3. Students indicated an average of less than three years experience with any class of animals other than dogs and cats.
4. Grades received in lecture and lab were significantly correlated with SAT scores and high school academic performance, but were unrelated to high school class size.

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Special Considerations With Enterprise Laboratories

Dan D. Garrison

Despite many other advances and changes occurring within higher education, instructors continue to count on effective laboratory support as an essential and basic dimension for teaching and learning.

Laboratories are of as many different shapes, sizes and descriptions as there are laboratories. With the occupational emphasis found in many of the academic offerings of two-year colleges or technical institutes, the enterprise laboratory holds a special appeal as a replica of the real world. Realism makes enterprise laboratories an exciting educational tool that is in high demand by faculty for motivating and preparing students through discovery and experience. However, enterprise laboratories require special considerations by educational administration, particularly if we are to achieve the most educational support for dollars spent.

Common Attributes of Laboratories

Whatever the laboratory, I believe we can agree there are certain basic common attributes. Some of these are:

1) In general, laboratories are more expensive and more complex than the usual classroom, seminar or conference room arrangement.
2) Laboratories have a direct impact on the quality and amount of educational yield in related teaching activities.
3) Laboratories are valuable and effective only in as much as they are expertly utilized by the faculty and students.
4) Good laboratory instruction like all instruction of merit simply does not occur unless carefully planned and supported by thorough involvement of faculty and students.
5) There are inherent non-instructional benefits to the total institution as a result of outstanding laboratories.

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Enterprise Laboratories

Over the past twelve years the Agricultural Technical Institute has developed an impressive set of laboratories for a small institution.

In addition to the twenty-two traditional laboratories for chemistry, botany, soil science, nutrition and similar agriculturally related laboratories, the Institute has also developed five major enterprise laboratories with a value in land, facilities, equipment, plants and animals between 4 and 5 million dollars. Specifically these five enterprise laboratories consist of:

1) An 1800 acre Apple Creek farm including:
   a. Swine operation; 80 sows - farrow to finish - 1500 hogs annually.
   b. Cow/calf operation - 150 brood cows plus feeding floor - 125 to 500 head yearly.
   c. Cropping program over 900 acres plus hay production on approximately 400 acres.
   d. Sawmill and 450-500 acres of woodlands.
2) Dairy operation - 56 head — moving to 75 head on line with a new one million dollar dairy under construction in April 1986.
3) 100 head horse operation - standardbred, pleasure horse and breeding with new breeding facilities under construction Spring 1986.
4) 400 bee colonies for pollination and honey production — pollinates adjacent Agriculture Research Center crops — moved into new teaching laboratory in 1985.
5) Horticulture enterprises including over 20,000 square feet under glass or plastic for production and specimen production. Also 10 acre nursery at Apple Creek Farm.

The 1985-86 operating budget exclusively for the five enterprise laboratories will exceed $600,000 not counting faculty and support personnel salaries involved in their operation.

As enterprise laboratories, these laboratories are commercial-like; operated as if to make a profit. Animals, animal and plant products are purchased and sold on the open market while all inputs of goods and services including electricity and fuel are also acquired from the market place. Therefore, they are subject to all the rigors of market, weather and natural disasters not to mention the incredible impact of technology. Enterprise laboratories bring these factors together in a teaching-learning setting unparalleled in opportunities for students to learn while enrolled in a structured part of an academic program. Each academic year the faculty and chairmen prepare budget submittals including income estimates and expense estimates that must balance. The significant advantage is the real life set of activities and circumstances where student learning can be coached and supervised by faculty.

Special Administrative Considerations

Obviously, there are special considerations and administrative concerns related to these types of laboratories. Probably first among these concerns is the potential for financial loss. Other concerns include the matters relating to student safety, competition with related businesses, and coordination with the on-going academic program when outside factors affect the laboratory.

As fantastic as enterprise laboratories are for individual student growth and educational yield, they are equally fantastic in challenges to educational administration to avoid the normal pitfalls and concerns while achieving support for the academic program. In our experience at the Agricultural Technical Institute, we have determined that there are several key considerations in successful administration of enterprise laboratories if we are to assure academic creditability for the laboratories including appropriate evaluation and appropriate activities in support of the instructional program. These considerations are not offered as an exhaustive list or in any particular priority.

1) An enterprise laboratory must be legitimately in support of an academic program as documented by the faculty in terms of educational needs and objectives.

   For the purpose of this discussion, I am not including the many different kinds of resources that are passed to Colleges and Universities by Alumni and friends that become aesthetic additions to the campus. Farmsteads and farm lands are common among these resources, but they are not enterprise laboratories, unless they meet the test of academic legitimacy.

2) Faculty must have leadership responsibilities and authority in the formation and day-to-day operation of the laboratory with qualified and compatible support personnel to keep the faculty's time free for teaching and student counseling.

   There are several reasons for this consideration being important. Foremost is the need for coordination of instruction between the classroom and laboratory to assure that the principals and practices set forth in the classroom are also practiced in the laboratory. The faculty member in charge of the course utilizing the laboratory must have leadership authority for the laboratory if the educational objectives are to be accomplished. In the early days of the Institute we thought a faculty member couldn't possibly head his class and be in charge of the laboratory too, but we soon found it was less of a problem in time and frustrations for the faculty leader if he/she held authority in both places. However, there must be support personnel at the laboratory who are responsible to and compatible with the faculty leader. During all those hours the faculty leader is away from the laboratory teaching classes, counseling students, grading papers, attending conferences or whatever, the laboratory needs to be functioning in support of the directions set by the faculty leader. Already it is apparent the faculty leader's role expands into the employment and evaluation of laboratory technicians. Administration must assure that the appropriate personnel practices are followed to assure support for the faculty.

3) Faculty must have appropriate experience and preparation for making operational decisions associated with a progressive and viable enterprise laboratory.

   We simply don't put an inexperienced person in charge of a course that has sophisticated enterprise laboratory support. If the laboratory includes live animals, large equipment or sophisticated processes the faculty member will need to be knowledgable and experienced or otherwise we flirt with disaster.

4) Strict financial and academic accounting is absolutely necessary for each separate enterprise laboratory.

   This is probably one of the most serious considerations. as educators we seem to be able to overlook many imperfections until it comes to matters of balancing our budgets. Since unbalanced budgets

translates into loss of support people, supplies and travel money to mention a few. I know of several institutions that have found that having a stable of horses is wonderful for physical education and campus activities but terribly expensive and unrealistic when they looked at the budget. At the Agricultural Technical Institute we have experienced the effect of a poor state and national economy on a laboratory that is counting on income from the private sector. Only good record keeping and decisive action can avert serious financial consequences. The faculty in charge and the administration must be able to determine:

a. What is student utilization of the laboratory?
b. What student activities are involved and how do they relate to a course or program requirement (student competencies)?
c. What are the per student costs; cost trends and cost relationships?
d. How much general ledger support is required?
e. How much income is derived from the outside and what are the trends?

5) The enterprise laboratory must incorporate the latest technology within a good commercial style that will stand the test of sound profit management.

Educational institutions seem to have more of a problem in having reasonably current technology available to faculty and students rather than too advanced technology. In actual practice with an enterprise laboratory, technology needs to be a combination that provides the best learning experiences while remaining sound in a commercial sense. Because of the requirement to involve students it often makes sense to have two smaller instructional equipment items rather than one large unit that can involve only one student.

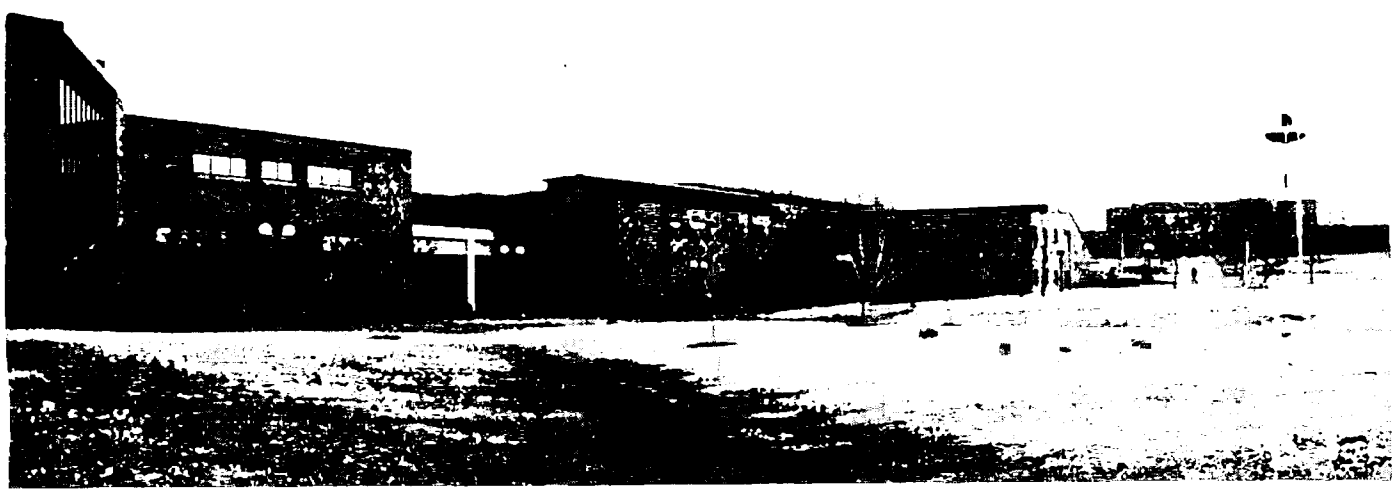
6) Individuals who hold administrative authority and responsibilities for enterprise laboratory operations must be educators first, but educators who can organize and manage.

Laboratories are for instruction. As expenditures and savings are considered in a week by week management, the decisions must be weighted in light of educational merit. For example in an enterprise laboratory such as the Agricultural Technical Institute's 1800 acre livestock crop farm, it would be less problematic to move with dispatch in planting than to slow down for involvement of students. In an enterprise laboratory it's easy to forget it exists for education.

7) Active industry curriculum advisory committees are essential.

This is the important group of professionals that must remain active in the establishment and update of enterprise laboratories. Inactive members should be removed and replaced by interested members. An industry person should chair the committee and the membership representation must be ambitious and forward looking. The role of the committee needs to be clearly defined and meetings adequately prepared for since members' time is

Photo 1. Central campus of the Agricultural Technical Institute, Wooster, Ohio.



valuable and meetings limited. The role should include the review of matters of curriculum content and appropriateness of a laboratory in terms of latest technology and practices. The committee also needs to be of assistance in funds development and gifts-in-kind.

Too often education is trailing and not leading. We must be constantly looking to the future, utilize the latest "State of the Art," computerize our academic curriculum, and move with dispatch. Enterprise laboratories offer a superb opportunity, but, faculty and administration must modernize and plan ahead because accountability is so visible.

Summary

Enterprise laboratories operating within the normal rigors of the market place offer an exciting educational tool that is in high demand by faculty for motivating and preparing students for occupational opportunities at the technical level. Considering the high potential for financial risks, student safety and other similar matters, it is extremely important that laboratories be legitimately in support of an academic program as documented by the faculty in terms of educational needs and objectives. Moreover, faculty must hold leadership responsibilities and authority in the formation and day-to-day operation of the laboratory. Faculty must also possess the experience and capabilities to handle operational decisions, and strict accounting of both financial and academic matters is an absolute factor. Today, for laboratories to be viable they must be forward looking and incorporate the latest technology and management style. Individuals who hold administrative authority and responsibilities for enterprise laboratories need to be educators first, but educators who can organize and manage.

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Helping Students Learn by Understanding How They Think

John E. Fulkrod

Have you noticed that certain topics in your courses never appear to be mastered by a significant portion of students? I am not referring to students who make no effort to learn. Some conscientious students who really make an honest effort just cannot seem to master certain topics and concepts.

According to Piagetan theory, intellectual development occurs in four stages (1,2,3,4,5). These are called: 1) sensory-motor; 2) pre-operational; 3) concrete operational and 4) formal operational.

Piagetan theory assumes that children enter the formal operational stage around 12 years of age and complete this stage at age 15 or so. This theory of intellectual development was widely accepted for a long time and considerable curriculum content was actually based on this theory. However, other studies suggest that as many as 50% or more of entering college freshmen may function entirely at the concrete operational stage (6,7).

Many topics as they are presently covered in the agricultural curriculum may require formal operational thought for the student to fully master them. Students functioning at the concrete operational level of thought require concete examples and observations and have difficulty in understanding concepts that depart from their concrete experiences. A student operating at the formal operational level begins to think in terms of what is possible and what variables must be controlled before drawing conclusions. A student at the concrete level of thought relies on past experiences.

As an instructor of chemistry at an agricultural college, I have observed many students entering my classes whom I think have not yet reached the formal operational level of thought. As an example of this let us consider the calculation of the percentage composition of a compound. This is one of the earliest topics in most chemistry courses. Practically all students can, after some practice, calculate the % composition of Fe_2O_3 as 70% iron and 30% oxygen when given the atomic weights of Fe = 56 and O = 16. However, if you tell the students that a hypothetical compound of formula X_2O_3 is 30% oxygen by weight, only those students who have reached the formal operational level of thought will calculate the atomic weight of X to be 56 without prior experience at solving this type of problem.

In discussion with faculty members at our college who teach courses in fields of agriculture such as agronomy, soils, animal science, horticulture and economics, I have found many topics that require students to think at the formal operational level. Practically any concept involving a ratio or proportion can give students who are not at the formal operational stage trouble if they are asked to apply the concept to a new problem or example or to explain the meaning in general terms. Suppose you tell your students that two different solutions of a herbicide are to be sprayed onto a field. If you tell the students that solution A is less concentrated than solution B, and ask which will cover the most area to produce a desired level of herbicide,

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