moreover, net income (and the positive and negative determinants thereof) are changes in owner's equity - not the only changes; but understanding of the second equation depends absolutely on understanding the first.

5. Of course this is still unsatisfactory. Subsequently, in one small class, the poorest result on this subtest (included in the final) was two of these defects.

6. Each of the three teachers conducted some of these sessions. There was no noticable difference in attendance related to teacher-in-charge.

7. Our attrition was greater than in other sections of the course in this semester. I have been told by a publisher's representative that, nationally, 40% is normal for elementary accounting. While I can not vouch for this statistic, the firm explains its support of a multi-media project in this subject as being prompted by this indication of need. Our experience is more or less extreme according to the numbers who are viewed as participating in the experiment.

8. This remark is not intended to dismiss the importance of entering repertoire (on the contrary). It is a rebuttal to the argument that the importance of advanced topics makes it impossible to give individuals enough time for fundamentals.

EXHIBIT A
SYSTEM DIAGRAM

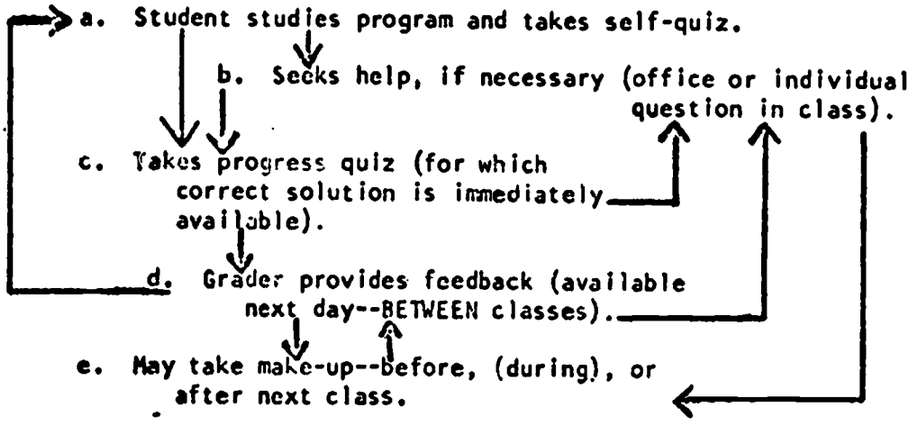

EXHIBIT B

A Sub-test of the Evaluation Instrument
With Sample Student Responses

REQUIRED: Indicate the actual effect (both BEFORE and AFTER CLOSING) of the following (independent) errors on each of the accounting elements described in the column headings below. Use the following code:

+ overstated - understated 0 no effect

Error	Accounting Elements: Net Income	Total Revenue	Total Expense	Total Assets	Total Liabilities	Total Owner's Equity
Example: A failure to record an investment by the owner	0	0	0	-	0	-
1. Failure to record sale of services to a customer	-	-	+ X	-	0	-
2. Revenue is credited when cash is collected from a credit customer.	+	+	0	+	0	+
3. Failed to adjust prepaid expense account, so it remained overstated by $300	+	+ X	-	- X	+ X	0 X
4. No adjusting entry was made to record accrued salaries payable of $1,000	+	+ X	-	- X	-	0 X

X in upper right-hand corner of a cell identifies symbols which are incorrect.