Basic Science and Applied Science Instruction: Are They Compatible?1

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ABSTRACT: Basic science and applied science instruction are compatible and essential for animal science professionals to succeed in their chosen career. Application of science is a continuum. Although production methods are constantly evolving, the science on which changes are made is fixed and fundamental. Only our understanding changes. We are educating students in preparation for a life-long learning process. Viability of animal science departments depends on attracting and challenging students with curricula that are demanding, create curiosity, and prepare students to understand the “whys and hows” of the phenomena of animal biology.

Key Words: Curriculum, Teaching, Students

Introduction

At the Midwest American Society of Animal Science meeting 6 yr ago, I addressed a similar topic: “Maintaining a Balance of Applied and Basic Research in an Animal Sciences Program.” As universities and as individual departments we monitor the balance of basic and applied inputs, both in teaching and research programs. Each university answers slightly differently in attempting to fulfill responsibilities to students, industry, and society. It is a concern each administration must address as new faculty programs are offered and new positions are filled. My answers reflect one more judgmental position that may or may not be correct. Nonetheless, in planning for the future, this is one of the issues that we must evaluate as we assess our essentiality and effectiveness.

Basic Science and Applied Science Instruction are Compatible

As a department head and as a professional animal scientist, the answer to the question in the title of this paper is quite simple. Yes, emphatically, yes. Basic science and applied science instruction are quite compatible. Conversely, it is very difficult to teach animal sciences without using the more basic sciences to support our subject matter. In addition, we should expect students coming into our courses to have a reasonable understanding of the basic sciences, either with or without prerequisites.

I would like to address the question raised in the overall title of this symposium: Are we losing our identity? If we do, it is our own fault because we have resisted change. Production has become more technically basic and complex. Hopefully, the same can be said of the quality and content of education provided to our majors. Our students have the ability, but we must have the fortitude to challenge them to their fullest.

To position animal science programs within academia, there are similarities but distinct differences between animal sciences and biology. As for course work, our science majors take many of the same courses as biology majors. The main difference between programs in biology and in animal science is that career options and application of education seem clearer in the animal sciences. The application of basic biology to animal protein production serves to reinforce the relationships between basic biology and applied science. Our students see application and career opportunities much more clearly. Frankly, we probably do not exploit that advantage as much as we should.

Clearly, animal sciences is not a vocational training program, but these remarks should not be

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interpreted as suggesting that society doesn't need vocational programs in agriculture. There is a role for such programs, but not as part of animal sciences within a B.S. degree program. For instance, swine feeding can be taught in high school or vocational schools, but that is hardly what is expected to be taught in a baccalaureate program. There are employers who want to hire animal science graduates and give them vocational pay and responsibilities. That too is changing as professionalism moves on through the production segment of the animal industry. For the most part, that is not a problem in supporting industries. Animal scientists are assigned responsibilities commensurate with their education. There is an expectation of performance and the rewards are provided accordingly.

There are some selfish reasons for wanting to use basic sciences when teaching the principles in animal sciences. Effective teaching is much more interesting and exciting when one is developing a principle by unraveling the science that resulted in the current understanding of the phenomenon. I was impressed at the Academic Quadrathlon competition when the student responded to the question on the occurrence of rigor within muscle by describing both the chemistry and physics of the changes that result in rigor.

By almost anyone's standards, animal science is becoming more basic. We are more dependent on the classic basic sciences to explain events and to apply technologies, whether from physics, mathematics, chemistry, or molecular biology. These are applied as we use computers to monitor and control environment, calculate an EPD, assign an amino acid dietary level dependent on lean growth deposition, or accurately measure carcass protein without invading the carcass. Thomas Urban, chief executive officer of Pioneer Seed, recently predicted that identity-preserved corn would constitute 25% of all corn produced by the year 2000. At some point a genetically specific corn will be developed for individual animal species. Such biotechnology innovations will require adaptive changes in animal production, as well as in collateral industries. The example demonstrates the rapid changes in the quality of applied science essential for an effective animal scientist in the near future.

The academic institutions represented in this professional society have a responsibility to produce the educated person. That means students in animal sciences will have a strong liberal arts education, excellence across the basic sciences, and, most importantly, a knowledge of the why and how of the biology and animal science that influence animal protein. The education should provide a global perspective.

If we continue to develop programs that have a strong cadre of basic courses and understanding of chemistry, mathematics, physics, biology, microbiology, and anatomy, we can teach the fundamentals and subdisciplines of nutrition, genetics, growth, and physiology to prepare students to understand the continual breakthroughs in biological and animal research that occur at a sizzling pace. We are opening the door for a life-long education that will include numerous tangential changes in long, productive careers for students who typically will change employers three or four times.

A college education is not essential for the purpose of following a recipe, a mixing chart, or a prescribed plan. I want our students to know a lot more than where to look up the answers. I put the recipe follower alongside the individual that says "if it isn't broken, don't fix it." Neither philosophy will lead to change or progress. Production answers will evolve but the "hows and whys" are ongoing. For these reasons, I have problems with some production courses taught in B.S. programs. I can guarantee you that tomorrow morning the methods used in production will change, but the science behind production will continue to be there. It will only be enhanced.

The program committee had asked the question of whether undergraduate and graduate programs were compatible with industry needs and career opportunities. Just as production changes, industry changes. Companies compete to lead that change. They have invested in research and development to provide breakthroughs to distance themselves from competitors. During my 10 yr in industry, I found it interesting to view new employees. It was very clear that students with the best command of basic sciences as analytical tools advanced most rapidly and contributed most changes in the companies.

We as university faculty lose the respect and expectations of industry if we fail to prepare our graduates to understand change or, more importantly, to be the driving force to bring about change.

Not all technological changes are introduced to an industry by formal research programs. Animal science graduates with fundamental knowledge, basics if you like, will be in excellent positions to evaluate concepts, change components, develop systems, and make improvements in the industry. Sometimes changes are made, and only later is the science determined. Such a situation occurred with all-in-all-out swine production management. Now we are studying the "whys."

We have an ever-increasing responsibility to industry representatives who employ our products, which are our graduates. Today, supporting industry employs seven of eight of our students in
careers that provide products and service to producers and services beyond the farm gate. We have done a good job of convincing companies of the quality of our graduates. In most cases the employment records are great. The demand continues to look good. Over the next half-decade it is anticipated that the annual need in agriculture will be 48,800 young people with college degrees. Unfortunately, during that period there will be about 23,000 graduating annually from schools of agriculture. The solution is that college graduates without degrees in agriculture will be employed to fill much of this gap. Even with interested allied graduates, there will be an annual shortage of about 5,000 (Coulter et al., 1991).

Based on the continued recruiting efforts, employers prefer to fill positions with agricultural college graduates. Agricultural corporations prefer sales, marketing, technical, accounting, and manufacturing staff workers with agricultural degrees. With respect to the knowledge that industry expects of its employees, feed and pharmaceutical companies are no different from any other industry, such as electronics. A manufacturer of home electronic equipment would no doubt prefer to hire someone with a knowledge of electronic engineering to handle the design, manufacture, marketing, and sales of video cassette recorders.

As we address our educational goals and content, we must consider such terms as quality, depth, and experience. I went back to my talk given to this group 6 yr ago. One point made at that time, with which I still concur very strongly, is that I have never seen a department of animal sciences I felt had migrated too far in the direction of basic sciences, but I have seen departments that are much too applied for long-term contribution. I would make that same statement for instruction today. There is another point in that paper that fits also into this discussion: basic research provides the concepts, the grist, the raw material from which ideas are spawned for extending applied research. Applied research is opportunistic, it provides findings that measure the magnitude of response of entrepreneuristic application of basic research often for a totally unintended use or species. Those same statements fit the purposes and advantages for incorporating basic science into the teaching of applied animal science courses.

Implications

The committee asked whether undergraduates suffer in our institutions because of emphasis on research. I say a resounding No—quite the contrary. The research enhances the vitality of the teaching. That has not changed from the time we were students in animal sciences. It we want to continue to attract bright young people into animal agriculture, we should challenge them with rigorous courses in the basic sciences and then allow those students to apply that knowledge in understanding and implementing the phenomena that result in the production of animal protein for the betterment of society.

Literature Cited