IMPROVING TEACHING LABORATORIES IN MEAT SCIENCE[1]

by
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Expanding enrollments and limited finances have created hardships in teaching meat science. At a time of needs for additional facilities and instructors to conduct laboratories, department administrations have been confronted with serious budget adjustments that fail to maintain equilibrium with inflation and with the responsibilities of education. Science and technology have not only created new principles and facts to be learned in meat sciences, but have provided an array of techniques in which the transfer of thought can often be accomplished more successfully. Nevertheless, the learning of new concepts and the use of more advanced techniques essential to teach them (closed circuit television, computerized automation, individualized audio-tutorial study programs, etc.) require expanded financing as well as more assistance, especially in laboratories.

This report attempts to describe laboratories as they should be used in meat science and to suggest ideas that may be useful in improving learning experiences while minimizing the needs for additional facilities and salaried instructors. Most of the suggestions are not new, but perhaps this review will serve as a stimulus for improvement. Much has been written about the significance and methodology of laboratories, however, I will limit this presentation to my own practical experiences and untested ideas. The paper is the direct result of observing and personally assessing the methods and ideas applied to a variety of in-class circumstances.

Purposes of Laboratories

According to the Random House Dictionary, a laboratory is any place, situation, set of conditions, or the like, that is conducive to experimentation, investigation, observation, et cetera. This definition appears adequate for general considerations, however, more specific details need including. The laboratory can be thought of as a concrete experience that one can physically associate with principles and ideas. However, if one needs only to learn empirical laws or data, a laboratory is superfluous. But if one wishes to validate a function, law, or principle, then the laboratory is essential. Even though it is difficult to measure the effectiveness of a laboratory, I conclude that the laboratory is usually indispensible to complete the learning process in meat science. Laboratories exist for at least four reasons:

1. To extend, supplement, demonstrate and discover principles, ideas and concepts that have already been provided in lectures or in textbooks and other references. An example would be observing and measuring the presence of contaminating bacteria in sausages having either low or high pH values. This can be discussed and read about but until observed in the laboratory, complete comprehension might be curtailed.

2. To introduce skills and techniques that cannot or would not be taught as effectively by other methods. An example is the dissection of a muscle to determine its attachments, function and gross appearance.

3. To motivate students to maximize their learning potential. Virgin hypotheses are not always taught but are often conceived through laboratory experiences. To illustrate, the subjective assessment of composition of a live market animal is verified by an examination of its carcass after slaughter.

4. To teach students to be good observers and how to conduct experiments. For example, the provision of a study to use isotopes to label a substrate and recover the isotope as metabolized products, provides a first hand technique to illustrate post mortem muscle glycolysis.

Circumstances that Differentiate Laboratory Experiences

All laboratories are not the same for a variety of reasons. They are not meant to be because of the expected outcomes that are related to the nature of the subject. Here are six circumstances that exemplify the need for a variety of laboratories:

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1. Experiments and exercises that require high density supervision such as a proximate analysis exercise.

2. Exercises that require low density supervision, such as market animal evaluation in which one instructor can supervise large numbers of students who are simultaneously examining several animals.

3. Laboratories that are essentially expanded lecture demonstrations to conserve on space and materials. An example would be preparing a post-mortem, pre-rigor muscle for determining the time course of rigor mortis.

4. Field trips that require transporting students away from the campus such as reviewing commercial processing techniques in a meat packing plant. Such experiences are discussed more completely in another paper (Kauffman *et al.*, 1970).

5. In addition to field trips away from the campus, there are those on campus that do not require transportation but do require time to move classes to sites. An example would be viewing the biopsy of muscle in a surgery room.

6. Infrequently, some laboratories become extended problem solving experiences that require high density supervision and much expertise by both instructor and student. This approach is reviewed by Schaefer and Kauffman (1975). An example would include a study of U.S.D.A. grading practices throughout the United States. Extensive time is required to develop procedures, collect data, analyze results and write the report.

Approaches to Conducting Laboratories

Even though there is some similarity between approaches and circumstances of laboratories, it seemed relevant to mention three approaches that instructors may take:

1. Individual exercises that include the conduct of specialized experiments such as determining the composition of a meat product, or the viewing of carcass dissection using library audio-visual facilities.

2. Group exercises in which several students work together to achieve a common outcome. An example would be the making of a sausage product in which each student contributes to the completion.

3. Some lectures develop (either intentionally or unintentionally) into demonstrations for the whole class. Even though it may be questionable to differentiate between the lecture and demonstration laboratory, I consider it a third approach. An example would be demonstrating and discussing cold shortening and thaw rigor.

Characteristics of an Effective Laboratory

Types, approaches, and definitions of laboratory experiences are incomplete unless quality is considered. A good laboratory should:

1. *coordinate* the lecture with the laboratory.

2. allow for adequate *organization* and *supervision* before the laboratory starts, during its operation, and after it has been completed.

3. help the student to *discover principles* and methods as well as learn factual information and technical skills.

4. provide up-to-date *procedures* in advance to outline the appropriate course of events, consequently permitting for a reasonable pace and understanding of the purposes and outcomes expected.

5. provide *relevant* and *realistic* information.

6. attempt to deal with *deductive reasoning*—a logical process in which a conclusion is drawn from a set of premises and contains no more information than the premises taken collectively.

7. attempt to *motivate* the imagination and initiative of the student to maximize learning potential.

8. obligate the instructor to be *selective* and *creative* in the content.

9. yield *educated* and *inspired* students that are accurate observers.

Seventeen Suggestions to Help Improve the Laboratory

The following have been assembled to provide some practical and workable suggestions to improve the laboratory. They may help to minimize needs for additional facilities and salaried teachers that create financial burdens for administrations. In addition, each suggestion should be especially welcome when class enrollments increase.

1. Examine the *objectives* of the laboratory and decide if the laboratory is actually necessary. One needs to ask, "what are the alternatives and the consequences if selected?" Instructors should not become victims of tradition or creatures of

habit. They should decide if the laboratory motivates rather than maligns, supplements rather that sabotages, and teaches techniques rather than toys with trivialities.

2. Examine the total *number* of laboratories offered and decide if all are necessary. Whatever the case, do not pad hours.

3. *Perfection* is relative. Since most teachers are also scientists (or should be), they sometimes believe that a teaching laboratory is synonymous to the research laboratory and expect maximum perfection. This attitude may prevent the completion of an assignment. The instructor should decide on the expertise required and expect no more, especially in introductory laboratories where much time can be wasted in setting goals ridiculously high.

4. Decide upon a class *size* that will provide maximum net educational return. Either establish new sections or limit enrollment to prevent dilution of the learning environment. Adding five more students may create physical hazards and reduce net learning of all students involved.

5. Be courageous and conscientious by encouraging those students who disrupt, to *withdraw* from the course. This is neither a desirable nor easy solution but it may be the best alternative.

6. If a laboratory requires greater finances than funds can support, seek *grants* from (a) the college or university, (b) industry, or (c) national agencies such as the National Science Foundation.

7. *Graduate students* should have the opportunity to assist with teaching programs since they should be prepared to teach. Make it a requirement for all graduate students to teach, and involve them by providing a meaningful program in which they not only help, but also learn the teaching process. Since most graduate students are considered research assistants, it is essential that professional advice be sought to know the rules related to the Internal Revenue Service and to Teaching Assistant Associations.

8. Some laboratories have large numbers of students and many sections that require testing. When appropriate, develop a *computer program* to assist in scoring student performances. It should be flexible to insure longevity. If the computer is programmed effectively, it easily compensates for the time spent. Don't expect miracles, but the computer can be useful.

9. When numbers and time are limitations, group projects that replace individual exercises are desirable and can economize on supervision.

10. When possible, *bring* examples to the class rather than vice versa. Transporting students and staff is often inefficient and wasteful.

11. When equipment and space are limited, develop individually scheduled laboratories to maximize on (a) student time, (b) use of laboratory equipment and (c) space available.

12. Examine subject material carefully and select exercises that insure *dramatic results* to emphasize a point.

13. Sometimes a professionally prepared notebook can be purchased. However, for best results, the instructor should develop his own *laboratory notebook* and update it each year. This minimizes student expenses and encourages continual revision.

14. Laboratory notebooks help guide the students through an exercise, but some instructors believe that it is also important to grade write-ups. Don't grade the notebook! Spend the time used for grading to discuss procedures, techniques and results. The use of examinations is more appropriate for evaluation.

15. When class size and sections are large, prepare a *pre-lab video-tape* to standardize all information needed. Television is not always available and may be expensive to obtain, but it should be considered if it is difficult to coordinate the laboratories.

16. Use *upper-class undergraduates* who have already completed the course. Establish special problems credit or an internship to develop students' leadership qualities and to solicit their assistance. Use care to select the appropriate students. Regardless of intelligence or maturity, be aware that their relationship with fellow students enrolled in the course may be strained, creating adverse conditions.

17. Seek advice of others on campus. There are always several dedicated teachers that devote their energy to structuring excelled laboratory programs.

REFERENCES

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APPENDIX

SUMMARY OF RESULTS OF QUESTIONNAIRE APPRAISED SUBJECTIVELY BY R. G. KAUFFMAN

1. Almost everyone agreed that:

   A. They carefully consider whether or not a laboratory is necessary.
   B. They consider the number of laboratory sessions essential and that they would eliminate unneeded sessions.
   C. Class size should be limited to prevent dilution of effectiveness.
   D. Graduate students should be included in the teaching of laboratories.

2. The following ideas were apparently new to a few respondents:

   A. Am I expecting too much from the students?
   B. Are the results of exercises dramatic enough?
   C. Should group projects replace individual exercises?
   D. Should I consider not grading laboratory assignments?
   E. Have I sought out dedicated teachers on my campus?
   F. Should I prepare my own lab notebook and revise it often?

For all of these questions, more said they would consider trying out the ideas than those that said they would not consider them.

3. The following ideas were apparently new to a significant proportion of the respondents:

   A. Using video-tapes to standardize multi-sectioned labs.
   B. Seeking outside financial aid through grants.
   C. Encouraging disruptive students to withdraw from the course.
   D. Seeking support of computers.
   E. Providing an opportunity for undergraduates to assist with laboratories.
   F. When equipment and space are limited, trying to schedule individual lab times.

For all of these ideas, more said they would consider trying out the ideas than those that said they would not consider them.

4. A significant number of respondents indicated (col. 3 + col. 4) they would not consider the following:

   A. Using computers.
   B. Using video-tapes.
   C. Asking undergraduates to assist with courses.
   D. Asking disruptive or uninterested students to withdraw from courses.
   E. Discontinuing grading of notebooks.

(Continued on next page)

1977 RMC QUESTIONNAIRE ABOUT LABORATORIES

N = 64 (percentages not additive—more than one answer)

IDEA SUGGESTED FOR CONSIDERATION	New to me	Will consider it	Won't consider it	Not new & won't consider it	Not new, tried it but failed	I use idea in my planning	N/A or Blank
	%	%	%	%	%	%	%
1. Do objectives of course require a lab?	0	2	0	0	0	98	0
2. Are there too many sessions?	0	8	0	3	2	88	0
3. Are expectations too great?	11	13	6	3	0	75	3
4. Should class size be limited?	3	11	2	0	8	75	2
5. Do you encourage withdrawal?	27	36	9	8	9	34	2
6. Do you seek grants?	42	44	6	3	14	23	0
7. Are graduate students helping?	6	3	2	0	2	89	2
8. Have you asked for computer support?	25	28	9	16	6	38	0
9. Can group projects replace individual exercises?	8	9	5	3	6	75	2
10. Do you travel too much?	6	14	3	5	6	64	6
11. Have you tried individually scheduled lab times?	14	22	9	8	11	48	2
12. Are results dramatic enough?	11	16	0	3	3	67	11
13. Do you prepare your own lab notebook?	6	9	2	0	3	75	9
14. Is there time to grade lab notebooks?	8	13	6	8	5	58	9
15. Have you standardized multi-sectioned labs with video tapes?	47	55	14	8	5	9	5
16. Can undergraduates assist?	17	19	9	9	2	59	0
17. Are there dedicated teachers on campus available for consultation?	8	13	0	0	0	88	2