A Survey of Laboratory Programs for First Year Medical Students

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Introduction and Methods

Basic science courses offered to freshmen medical students have been traditionally taught by didactic presentations and laboratory work. Various factors have prompted many departments to either markedly reduce the time allotted for the traditional, but more vulnerable, laboratory phase of these courses or drastically alter the content of the laboratory programs. Information concerning the desirability for such changes is incomplete and no evaluation has been developed to determine the effectiveness of change. Before beginning any further alterations in the laboratory programs at the Medical College of Virginia, it seemed desirable to determine anew what we wish to teach in the laboratory. This problem was approached in part by surveying the attitudes of other anatomy, biochemistry, and physiology departments.

Questionnaires were sent to the chairmen of anatomy, biochemistry, and physiology departments in 116 medical schools. These schools included 102 US medical schools, 12 Canadian medical schools, and 2 American type medical schools in foreign countries. The US schools included some new medical schools which have opened only recently or which are scheduled to begin classes in Medicine within the next few years. Seventy-one anatomy departments, 70 biochemistry departments, and 72 physiology departments responded by returning completed or at least partially completed questionnaires. (Incomplete answering of questionnaires by some departments resulted in slight variations from question to question in the total number of departments responding.) The data were obtained with the promise of anonymity and, although some direct quotations will be included, anonymity will be preserved throughout this report.

The first section of the questionnaire attempted to determine the characteristics and teaching responsibilities of the departments responding. The second section of the questionnaire was designed to indicate the significance which the departments place on the laboratory and to establish how they conduct their laboratory programs.

One part of the questionnaire listed seven possible objectives of a laboratory program:

1. Interpretation of clinical laboratory findings
2. Acquirement of manipulative skills
3. Supplementation and reinforcement of didactic material
4. Development of student-faculty relations
5. Appreciation of experimental development and methodology
6. Experience and responsibility of working with live animals or tissues
7. Other (to be specifically stated)

The department chairmen were then asked to rate these objectives using a system of 1 through 4 with 1 representing a very important objective and 4 representing an objective of much lesser importance. In evaluating the returns we considered a rating of 1, 2, or a checkmark to indicate an important objective and other ratings to denote relatively unimportant objectives.

The data concerning the three disciplines of anatomy, biochemistry, and physiology were analyzed separately using an IBM 1130 computer. The

* Analysis of data supported in part by NIH Grant FR 0016. We gratefully acknowledge assistance given by R. Flora and V. Hutto, Department of Biometry, Medical College of Virginia.

results associated with each discipline are also reported separately for the convenience of those with discipline-oriented interest.

Some Characteristics and Teaching Responsibilities of the Departments

According to the departments that responded to the questionnaire, the average anatomy department consists of 10.6 full time faculty members and 2.9 part time members. Of the total 66 replies analyzed, 63 teach graduate students in addition to medical students; 25 have responsibilities in dental, 24 in nursing, 21 in physical therapy, 10 in dental hygiene, and 6 in pharmacy curricula. There are 26 departments that have commitments in disciplines other than those listed in the questionnaire. These include occupational therapy, medical technology, veterinary medicine, postdoctoral education, residents, and undergraduate courses in the arts and sciences. Forty-nine of the 66 anatomy departments analyzed are at institutions operating under the traditional program based on the departmental courses. Fourteen departments are part of an integrated program involving at least one other department. Three departments felt their program did not fit any of the listed categories. Of 64 replies, 33 departments still identify their courses of neuroanatomy while 31 list their course as an integrated neural science course.

The departments of biochemistry responding to the questionnaires report a mean of 9.7 full time and 5.8 part time faculty. All of these departments teach medical students; most teach graduate students; almost a third teach dental students; and some teach various other students in paramedical, agricultural, or liberal arts areas. Fifty-nine of 67 departments are at medical schools which utilize separate departmental courses; the remaining eight departments teach medical students in an integrated program involving other departments.

The physiology departments responding to our questionnaire make up a population which has an average of ten full time faculty members and three part time members. Of the total 72 physiology departments responding, 70 teach graduate students in addition to medical students; of these, 28 have no other teaching responsibilities. The remaining departments have teaching obligations to a variety of combinations of dental, pharmacy, nursing, physical therapy, and dental hygiene students. Other students who are taught by some of the departments include occupational therapy students, residents, biomedical engineers, and undergraduate students in the arts and sciences. Fifty-eight of the 72 responding physiology departments are at institutions operating under the traditional program based on departmental courses. Fourteen departments are part of an integrated program involving at least one other department.

Significance of and Methods for Conducting a Laboratory Program

Anatomy Laboratories

Of the departments supplying complete information in gross anatomy, 27 spend between 25 and 50 hours in lecture, and 25 spend 50 to 100 hours. The mean is 50 hours of lecture; two departments spend less than 25 hours in the lecture portion of the course and four are in the 100–150 hour range.

In microscopic anatomy the mean time devoted to lectures is 41 hours with 38 departments ranging between 25 and 50 hours and 16 departments teaching between 50 and 100 hours. One department has a lecture time of less than 25 hours. In neuroanatomy the mean time allotted for lectures is 37 hours with two departments in the 0–25 hour range and seven departments in the 50–100 hour category. The majority of 48 groups spend between 25 and 50 hours in lectures.

Fifty percent, 69%, and 72% of the anatomy departments feel that the time which they have allotted for the laboratory phase in gross anatomy, microscopic anatomy, and neuroanatomy (respectively) is adequate to meet the objectives of the laboratory. Thirty percent feel that the time allotted for gross anatomy is less than adequate, 20% believe the same of microscopic anatomy, and 23% could use more time in the teaching of the neuroanatomy laboratory. More than adequate time was reported by 11% in gross anatomy, 9% in microscopic anatomy, and 5% in neuroanatomy. The mean time spent in the laboratory is 180 hours in gross anatomy, 80 in microscopic anatomy, and 59 in neuroanatomy.

The departments vary greatly as to the number of hours which are devoted to laboratory teaching. Some persons apparently feel very strongly, especially in gross anatomy, that laboratory programs are tremendously meaningful and important while others express doubt regarding their value. Ten departments spend between 0 and 125 hours in the gross anatomy laboratory, 29 teach between 125 and 225 hours, 7 are in the 225 to 300 hour range, and 1 department spends more than 350 hours in the gross anatomy laboratory. In microscopic anatomy 6 departments are in the 0–5 range, 16 in the 50–75 group, 17 in the 75–100 range, 12 in the 100–125 hour range, and 3 devote between 125 and 150 hours to the laboratory portion. In neuroanatomy, 19 departments teach 0 to 50 hours, 23 teach 50 to 75 hours, 11 teach 75 to 100 hours, while 3 departments spend 100 to 125 hours in the laboratory.

The distribution of the number of students per faculty member in a typical laboratory has a mean value of 24 in gross anatomy, 25 in microscopic

anatomy and 27 in neuroanatomy. When the student/faculty and graduate assistant ratio is considered, the value shifts to 19 for all three courses.

Laboratory attendance is required in 75% of the departments, and accordingly (Fig 1) in gross anatomy an average of 42% of the student's final grade is derived from his laboratory performance; the figures are 39% and 35% for microscopic and neuroanatomy courses respectively.

In gross anatomy 22 (42%) departments count practicals as 50 to 90% of the final grade while 13 (24%) use practicals as the sole measure of a student's accomplishments. In microscopic anatomy and neuroanatomy the figures for the 50–90% range are 32 (52%) and 24 (35%) respectively. Practicals are employed as the only evaluation of students in 12 (22%) microscopic and 14 (26%) neuroanatomy courses. Oral examinations are used by very few departments in all three disciplines for the evaluation of the students' performance. Written examinations, either as a separate examination or in conjunction with a lecture examination, seem to be quite popular since they are used by approximately 61% of the departments in all three subject areas. Written or oral laboratory reports are used in one department to aid the evaluation of the students' performance. Another method mentioned for evaluation of students' laboratory progress is a subjective evaluation of the students by the faculty either in the laboratory or in conferences and discussions about the laboratory work.

Flexibility in the curriculum for long or short laboratory periods as needed was reported in 43 (75%) of the departments while in 15 (25%) this possibility did not exist. The most popular length for any gross laboratory period is 3 to 5 hours although shorter and longer labs are often used. Laboratories in microscopic anatomy and neuroanatomy utilized periods of less than 3 hours to the greatest extent.

The three most esteemed objectives of laboratory exercises in all three courses in their order were (Figs 2a, b, c): *supplementation and reinforcement of didactic material, interpretation of clinical laboratory findings,* and *appreciation of experimental development and methodology.* The latter is essentially an appreciation of the "scientific method." Of less importance were the objective of *acquirement of manipulative skills* and *development of student-faculty relations.*

As can be seen in Figs 3a, b, and c, demonstrations and class discussions were used by about one-third of the departments and reflected 10% to 20% of total class time. Research projects were not employed and student conduction of pre-assigned experiments was also extremely rare in the three anatomy specialties. The mean percentages of lab-

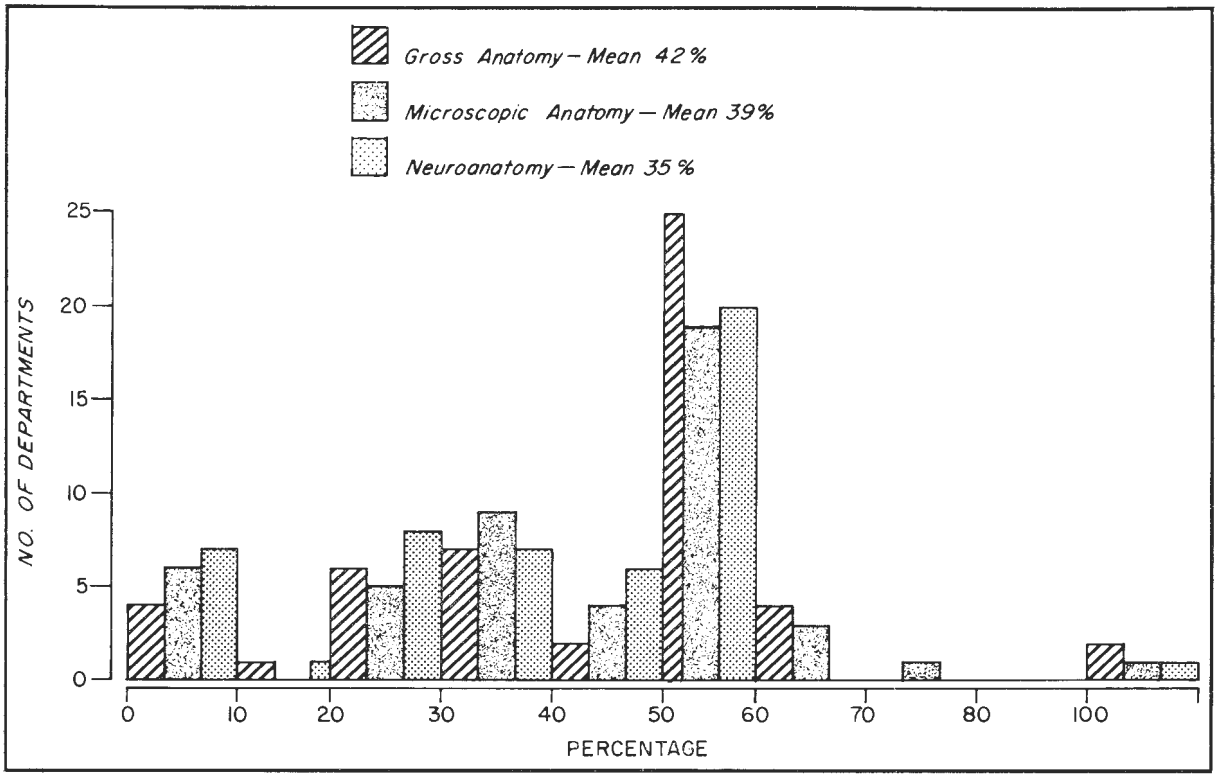

Fig 1—Distribution of percentage of the student's final grades derived from his laboratory performance.

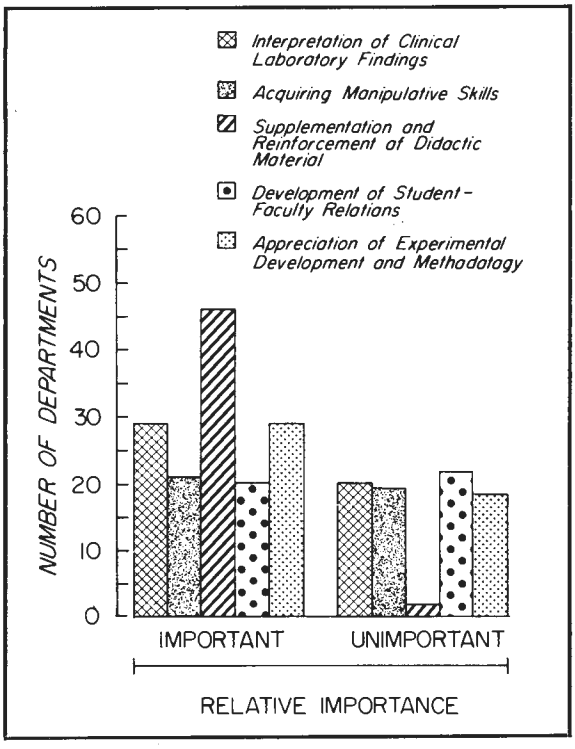

Fig 2(a)—Distribution of opinions concerning the importance of certain objectives of a gross anatomy laboratory program.

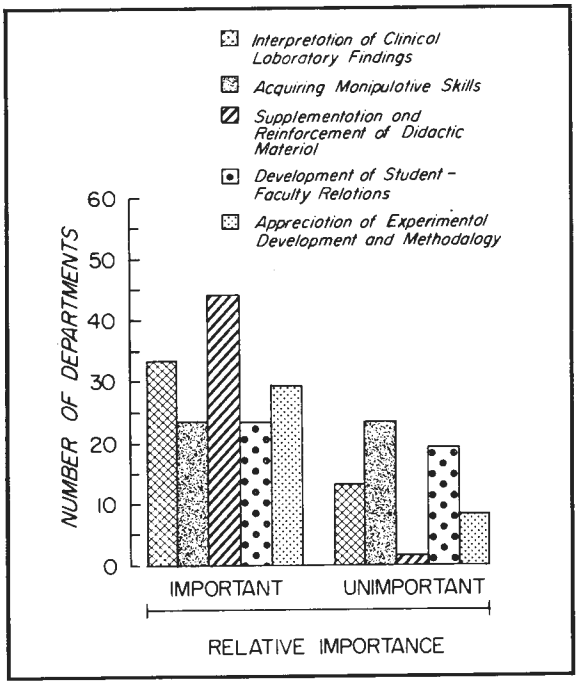

Fig 2(b)—Distribution of opinions concerning the importance of certain objectives of a microscopic anatomy laboratory program.

oratory work carried out by the students were 90% in gross anatomy, 80% in microscopic anatomy, and 82% in neuroanatomy; demonstrations in these three areas, respectively, comprised 8%, 10%, and 14% of the time.

The prevalent opinion of anatomists throughout the country seems to be that anatomy is a visual and manual science. Dissection and microscopic examination of material and painstaking repetition are still the most valuable assets to the student.

There is relative agreement that while planning effort and budget for the laboratory program have either remained unchanged or increased over the past five years, the actual laboratory time has either remained unchanged or decreased during the same period. Fifty-six percent of the departments have experienced a decrease in their time allotted for gross and microscopic anatomy; for neuroanatomy the corresponding figure is 42%. An increase for the anatomy disciplines was reported by 17% of the departments; the remainder report no drastic change in the time used for laboratory teaching.

Seventy-two percent used original microscopic slides in microscopic anatomy 90–100% of the time

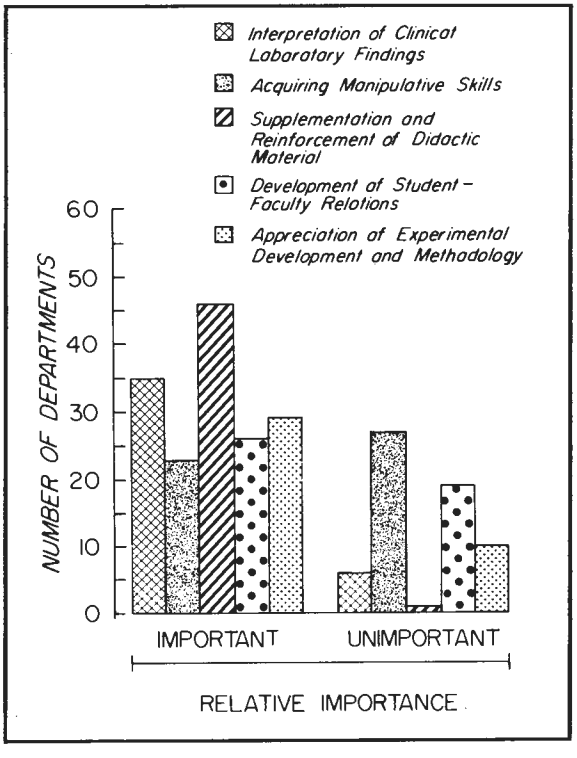

Fig 2(c)—Distribution of opinions concerning the importance of certain objectives of a neuroanatomy laboratory program.

while 59% do the same in neuroanatomy. Kodachrome projection slides are used between 0% and 20% of the laboratory time by 73% of the microscopic anatomists and by 64% of the neuroanatomists. Seventy-eight percent of the departments feel that the published laboratory manuals in the three anatomy disciplines do not meet the requirements and needs of the students and faculty. Of the responding departments 59% feel that some use of special visual aids (including films, tapes, and closed circuit television) improves student learning. Thirty-four percent of the departments feel that these visual aids shorten the time required for laboratory teaching while 56% feel the required time is unchanged but may be more effective. Ten percent think visual aids increase the time required for laboratory programs.

Most departments (90%) indicated that they use live black and white television (no one that replied indicated color capability), tapes and films, projections, predissected materials, and charts and models to a certain extent. In general, however, no more than 10% of laboratory programs are occupied by audio-visual aids. The basic teaching goals of 75% of the anatomy departments have, despite the current stress on change, remained the same; they are still interested in giving the student a well rounded and fairly complete course in the basic anatomy disciplines which will be a foundation for his future clinical training.

Several comments include the sentiments that "it is just plain stupid to cut hours in all courses to the same degree. Such a maneuver emasculates a course in Anatomy but does relatively little harm to Biochemistry and Physiology." Many people feel that "the trend to reorganize anatomy with a view to preparing specialists only is shortsighted and dangerous; there is a need for a family-type practitioner, which precludes the dangerous shortening of basic science material." The sentiment also voiced quite frequently points out a basic contradiction in our system of revising and changing curricula. At a time when more elective courses are being introduced, many decry the short span of four years available for medical education.

The feeling that "Anatomy is a laboratory subject; . . . (especially) so with Gross Anatomy, least with Neuroanatomy and with Histology in an intermediary position" is held by virtually everyone. "It is a visual science and as such reading textbooks gets one only partially and incompletely on the way to its understanding."

Several comments include the sentiments that "nothing replaces a high ratio of instructors to students," that "audiovisual aids are essential for small staffs with large numbers of students" and that

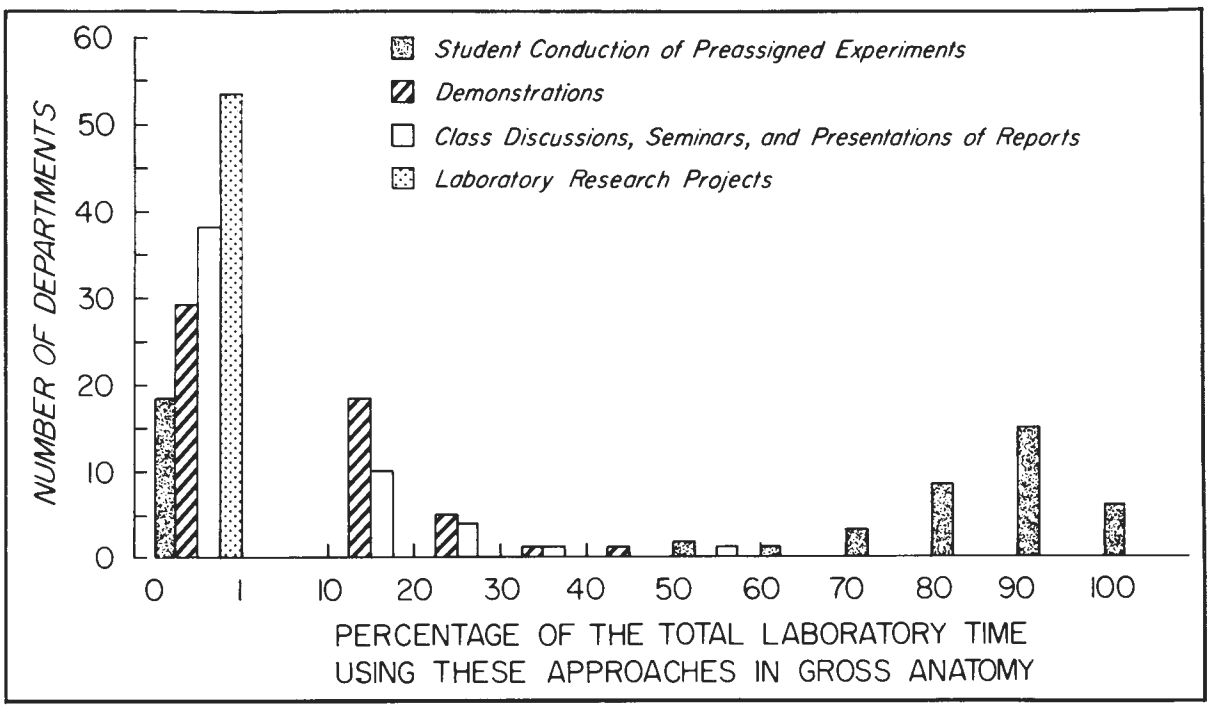

Fig. 3(a)—Distribution of approaches used in conducting the laboratory program.

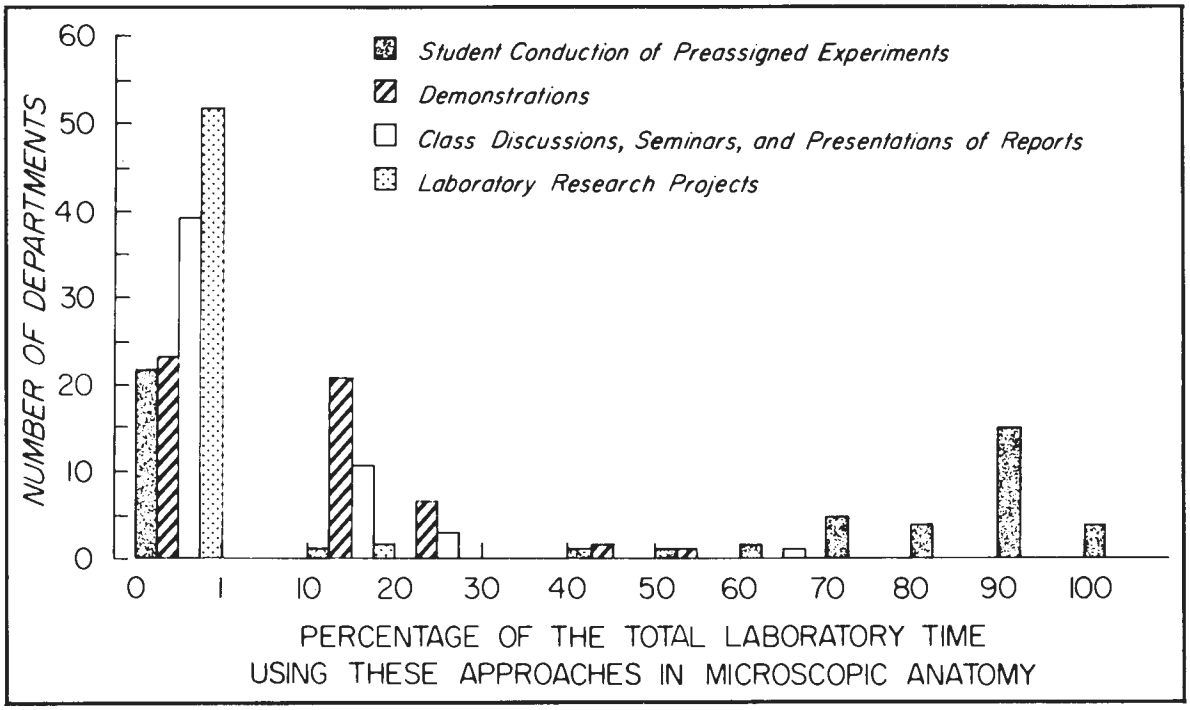

Fig 3(b)—Distribution of approaches used in conducting the laboratory program.

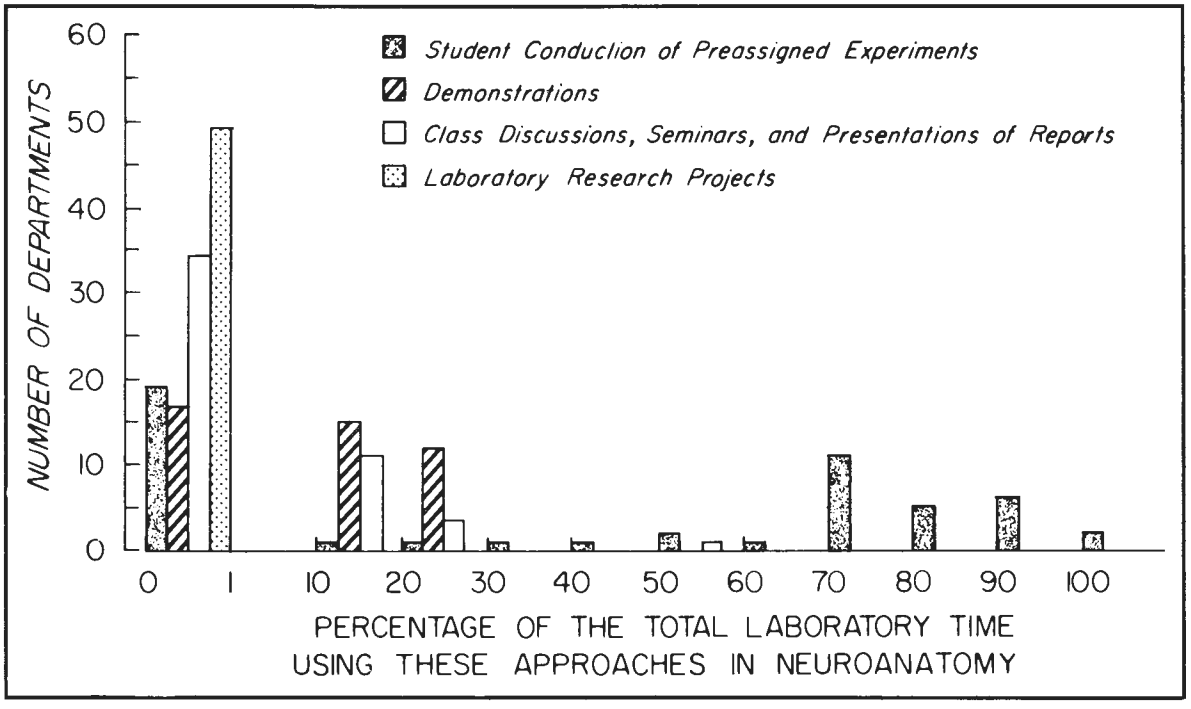

Fig. 3(c)—Distribution of approaches used in conducting the laboratory program.

"supervised dissection, predissected cadavers, chalk drawings and explanatory lectures are absolutely mandatory if the student is to gain any lasting value from the laboratory courses."

The feeling seems to be universal that a change in time and emphasis was needed; people feel that "tests are more reasonable in length and emphasis" and that the "attitude of the faculty is fairer" now. The opinion that an "M.D. needs a good general background" and that "repetition contrary to the thoughts of many is essential" is widely held.

The idea that "we should fight for maintaining our Gross Anatomy courses and should integrate Micro and Neuro" is widely held, but some people voice that the "integration scatters histology too much since the lectures and laboratories occur sporadically through the whole year." One could agree probably with the statements "deemphasize lectures, the lab is more important"; however, "it needs clinical orientation to a degree." "Laboratories should be made a learning experience instead of a teaching experience" expresses the sentiments of most anatomy departments.

Biochemistry Laboratories

Of 65 biochemistry departments reporting, 46 spend between 50 and 100 hours in lectures while 5 spend less than 25 hours. In the laboratory teaching program (including demonstration) there is a mean of 94 hours. The individual values range from 0 to 348 hours. Of 65 departments reporting, 44 feel that the time allotted for the laboratory is adequate. Forty-three of these departments reported the number of hours spent in the laboratory program, and it will be noted that these range from 0 to 304 hours. It is interesting that although the mean time spent in the laboratory is only 94 hours, two departments having more than 175 hours of laboratory time felt that this was less than adequate. Of the 14 departments reporting more than adequate time, the range is from 40 to 348 hours.

The student/faculty ratio has a mean value of 23, but the ratio is decreased to 13 when graduate assistants are included with faculty. Although laboratory attendance is required in 84% of the departments responding, the mean value given to the laboratory grade in the calculation or determination of a student's final grade is only 18% (Fig. 4). In 17% of the departments the laboratory work contributes nothing to the student's final grade, and in 58% of the departments the laboratory work contributes less than 20% to the student's final grade.

Eight of 63 biochemistry departments use a practical examination in helping to determine the student's grade in the laboratory; three of these give it credit for 50% or more of the student's laboratory grade. Oral examinations are used by only four departments. Written examinations are used in helping to determine the student's laboratory grade in 29 departments, and in 21 departments, written examinations comprise 50% or more of the student's laboratory grade.

Written laboratory reports assume somewhat greater importance in the evaluation of the student's laboratory grade. Only 16 of 63 departments give no weight to written laboratory reports; in 40 departments they comprise 20% or more of the student's laboratory grade. Indeed, in seven departments, the total laboratory grade is derived from this aspect of the student's performance. Oral laboratory reports assume somewhat less importance, but in 4 departments out of 63, they comprise 50% or more of the student's laboratory grade. This method of grading is not used at all in 53 departments. Other methods of determining the student's laboratory grade are used to some extent in 22 departments. In 11 of these, other methods determine 50% or more of the student's laboratory grade. (The majority of these involved an unspecified subjective evaluation of the student's laboratory performance. Some departments also mentioned grading of analytical results on laboratory unknown samples, seminars, and laboratory technique.)

Sufficient flexibility of curriculum to allow longer or shorter laboratory periods is reported in 40 of 64 departments. The laboratory of 3 to 5 hours length is still the most popular, but it may also be noted that seven schools use laboratories longer than 5 hours exclusively.

It is noted in Fig 5 that supplementation and reinforcement of didactic material and appreciation of experimental development and methodology are the most uniformly important objectives. These were considered important by 48 and 50 departments respectively of 66 answering this question. It is per-

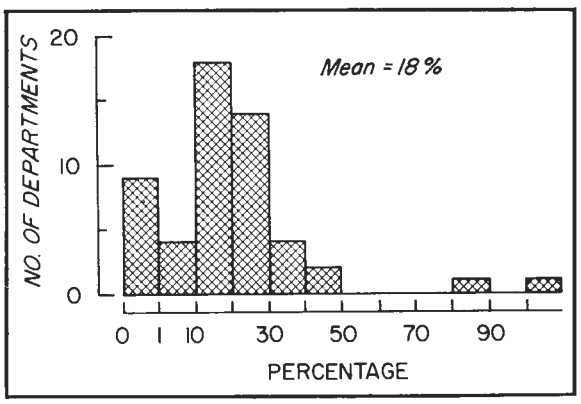

Fig 4—Distribution of percentage of the student's final grade derived from his biochemistry laboratory performance.

haps surprising that interpretation of clinical laboratory findings is considered quite unimportant. Experience and responsibility of working with live animals or tissues is similarly rated unimportant. The objective of development of student-faculty relations is considered to be an important objective in slightly more than half the departments.

Of 66 departments responding to this question, 55 use student conduction of pre-assigned experiments for a portion of their laboratory program (Fig 6). Although 46 departments spend 50% or more of their laboratory time in student conduction of pre-assigned experiments, no school uses 100% of its laboratory time for this purpose. Forty-eight use demonstrations in their laboratory program, but only six use this in more than 50% of their laboratory program. Two schools are noted to use demonstrations exclusively. Forty-one departments use class discussions, seminar, and presentation of reports for at least a portion of the laboratory program, but in only four departments does it amount to more than 30% of the laboratory time. Twenty-six departments use laboratory research projects in their laboratory program. Of these 26, 15 allot this approach 30% or more, and 8 departments use this approach for greater than 70% of the laboratory time. Since supplementation and reinforcement of didactic material is often considered an important objective of the laboratory program, the departments were asked which approaches they considered to be most effective in achieving this objective. Twelve of 41 departments selected student conduction of pre-assigned experiments, and 13 of 41 departments selected class discussion, seminars, and presentation of reports to be most effective. Laboratory research projects, and demonstrations were considered much less effective in reaching this particular objective.

Although the time devoted to the laboratory program was not reported to have increased in any of the responding schools, planning effort has increased in 35 and remained unchanged in 10 of 59 departments responding. In the past five years the budget has increased in 30 and remained unchanged in 19 of 57 departments reporting.

The use of visual aids is considered by 28 of 33 departments to improve student learning. At the same time 14 of 27 departments consider that the time required for laboratory teaching would be unchanged and 3 departments indicate that the time required for laboratory teaching would increase with use of visual aids. Only 4 of 58 departments make any use of live, closed-circuit television in laboratory teaching, and none utilize color.

Having presented tabulations of ordered responses, we would be remiss if we did not also report anonymously some remarks made in a section of the questionnaire requesting comments. One respondent stated tersely, "Biochemistry does not exist apart from the laboratory. Medical students may not like biochemistry laboratory. They need it to become acquainted with biochemistry."

On the other hand, one responded, "I am beginning to question seriously in my own mind the role of a laboratory in biochemistry to freshmen medical

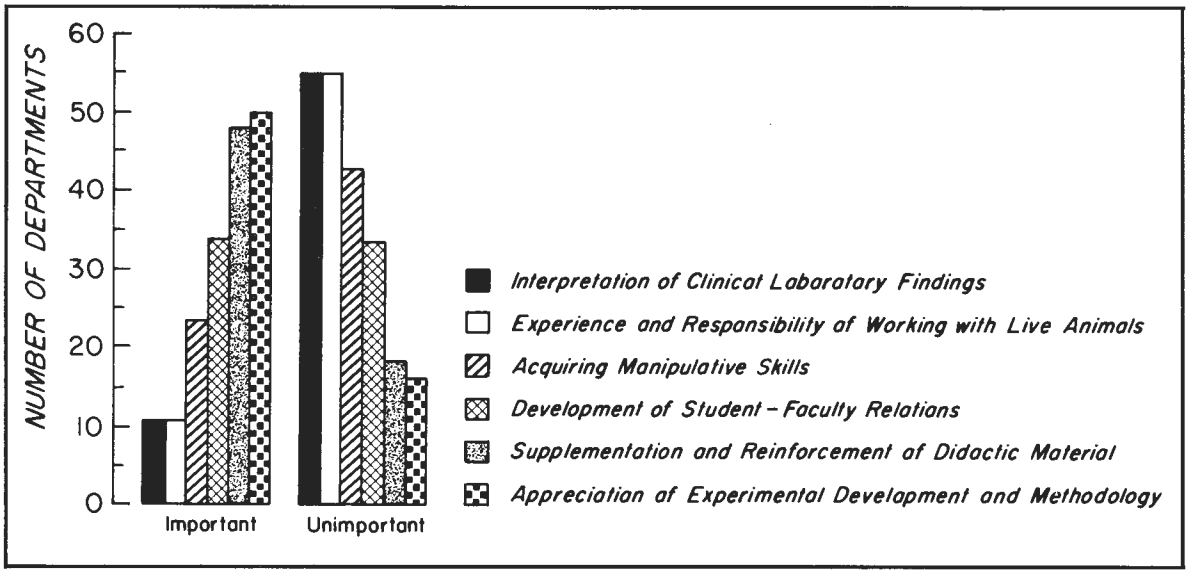

Fig 5—Distribution of opinions concerning the importance of certain objectives of a biochemistry laboratory program.

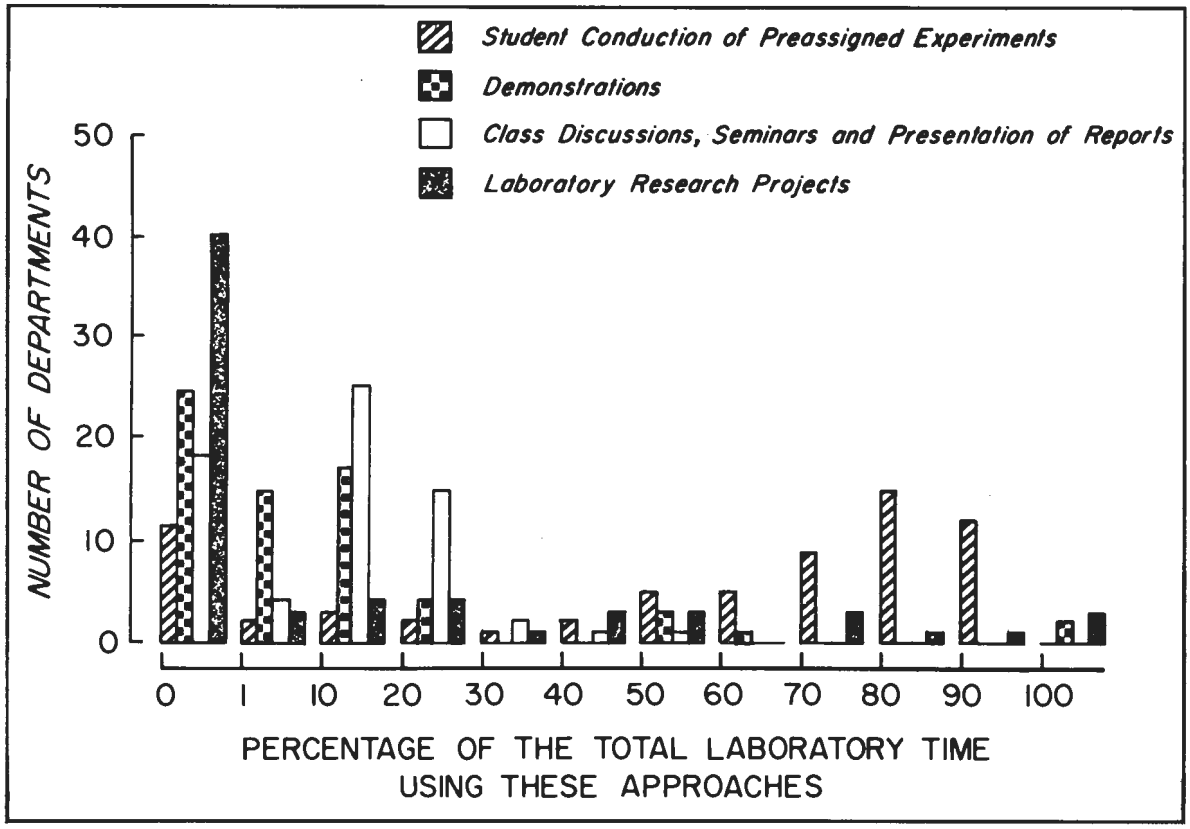

Fig. 6—Distribution of approaches used in conducting the biochemistry laboratory program.

students in general. For the relatively large investment in time involved I am not convinced that the student derives very much about biochemistry for his investment." Another says that "Our own staff is split . . . on [the] value of continuing any lab training in biochemistry." The view is also reported that ". . . the first year medical students dislike the lab as does the faculty."

Still another reports that, "It is becoming increasingly apparent to us that the laboratory program is the most difficult part of the course to make meaningful to students." And, questioning the need again, "Of the 10% [of the students] essentially opposed to laboratory experimentation, some have excellent backgrounds and do very well as measured by examination."

One responded at some length, "It is our feeling that the laboratory for first year medical students should be constructed to emphasize problem-solving and introduction to the experimental method. We do not attempt to make research biochemists of these students but to introduce the concept that the practice of medicine involves asking scientific questions and interpreting data. Although the 'cook-book' approach is traditional, it does little to motivate, does not challenge, provides very little instructional benefit and renders the educational effort group-centered instead of individualized. The small group project approach makes it possible to give extra instructional effort for those who need it and to expand the scope of the project for those who are capable."

There appears to be a move in the direction of more flexibility in the laboratory program. At some schools there are a number of options for the student in regard to biochemistry laboratory. Thus various students in a given freshman class may be assigned to (or at some schools may elect) pre-assigned laboratory experiments, research projects, library work (with or without reports), or nothing. At some schools biochemistry laboratories are not available. In the *Comments* section of the questionnaire, 24 departments gave responses indicating that now (or in the next two years) there is no requirement for students to participate in a traditional laboratory program of pre-assigned experiments. When we consider that not all respondents addressed themselves to this particular problem in their comments, it seems safe to suggest this as a minimal figure. The fact that

only 11 departments reported no student conduction of pre-assigned experiments (Fig 6) does not really conflict with this if we consider that: (1) the answers from which Fig 6 was derived were based totally on past experience as opposed to both past experience and some short term plans reported in Comments; (2) in some schools certain students are assigned to or may elect the traditional laboratory program while other students are in other programs; and (3) in some schools an introductory series of laboratory exercises prior to different experiences (including research projects and library problems or discussion groups) has been calculated as pre-assigned experiments and appeared to increase the magnitude of this category in Fig 6.

Physiology Laboratories

Of the 68 departments reporting, 21 spend between 50 and 75 hours in lectures and 25 spend 75 to 100 hours. Ten departments spend over 125 hours in lectures while seven spend less than 50 hours. There is a mean of 113 hours devoted to laboratory teaching (including demonstrations) in these courses with a wide distribution ranging from 16 to 360 hours.

Fifty of 66 physiology departments feel that the time which they have allotted for the laboratory phase is adequate to meet the objectives of the laboratory. These 50 departments vary greatly as to the number of hours which they spend in the laboratory. Fifteen departments report that less than 75 hours is adequate while 13 have over 150 laboratory hours and feel that this is the appropriate amount. Of the five departments which feel their laboratory time is less than adequate only one had over 100 hours of laboratory teaching. Of the ten which feel the time they have allotted for the laboratory phase is more than adequate, seven had over 100 hours of laboratory teaching (two of these had over 200 hours) while three departments spend between 75 and 100 hours for laboratory teaching.

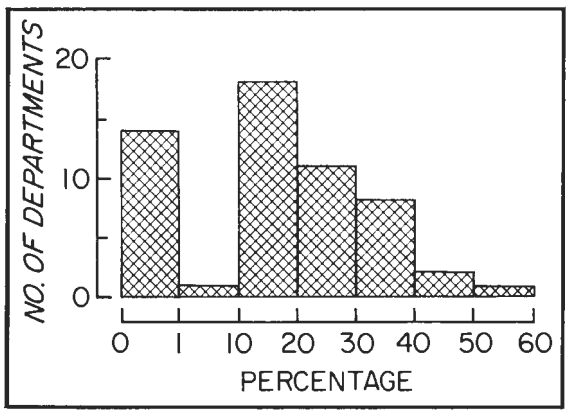

Fig 7—Distribution of percentage of the student's final grade derived from his physiology laboratory performance (Mean = 16%).

The wide distribution in allotted laboratory teaching time and in opinions regarding adequacy is the reflection of greatly diverse ideas concerning the significance of the laboratory phase in the first year medical student's program. Some persons feel that laboratory programs are tremendously important while others feel that they do not merit much time.

The distribution of the number of students per faculty member in a typical laboratory has a mean value of 16 but shifts to 9 when graduate assistants are included with the faculty.

Laboratory attendance is required in 71% of the departments. However, in 14 of 55 responding departments the students' laboratory work *per se* contributes nothing toward their final grades (Fig 7); in 30 other departments, evaluation of the student's laboratory performance contributes less than 30% of his total grade. On the average the student's laboratory performance contributes 16% of the student's final grade.

Only four physiology departments report using practical examinations to any extent in evaluating the student's laboratory performance. Oral examinations are also used by only a small number (8 out of 63 departments) for evaluation of the student's performance. Thirty-one departments use written laboratory examinations to some extent either as a separate examination or in conjunction with a lecture examination. Written examinations seem to be the most popular method for evaluating the student's performance.

Nine departments use oral laboratory reports to help evaluate the student's performance while 23 departments use written laboratory reports for this purpose. In four cases these reports make up the entire laboratory grade and in 15 other departments they contribute to 50% or more of the final laboratory grade. Another method mentioned for evaluation of the student's laboratory performance is a subjective evaluation of the students by the faculty either in the laboratory or in conferences and discussions about the laboratory work. Mentioned also as influencing the laboratory grades in some departments are projects, electives, attendance and term papers.

Flexibility for having long or short laboratory periods as needed is reported in 55 of 69 departments. The most popular length for a lab period is 3 to 5 hours although shorter and longer labs are being used considerably. Twelve departments use lab periods over 5 hours long exclusively.

The two most esteemed objectives for a laboratory program were supplementation and reinforcement of didactic material and an appreciation of experimental development and methodology (Fig 8).

The latter is essentially an appreciation of the "scientific method." Of less importance were the objectives of acquiring manipulative skills, interpretation of clinical laboratory development and development of student-faculty relations. As for the objective of obtaining experience and responsibility of working with live animals, 38 of 72 cases rated this objective as being important while 34 rated it as having much less importance.

Of the 69 departments responding, 62 used student conduction of pre-assigned experiments to some extent in their laboratory program (Fig 9). Forty-eight used this approach in greater than 50% of their laboratory programs. Fifty-one departments conducted demonstrations as part of their lab programs; however, they were used for only a small percentage of the total lab time. Forty-two of these departments used demonstrations for less than 30% of the total time. Forty-five have class discussion, seminars and presentation of reports also as part of their lab programs. As in the case of demonstrations the class discussions occupy a relatively small percentage of the total laboratory time; 39 of these departments had class discussion in less than 30% of their lab programs. Twenty-three departments use laboratory research projects to some extent in their lab programs. Of the 23, 14 use it for less than 30% of the time while 3 use it for more than 70% of the total lab time.

There are diverse opinions on which approach is most effective for supplementation and reinforcement of didactic material. Twenty thought demonstrations made the best approach while ten thought laboratory research projects made the best approach. Intermediary importance for accomplishing this goal was given to class discussions and student conduction of pre-assigned experiments. There is relative agreement that while planning effort and budget for the laboratory program has remained unchanged or increased over the past five years the actual laboratory time has either remained unchanged or decreased during this same period.

Forty-eight of 54 responding departments feel that some use of special visual aids (including films, tapes, and closed circuit television) improves student learning. Twenty-seven of 53 think these visual aids shortened the time required for laboratory teaching while 23 departments feel the required teaching time is unchanged but may be more effective. Three think visual aids increase the time required for laboratory teaching.

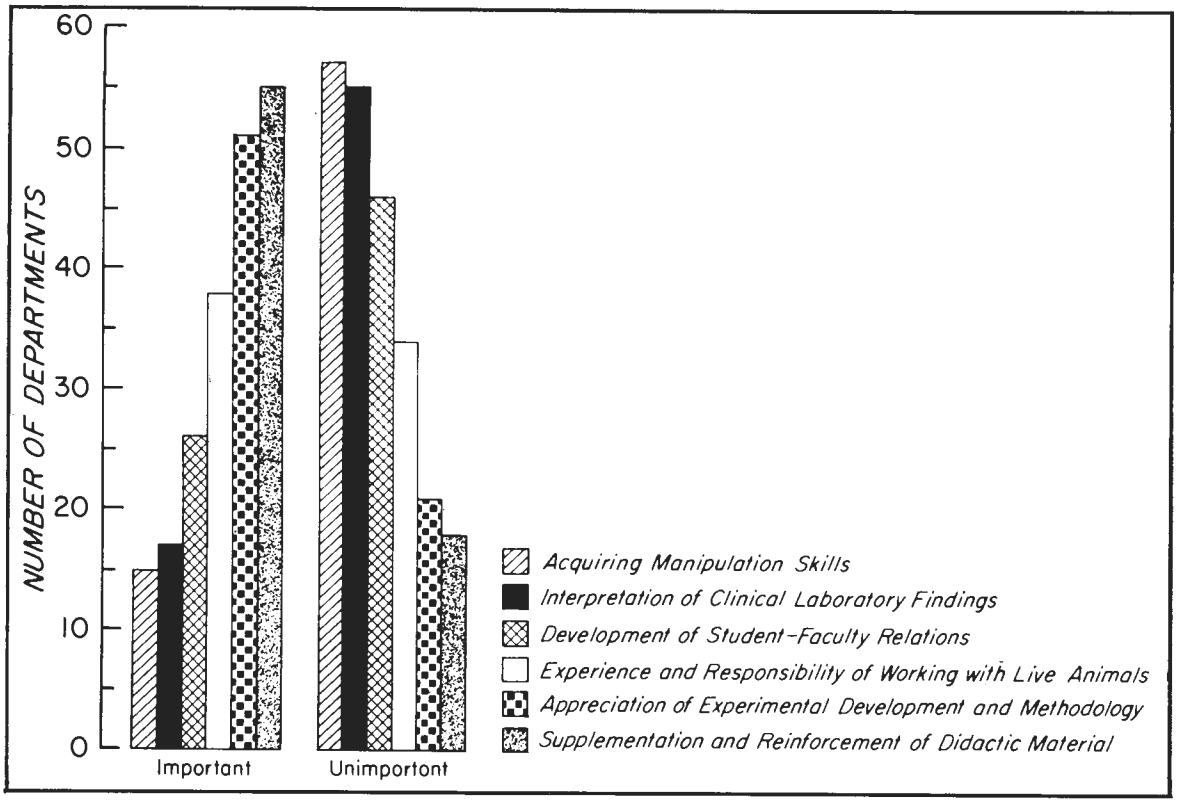

Fig. 8—Distribution of opinions concerning the importance of certain objectives of a physiology laboratory program.

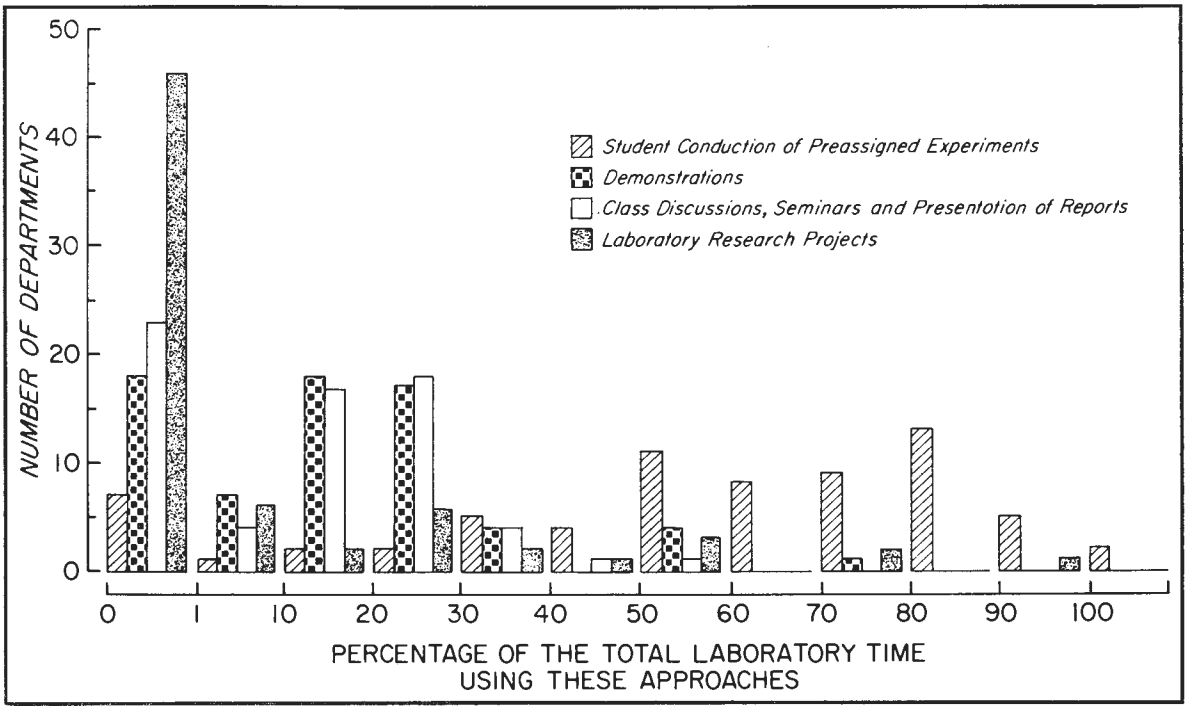

Fig. 9—Distribution of approaches used in conducting the physiology laboratory program.

Thirty-one physiology departments indicated the use of closed circuit television (two of these use color TV to some extent). Twenty-seven of these 31 use TV in less than 30% of their laboratory programs.

Many comments accompanying the returned questionnaires cannot be summarized in a graph or table but are as enlightening as the tabulated data. There is a broad spectrum of opinion concerning the significance and proper conduct of a laboratory program. Several comments include the sentiments that "laboratory teaching is of great importance in teaching medical physiology, although, in the absence of alert and enthusiastic faculty, the experience becomes stultifying and meaningless for the student. Laboratory teaching is extremely hard work and requires the full-time vigorous attention from each faculty person involved." In contrast there are those who feel that "the effort to teach physiology to medical students is a hopeless task and should be abandoned. Let the clinicians teach them as the clinicians did from the days of Galen until recently. In the meantime, let us not struggle too hard." The latter opinion may be received as humor but still might be used to represent an expression of concern shared by many about the merits of any laboratory program.

Some departments have substituted for the traditional laboratory a program of demonstrations with the objective of supplementation and reinforcement of didactic material. These departments undoubtedly feel that "the laboratory in the formal course is not the place to learn 'research' or 'scientific method' or special manipulative skills" but rather a place "to focus attention on outstanding physiological concepts which can be made more exciting by some laboratory exposure." In contrast, other departments have initiated a research project system to supplant the traditional laboratory. Here the objective is to expose the medical student to the scientific method.

The approach still being used by the majority of departments for most of the laboratory program of each is student conduction of pre-assigned experiments. This approach has the potential of contributing toward fulfilling two objectives. The proper selection of assigned experiments can supplement and reinforce the didactic presentation and do so in a way to encourage the student to use the scientific method involving observing, collecting data, and drawing conclusions from the results. This approach allows the instructor to know that within a certain period of time the student will have been guided into making certain observations which could be expected to lead to predictable conclusions. If this approach is to be successful, however, "the 'cookbook' experiments must be carried out in the mind

as well as by hand. The student will take the latter course if left to his own devices, hence the importance of active pursuit of the important principle by the instructor."

Opinions were also given concerning factors enhancing the students' enthusiasm and curiosity in the laboratory. These include assurance of "some perceivable clinical or career relevance in material presented" and insistence that "trivia must not be emphasized simply because they are readily recorded."

Summary

The laboratory in the anatomy disciplines is regarded as the cornerstone and foundation of the dissemination and mastering of the basic knowledge of anatomy. Laboratory time has been reduced in almost all instances and especially in gross anatomy. Histology courses still are satisfactory and the integration of neuroanatomy has been welcomed. These changes have occurred either by design or necessity. A moderate reduction in time in most cases has not produced inadequacies in the laboratory according to a subjective evaluation by the departments involved, but most would prefer a yardstick to measure the effectiveness of the changes. The majority of anatomy departments have, at least to the present time, retained the basic traditional laboratory program centered around student conduction of regimented work, sprinkled with demonstrations and audio-visual aids. This approach seems to suit the needs of the faculty and students and has as its primary objective supplementation and reinforcement of didactic material. These goals have remained the same from year to year although the precise nature and conduction of the laboratory program has often been changed.

Although many still feel that the biochemistry laboratory is an integral part of the biochemistry experience for medical students, the trend seems to favor reduction in the amount of time devoted to it. This reduction has not always occurred as a result of the biochemistry departments thinking it desirable in teaching, but more than two-thirds of our respondents consider their present time to be adequate and another 23% consider their time to be more than adequate. In addition to a decrease in laboratory time there appears to be a reduction in the percentage of laboratory time devoted to student conduction of pre-assigned experiments. As one individual says, "It is my opinion that conventional laboratory exercises are not effective in reinforcing lecture presentations or in teaching biochemistry methods or techniques." In deciding on the proper approach, however, a number of respondents sought to remind us that "the quality of the students is very critical."

The majority of physiology departments have retained in their medical physiology courses the traditional laboratory program centered around student conduction of pre-assigned experiments and sprinkled with demonstrations, conferences, and seminars. However, several physiology departments have reduced the time allotted to this laboratory work and their evaluation is that no inadequacies have developed. Some departments have substituted research projects for the traditional laboratory program indicating the importance they place on teaching the scientific method. Other departments have adopted a laboratory program centered around demonstrations designed to illustrate physiological concepts which either supplement or reinforce the didactic presentations.

The professional educators tell us that we must define the objective and be able to measure the degree to which the objective is reached in effective teaching experiences. It is clear that: (1) there is less agreement on the objective of the laboratory experience than might be desired, and (2) the degree to which the objective is reached is not easily measured. We feel the latter statement to be justified on the basis of our own experience in laboratory grading as well as the lack of emphasis of the laboratory grade in the student's final grade as compared to the relative time spent in the laboratory and lecture.

Hopefully the information and thoughts presented here will stimulate and aid many departments in evaluating their own laboratory programs. However, one contributor has cautioned, and rightly so, that teaching is a ". . . creative art. Hence, neither gathering statistics nor trying to mimic anyone else's program would be an appropriate technique for improving a teaching program. Any laboratory exercise to be successful must reflect the interests and convictions of the local staff as a worthwhile learning experience."