

# Comparing Individual Instruction & Lecture Formats in Human Anatomy & Physiology

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Since the beginning of education, teachers have probably wondered about the effectiveness of teaching methods and the relative effectiveness of one method over another.

When language developed and communication became easier, teachers wondered about the effectiveness of oral teaching versus visual demonstration. When written language and books developed, teachers wondered about the effectiveness of oral versus written teaching, and were reluctant to use the written word instead of or in addition to oral communication (Weimer 1988). We know now that combinations of methods work well and that different people learn in different ways (Stanton 1974). Over the centuries many different combinations of demonstration, oral and written teaching methods have been used.

In the second half of the 20th century the use of technological developments such as television, audio and video tape recording, automated slide projection, single concept film loop and computers have been resisted by traditionalists (Evans 1967). At the same time, that same technology stimulated the development of individualized instruction by those less reluctant to experiment (Drumheller 1971; Smith & Nagle 1972; Wittich & Schuller 1973).

## Central Community College's Individualized Program

At Central Community College (CCC) our major

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form of instruction is individualized. It is also self-paced. Course material is prepared in advance by the instructors and course outlines, study guides, materials lists, learning objectives and activities are pre-packaged and shelved waiting for student enrollment. Materials for projects are organized by course and unit and set aside in labeled drawers. With the course material waiting, a student's instruction can begin any day the college is in session. Progress is determined by proficiency in a subject. Students are allowed limited retesting until a subject, concept, or skill has been mastered.

Our method of individualized instruction can put as many as 15 students in biology at one time with one instructor. These students might be in different places in any of seven different courses, but most students enroll in Human Anatomy and Physiology (see Table 1). With individualized instruction many courses can be scheduled throughout the day, allowing for great flexibility in student schedules. Such individualization allows a course to operate at a time when its enrollment would not otherwise justify its existence. Since it is unlikely that more than two or three students will be at the same place in the laboratory portion of even a busy course like Human Anatomy and Physiology at the same time, we are able to operate without as much equipment on hand as is necessary for traditional courses. For example, we have only one physiograph but each Human Anatomy and Physiology student can use it for electromyogram, electrocardiogram and photoplethys-

mograph labs with one or two other students or with one-on-one attention from an instructor. We have 12 binocular compound microscopes (four with dual-viewing attachments), but we have to keep only three complete sets of histology slides.

Individualized instruction is, of course, limited by space and the time when an instructor is available. (The instructor acts as a resource, gives oral evaluations over fine points of structure and function, grades papers, guides projects, watches for safe practices, etc.) However, by using this method large groups of students cannot be moved through a course at the same pace.

CCC is a technical community college and as such its primary function is to prepare students for careers. Students take Human Anatomy and Physiology (A&P) as a required course in Biotechnology, Dental Hygiene and Medical Assisting programs. Other students take A&P to supplement the Bio-Medical Electronics Program or to transfer to nursing school or to other colleges. Biotechnology graduates find work in biologically-oriented industrial laboratories. Dental hygienists work in clinical settings, primarily cleaning, scaling, polishing and X-raying teeth. Medical assistants work primarily in physicians' offices with clerical and/or clinical duties.

Our A&P course has no prerequisites. The students taking this course have science backgrounds ranging from a minimum of high school science to that of registered nurses. Thus the A&P class is extremely heterogeneous in career plans, science background and—as we shall see—age.

Time restrictions within some technical programs at CCC make it impractical for students to work at their own pace to complete courses. The Dental Hygiene and Biotechnology Programs want to limit their students' time in A&P to one semester. To complete the five semester hour course our average self-paced A&P student spends eight to 10 hours per week in class for about one and a half semesters. In an effort to move a group of Dental Hygiene (DH) and Biotechnology (BT) students through A&P in one semester, I initiated a lecture option for the course during the Fall 1987 semester. There were three one-hour lectures and five hours of lab per week. The lab

Table 1. Central Community College Biology Courses

<i>Name of course</i>	<i>% of Biology students enrolled during study</i>
Concepts in Biology	11.3
Human Structure and Function	21.1
Food Microbiology	2.7
Ecology	8.2
Plant Science	5.5
Human Anatomy and Physiology	42.1
Microbiology	9.1

which had been completely self-paced was changed to a weekly schedule that complemented the lecture schedule. Chapter quizzes and unit tests were taken during lecture; oral evaluations were taken during lab time.

### A Natural Comparison

Since I used the same quizzes, tests, projects, text and workbook, and limited retake format as my individualized A&P class did, I saw the Fall 1987 lecture as a natural experiment to compare lecture with individualized instruction. Previous comparisons have been made between lectures and various forms of individualized instruction. In these studies instructional format made no significant difference in achievement as measured by final grades, especially if the formats compared were consistent and either allowed or disallowed retesting. These studies have been reported in General Psychology (Ulrich & Pray 1965; Kulik, Kulik & Carmichael 1974), General Chemistry (Ertwine & Palladino 1987) and Sociology Methods (Smith 1987). To my knowledge, no such published comparison has been made in Human Anatomy and Physiology or in any Biology course. Another distinction is that CCC has a well developed individualized format which I adapted to a lecture presentation, while other studies began with a lecture format and adapted it to individualized instruc-

Table 2. A & P Student Age and GPA Data

<i>Group</i>	<i>Mean age</i>	<i>S.D.</i>	<i>Mean GPA</i>	<i>S.D.</i>	<i>#</i>
Individualized Instruction	29.70	8.11	3.34	.52	48
Dental Hygiene	23.46	5.16	3.08	.62	11
Biotechnology	28.51	3.65	3.54	.40	9
Medical Assisting	31.92	9.34	3.30	.57	17
Lecture	28.78	10.85	3.06	.70	11
Dental Hygiene	22.68	7.27	2.63	.72	5
Biotechnology	36.92	9.29	3.39	.53	5

Table 3. A & P Complete Course Percent Averages

Group	Average	S.D.
Individualized Instruction	84.45%	7.77%
Dental Hygiene	83.29%	7.15%
Biotechnology	88.76%	7.76%
Lecture	80.48%	8.11%
Dental Hygiene	83.62%	8.51%
Biotechnology	79.35%	6.72%
	87.37%	9.69%

tion. This brings me to the question, "How do lecture and individualized instruction formats compare in the scores earned by students in Human Anatomy and Physiology?"

### The Study

Between the beginning of the Fall 1986 semester and the completion of my study at the end of the Fall 1987 semester, 89 students started Unit 1 and 55 finished Unit 5 of A&P in the individualized format. Of these, 48 completed the entire course in the individualized format. They comprise the Individualized Instruction Group (IIG) in this study.

At the beginning of the Fall 1987 semester 23 students began Unit 1 and 15 finished Unit 5 of A&P in the lecture format. Of these, 11 completed the entire course on the lecture format. These 11 students comprise the Lecture Group (LG) in this study. The other students dropped out, changed programs, only had part of the course to complete, changed formats, or for some other reason did not complete the whole course during the study.

Both the IIG and LG consisted of students in Biotechnology, Dental Hygiene, Medical Assisting Programs, plus some students who had not yet declared a major or whose majors were not represented in both groups.

In both formats, the whole course of A&P was worth 1,000 points—200 in each of five units. In each unit, 100 points were from a unit test, 10 from each of three quizzes and 70 from lab activities and oral lab quizzes over details of both structure and function.

The following information was collected for each student in the IIG and LG:

- age
- grade point average (GPA)
- percent score for the entire course
- point totals for each unit
- time spent in the entire course
- time spent in each unit

The Student t-Test was used to compare the groups and programs for significant differences at the 95 percent confidence level (Larsen 1975).

### Results

The ages and overall college GPAs of the groups were compared for significant differences. The age and GPA information is shown in Table 2. There was no significant difference in the groups' ages or GPAs. Within the programs, the Biotechnology lecture group was significantly older than the Biotechnology individualized group. Between programs within formats, both Biotechnology student groups were significantly older and had higher GPAs than the Dental Hygiene student groups. Within the IIG the Medical Assisting students were also significantly older than the Dental Hygiene students but their grades were not significantly different.

In comparing the percent scores for the whole five unit course, there were no significant differences between the individualized and lecture groups (see Table 3 for data). In comparing programs between formats there were no significant differences within Biotechnology or Dental Hygiene.

In comparing different programs within formats, Biotechnology students' scores were significantly higher than Medical Assisting students' scores within the individualized format. Medical Assisting students are not included as a program in lecture format comparisons since only one of the seven Medical Assisting students who started the lecture completed the course in that format.

Table 4 shows the Unit point totals for the groups and programs. There were no significant differences between the IIG or LG. Within programs between formats there were no significant differences. Be-

Table 4. A & P Student Unit Totals

Group	U 1	S.D.	U 2	S.D.	U 3	S.D.	U 4	S.D.	U 5	S.D.
IIG	171.9	13.8	167.8	18.0	168.9	17.7	170.1	17.1	165.1	19.7
DH	172.5	13.8	167.7	16.0	167.5	16.2	165.0	15.2	160.2	17.6
BT	177.9	13.9	176.2	16.1	176.6	20.2	176.7	18.2	180.3	12.4
MA	163.8	12.4	156.9	17.3	163.2	20.9	163.4	17.8	156.3	20.2
LG	169.8	17.3	164.4	15.6	168.9	20.6	169.0	18.2	164.1	18.4
DH	159.9	14.8	157.8	9.8	160.4	15.8	157.6	15.1	157.8	16.9
BT	177.4	17.3	171.3	20.0	174.4	25.1	179.0	17.5	171.6	20.6

tween programs within the individualized format the Biotechnology students' unit point means were significantly higher than Medical Assisting students' unit point means in Units 1, 2 and 5. In Unit 5 the Biotechnology point mean was also significantly higher than the point mean of the Dental Hygiene students. Between the Biotechnology and Dental Hygiene programs in the lecture format the Biotechnology students' point mean was significantly higher in Unit 4.

Figure 1 compares the weeks spent on each unit by IIG and LG students. Time spent on each of the first four units by the IIG students was significantly greater than the time spent by the LG students. There is a standard deviation on LG unit 5 because some students completed the unit up to one week before the end of the semester.

Figure 2 shows the time spent by students in each program in each unit. Medical Assisting students spent significantly longer in Units 1, 2 and 3 than either Dental Hygiene or Biotechnology students.

Figure 3 shows the time spent in the whole course by groups and programs. Medical Assisting students average two semesters in the course. The average time spent by any students completing the course in the individualized format (with the exception of Dental Hygiene students) is significantly longer than the time spent by corresponding lecture format students. The large standard deviation in individualized Dental Hygiene time made the average difference from lecture time insignificant.

## Discussion

Previous studies have compared individualized instruction formats with lecture in General Psychology (Ulrich & Pray 1965; Kulik, Kulik & Carmichael 1974), General Chemistry (Ertwine & Palladino 1987) and Sociology Methods (Smith 1987). These have been individualized courses developed from lecture courses. Here at Central Community College, individualized instruction is our normal format and lecture is an innovation. In comparing overall course grades between lecture and individualized formats, regardless of the relative origin of the course, no significant differences appear in student's final course scores. I looked at age, grade point average and time spent, as well as grades in my Human Anatomy and Physiology course. There were no significant differences between the ages, GPAs, or complete course scores of the individualized instruction and lecture groups.

In looking more deeply at my Human Anatomy and Physiology course, I found some differences within subsets of the study groups. Medical Assisting and Biotechnology students are older than Dental Hygiene students. The youngest group, the lecture Dental Hygiene students—many of whom

are just starting college—had the lowest GPAs. However, age and GPA differences are not as interesting to my study results as time and score differences. Individualized students in the Medical Assisting program scored significantly lower than individualized students in the Biotechnology program and took significantly longer than the individualized students in both Biotechnology and Dental Hygiene programs.

When I looked at the course in terms of its five units I found some trends. Individualized unit times decreased going from Unit 1 to Unit 3. As can be seen in Figure 4, Unit 4 contains chapters on blood and on the cardiovascular system—topics which many students find difficult. Unit 5 times decreased because students could see the end of the course and often went faster than care would have dictated. As a result, Unit 5 scores dropped for the IIG to the lowest level for the course. The average Unit 5 score dropped slightly for the LG for similar reasons and also because students could calculate the minimum number of points needed in Unit 5 to maintain a specific grade.

The time spent by the individualized Medical Assisting students is significantly longer in Units 1, 2 and 3 than either Biotechnology or Dental Hygiene individualized students. In Units 1 and 2 the Biotechnology students scored higher than the Medical Assisting students, and in Unit 5 the Biotechnology stu-

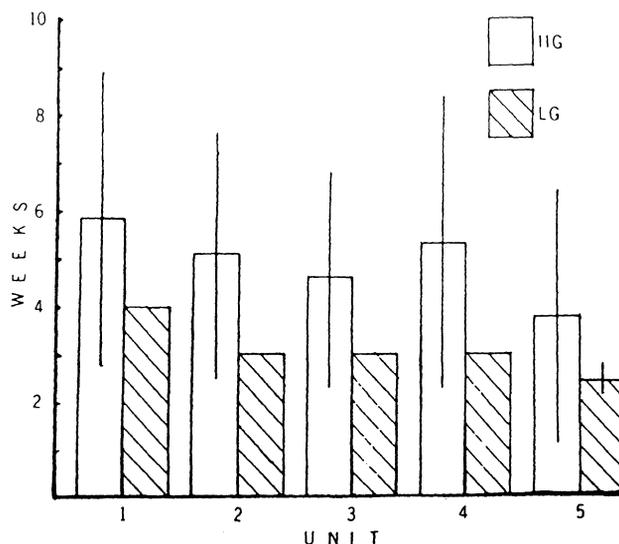


Figure 1. Time Spent In Human Anatomy and Physiology By Unit. IIG = Individualized Instruction Group (48 students); LG = Lecture Group (11 students). Vertical lines represent standard deviations.

dents scored higher than both Medical Assisting and Dental Hygiene students.

What happened in Unit 4? In it I found the only significant differences in the lecture group. The Biotechnology students again scored higher than the Dental Hygiene students. In the individualized instruction group all students spent more time in Unit 4 and were able to achieve better scores. In the lecture group, where extra time was not available, the trend of Biotechnology students scoring higher than other students was evident.

Medical Assisting students can satisfactorily complete Human Anatomy and Physiology, but it takes them longer than the lecture allows. It was this trend that drove the Medical Assisting students out of the lecture. They could not keep up.

At Central Community College, it appears that if the lecture course pace is not much greater than a student's individualized pace would be, that student will probably do as well in the lecture as in individualized instruction. If self-pacing is available, the student will use the time necessary to achieve his potential.

Human Anatomy and Physiology can be taught in either lecture or individualized formats. There were no significant score differences between heterogeneous groups completing A&P in either format. There are advantages and disadvantages to each format. Lectures are good for quickly dispersing information to larger groups, but do not allow for individual learning differences. Individualized instruction does allow for individual student differences in speed and preparation, especially if the format is also self-paced. Individualized instruction is economical in terms of equipment and facilities and thus is good for student scheduling flexibility, but it is not good for moving large groups through a course. Options in education make for the best overall results.

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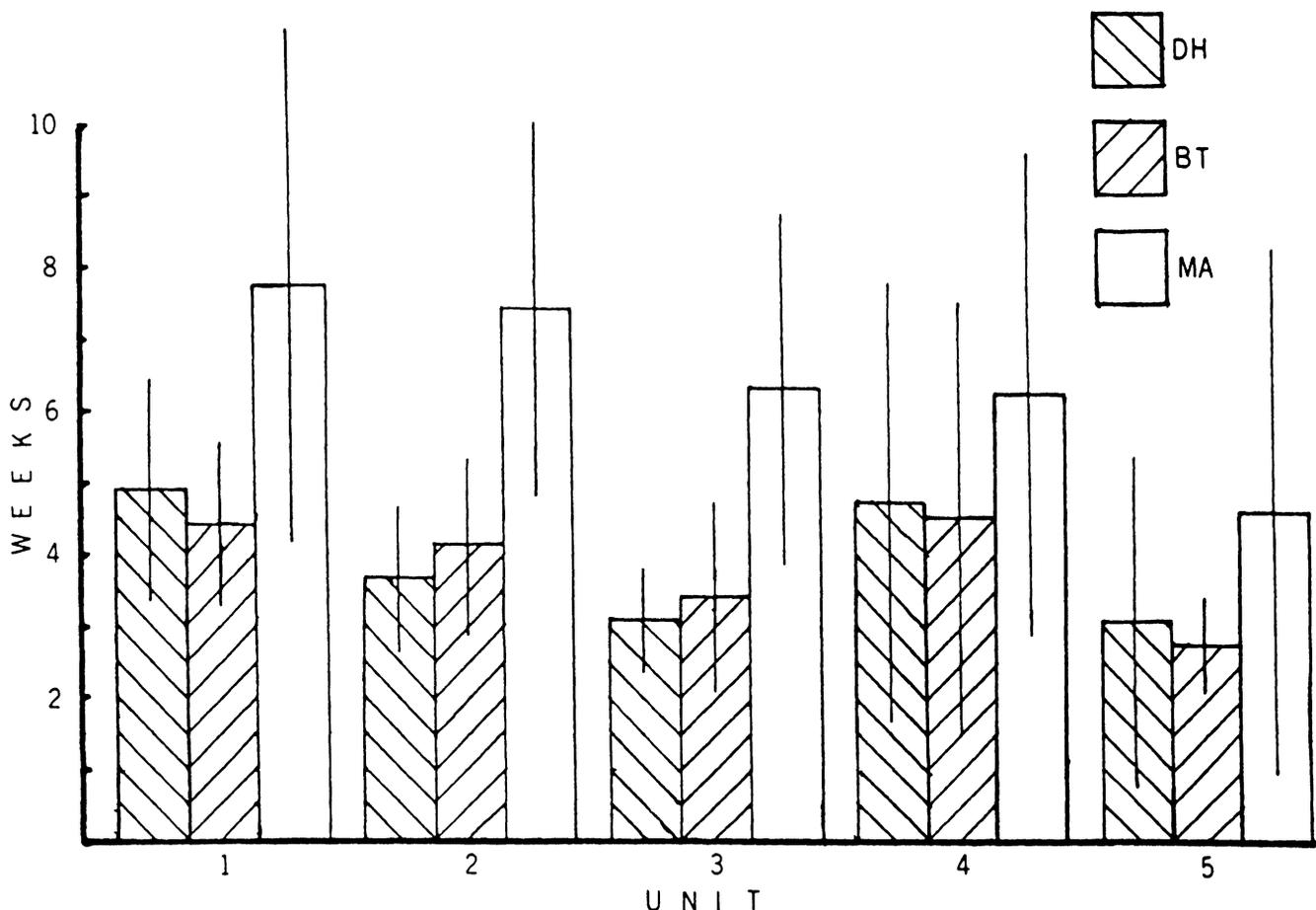


Figure 2. Time Spent In A&P Units By Individualized Programs. DH = Dental Hygiene (11 students); BT = Biotechnology (9 students); MA = Medical Assisting (17 students). Vertical lines represent standard deviations.

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Figure 4. Human Anatomy and Physiology Course Outline.

- Units:
1. Orientation, Organization and Tissues
    - A. Introduction
    - B. Chemical Basis of Life
    - C. The Cell
    - D. Cellular Metabolism
    - E. Tissues
    - F. Skin and Integumentary System
    - G. Body Organization
  2. Support, Movement and Integration
    - A. Skeletal System
    - B. Muscular System
    - C. Nervous System
  3. Coordination and Processing
    - A. Special Senses
    - B. Endocrine System
    - C. Digestion
  4. Transporting
    - A. Respiration
    - B. Blood
    - C. Cardiovascular System
  5. Life Cycle and Processing
    - A. Lymphatic System
    - B. Urinary System
    - C. Reproductive Systems and Pregnancy

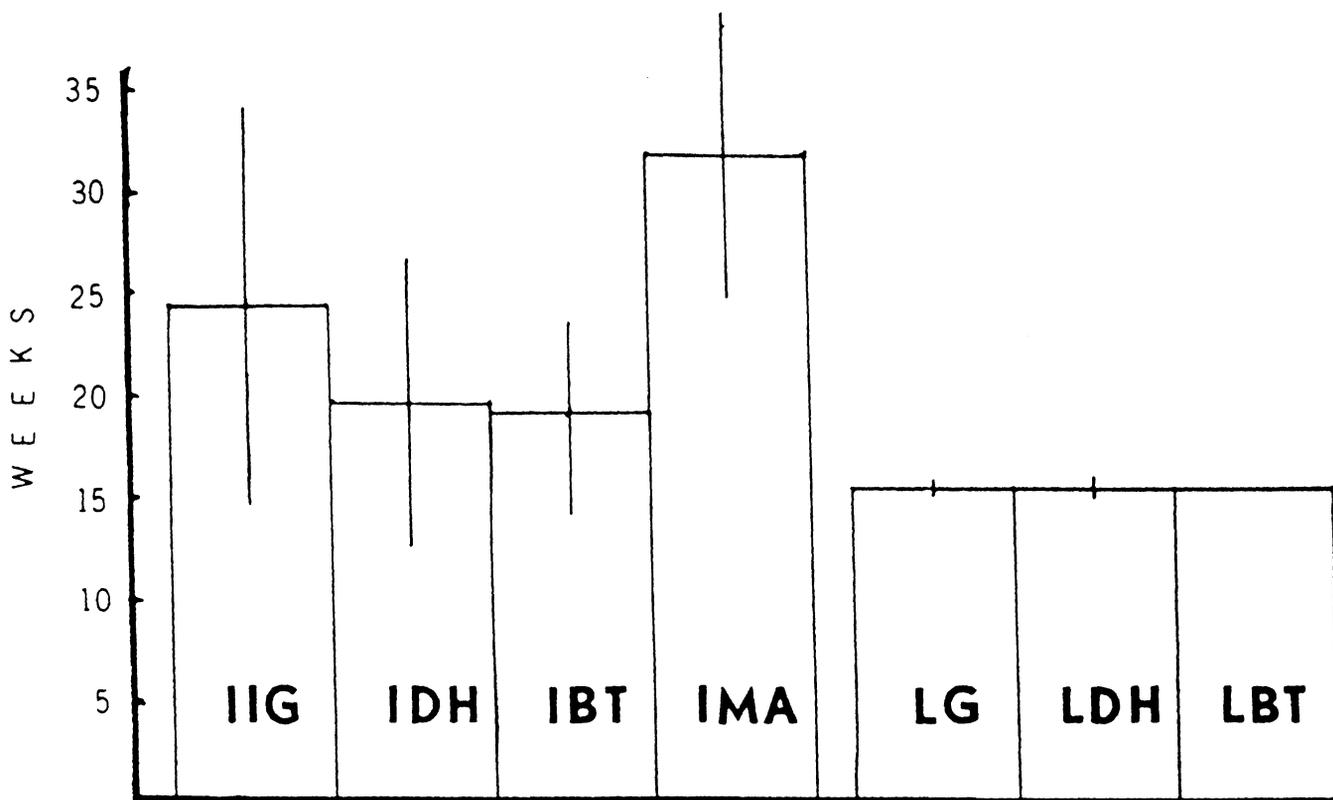


Figure 3. Total Time Spent In A&P By Groups And Programs. IIG = Individualized Instruction Group (48 students); IDH = Individualized Dental Hygiene (11 students); IBT = Individualized Biotechnology (9 students); IMA = Individualized Medical Assisting (17 students); LG = Lecture Group (11 students); LDH = Lecture Dental Hygiene (5 students); LBT = Lecture Biotechnology (5 students). Vertical lines represent standard deviations.