Interdisciplinary Curricula: Ingredients for Success

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It is a pleasure to have the opportunity to discuss a topic that complements the exciting theme, "Education in Agriculture: A New Dimension for a new Decade," so appropriately chosen for this meeting. Indeed, the topic of "Education in agriculture," itself, is exciting to me. This theme clearly suggests that we as agricultural educators realize that new things are happening both in agriculture and in education. These new things must be addressed in the classroom, in academic curricula, and in the student-advising process. I use the world "process" deliberately to reinforce the ideal continuous nature of student-teacher interactions. The benefits of this process are immeasureable when performed well, and equally serious when not performed well. We may know this on the basis of our own experiences or from reports by students.

The world is changing more rapidly than ever before. This staement is not unique to this decade, however. Only the specifics change with time. Of particular relevance to agricultural educators today is that the nature of our student population has changed. (4, 5, 6) These students are the maturing products of an environmental decade, a space age, and an era of intensive urbanization. Nonetheless their senses of commitment and mission are most admirable and promising. They realize that many of our contemporary problems have global and long-term implications. They realize that agriculture and all its components are essential. Some in fact will say, beautiful; and that's why they are in our classrooms. Most are either aware or willing to acknowledge that agriculture, as all human activity, is integral but inseparable from the one ecosystem that supports all life on earth. Consequently they realize that new guidelines for personal, social, and professional decisions must be developed and tried. They are ready to learn and to help in this new decade. An urgent question is — are we similarly prepared to help them learn? Can we adapt to this new decade the university mandate to teach our students "to continue to learn with others throughout their lifetimes," to help them become "adaptable specialists" who "know both how to analyze and how to synthesize facts, disciplinary concepts, and values and, thereby, obtain logically correct conclusions"? (2)

Clearly, in certain subject areas, new instructional approaches and new learning approaches must be taken — approaches that integrate subject matter, values, and ideas in order to understand more fully certain issues and phenomena and to deal with them effectively — not only for the personal objectives of individuals but also for the long term good of mankind. This requires that ". . . the whole person come into play so that the intellectual processes are deeply influenced by character and personality." (3) The burden of integration should not be placed solely on students, however, especially in their early college courses. It must be done by **faculty** at either the course, curriculum (or other higher academic) level. In more advanced courses, an adequate "instructional framing" of the subject matter may suffice to stimulate integrative thinking. But,

> **Forcing, coaxing, leading, or inspiring students into integrative thought is neither easily done nor always popular. Critical thinking for many students, particularly in their first exposure, is a frustrating experience. An instructor must be prepared to deal with this frustration, hopefully in such a manner that the frustration does not interfere with the learning process. (2)**

Obviously, if interference occurs, the "success" aspect of the subject of my presentation, "Interdisciplinary Curricula: Ingredients for Success," will not be achieved. This title assumes, of course, that some integrative subject areas do lend themselves to the structure of interdisciplinary curricula. This is one relatively new approach with which we are gaining increasing experience as we attempt to meet the educational challenges of the times.

But, education is **a process.** Instruction is only the input. Learning is the output. New learning approaches on the part of students also must be recognized as necessary. My experiences indicate that many students, especially in agriculture, are eager to assume an interdisciplinary approach to their learning, at least to a limited extent. They seem to realize its importance if not its necessity. Sometimes they learn this, to their regret and perhaps our mutual loss, at the end of their college careers rather than at the beginning.

Meaning of Interdisciplinary

Before proceeding, let us take a moment to examine the meaning of the term "interdisciplinary" as used in this presentation. I recently had occasion to develop a contextual definition for this term while conducting a university-wide opinion survey at NCSU on interdisciplinary activities in teaching, research, and extension. (7) In offering this definition to the university community, I learned why there usually are several definitions of a word in the dictionary.

> **Interdisciplinary: a term describing the deliberate cooperation and continuous activity of two or more persons from different disciplines directed towards the understanding, interpretation,development, assessment, and/or technological improvement of a concept, phenomenon, or problem.**

Although this definition does inadequate justice to the many scholars who **naturally** bring multidisciplinary expertise to their activities, e. g., social scientists, humanists, ecologists, agronomists — to name but a few, it does describe purposes and activities of some interdisciplinary curricula such as the one that I coordinate in

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Integrated Pest Management (IPM). This Curriculum (Program) and several others at NCSU — Biological Sciences, Ecology, Nutrition, Physiology, and Toxicology — as well as several divisions, centers, and institutes, are interdisciplinary by nature and formal designation. All function somewhat similarly under the general implications of this definition, i.e., involvement of several departments as well as individuals, and sometimes off-campus agencies. All subsequent commentary refers to this general type of interdisciplinary program, and is based not only on my own experiences and ideas, but my understanding of the experiences and ideas of other program leaders at NCSU and other institutions. Obviously, some comments apply more accurately to some programs than others, and to land-grant institutions that have tenure policies. Ultimately, my comments will focus on NCSU's interdisciplinary curriculum in integrated pest management.

Ingredients For Success

Interdisciplinary activity generally is not an end in itself. Rather, it is a means to end. Therein lies the first ingredient for success: **need** for an interdisciplinary approach by individuals well-founded in their respective disciplines. This need may relate to what I call "real" world problems such as agricultural crop production and protection; artifact construction such as the building of freeways, bridges, and buildings; or it may relate to "perceived" needs such as the development of an historical novel, bibliography, or work of art. In other words, the needs may be identified either by society and its constituents **or** by individuals who observe, have responsibility for, or react to those needs. There are countless examples of real and perceived needs in agricultural education. Some can be satisfied by individuals educated in interdisciplinary areas. Others can only be treated adequately by individuals from different disciplines bringing their interests and expertise to bear on the need.

Once a need is recognized, it leads naturally to the second ingredient for interdisciplinary program success: **people** — interested, committed, appointed, supportive. An interdisciplinary course, curriculum, or project can be enhanced greatly and in some cases may exist primarily by the contributions of cooperating faculty. This may be especially true in new or relatively new subject areas in which individuals have had neither the time nor opportunity to learn all aspects of a topic. Then, too, some subject areas are simply too comprehensive in scope to permit in-depth facility on the part of any single individual. But **people** are the ingredient that makes or breaks a program. They can be discussed at several levels depending on their degree of voluntary or expected interest, commitment, and support. Let me speak about program leadership and program cooperators.

Program leaders must have initiative and total commitment to the program whether it be a permanent assignment or a temporary assignment within a permanent assignment, as a rotating chairmanship. If an interdisciplinary curriculum is **being developed** (a growth process), program leaders may need to be visionary, patient, and willing to take risks. If an interdisciplinary program is **already established** and simply being maintained, different leadership qualities may be needed. In either case, I am convinced that an interdisciplinary program will function best with some one in charge, exclusively appointed to and responsible for the program. Advisory committees can be of tremendous assistance to the program leader, but unless held accountable for the success of the program, generally cannot provide the time and effort required for the daily operations of the program. And these are critical to its success.

Additionally, program leaders must be given the administrative flexibility (the necessary authority) to succeed in the position especially if the program has to operate within the realistic limits of departments led by appointed department heads. In this arrangement (especially in programs that rely heavily on the assistance of cooperators) program leaders must have the persuasion, the personality, and sometimes the audacity to succeed. This may involve informing, asking, encouraging, persuading, including, being turned down, and being discouraged. It always includes forging ahead. It always includes generating and maintaining enthusiasm. It always includes giving credit and sharing appreciation for the invaluable assistance of others. These characteristics you might recognize are those of any administrator. And I agree. Interdisciplinary program leadership is an administrative position and should be evaluated as such. However criteria for evaluating these kinds of positions generally do not exist. But educational systems should be flexible enough to justly accommodate new kinds of positions to serve new needs. And if interdisciplinary academic programs **are** a viable concept, they warrant qualified and unreserved leadership. Furthermore, that leadership should be empowered to reward the invaluable assistance of cooperators who generally are providing time and effort beyond their appointed assignments.

The third and last ingredient for success is **administrative support.** Although inseparable conceptually from the first two, it must be addressed more fully in its own right. In most academic institutions it can be viewed at three different levels: 1) support by peers whose responsibilities and experiences may not readily permit comprehension of the role of an interdisciplinary program leader; 2) support by administrative personnel as department heads, deans, etc., for both the program **and** its leader; and 3) support by the administrative structure; i.e., interdepartmental liasons and esprit de corps must exist and be administratively fostered to permit a program to grow and function. Various kinds of support are appropriate to the different levels, but they include psychological as well as technical and financial. Tantamount to these ideas is an ideal initiation of a program. A successful cooperative venture cannot be dictated at any level. Cooperating departments and faculty should be invited at the outset to help determine program needs, goals, parameters, mode of operation, and leadership.

For obvious reasons, academic curricula have an obligation to strive for maximum success. Achieving success requires identification and removal of stumbling blocks.

Stumbling Blocks

In the opinion survey on interdisciplinary activities referred to earlier, although responded to by only about 30 percent of the University faculty, about 83 percent of the respondents involved in teaching agreed that interdisciplinary instruction is desirable in their particular subject areas. However, 27 percent felt either that negative rewards result from such activity or they are uncertain about what value is placed upon interdisciplinary teaching especially by their peers. Ninety-two percent of responding administrators agreed that interdisciplinary teaching is desirable; 65 percent (and 57 percent of rank and file faculty) agreed that there is need for more interdisciplinary instruction at NCSU. Regarding interdisciplinary activity in general (research and extension as well as teaching), about 90 percent of the respondents agreed with the statements "interdisciplinary activity benefits both students and faculty by providing beneficial exposure to diverse viewpoints, information and methods," thereby "providing an opportunity to develop a broader understanding and perspective" of a given subject area. However, about 50 percent were concerned with potential superficial treatment of the subject, extra paper work and red-tape, less obvious and/or slower results to show for one's efforts. Approximately 54 percent indicated more funds would improve the success of their interdisciplinary project; 50 percent, greater willingness and availability of potential cooperators; 41 percent, more time; 39 percent, an improved reward structure.

Some stumbling blocks relate more directly to the efficiency with which a program can operate. They therefore relate indirectly to its success. Adequate technical and clerical support are essential. A good secretary can relieve the program leader of such routine but time-consuming duties as answering routine inquiries about the program and its daily operation from students, campus, and off-campus offices; processing graduate student applications; maintaining student records and the files of the program coordinator. The fact that this level of support is not generally available to the interdisciplinary program leaders attests to the fact that the position is not recognized for the administrative duties that it must perform, and that a program will be correspondingly hindered. Also one or more teaching assistants who can help in all areas of instruction may be needed, especially in small but broad-based interdisciplinary programs headed by a single individual. Adequate and appropriate physical facilities are corollaries to these needs. Students, especially graduate students, must be supported both physically and financially and not be viewed as extraneous or "different" in their home departments, if they are so accommodated. Ideally, students of a particular subject should be housed together. Unequal efforts by cooperating faculty, departments, and department leaders is a commonly heard and easy to understand problem. Often, the wider the disciplinary gap to be bridged, the more difficult and unequal the interest or cooperation. Interdisciplinary programs often are viewed as unfortunate necessities and drains on departmental resources.

Such stumbling blocks not only hinder the potential success of a program but compound the duties of a program coordinator. He/She then must spend extra time seeking ways and means to achieve the desired objectives. That in itself which often involves constantly asking for cooperation and assistance is a natural stumbling block that goes with the program coordinator job. Also, the more one extends oneself as a program coordinator in seeking to optimize the program, the greater the risks of making errors and/or of being judged as having made errors. Additionally they may jeopardize the professional viability of the program coordinator who needs time to think, to study, to write, and maintain professional competency while contributing to a home department and professional societies. Such is necessary for a full professional life while not precluding opportunities for advancement. These ideas and others speak to why I feel the position of interdisciplinary program coordinator should be viewed and evaluated primarily as an administrative position. It could be combined with other roles as director of certain research or extension projects.

Removal of Stumbling Blocks

Stumbling block removal may evolve, from a philosophical point of view. "When interdisciplinary programs are recognized as legitimate activities by the disciplinary guild, the concepts developed through these activities will become the foundations of the future." (1)

From a practical point of view, some improvements (There could be many others.) could come about by some administrative restructuring; e.g., closer physical associations of compatible interdisciplinary programs to permit pooling (and assumedly improved availability) of such resources as space, secretarial and technical staff, etc.; a new administrative office or official structure responsible for interdisciplinary programs with corresponding separate funds, fund-raising efforts, and financial allocations to the component programs. A modification of this approach might allow a channelization of separate funds to departments that cooperate in interdisciplinary curricula, based on their level of cooperation — interdisciplinary FTE's, if you will. Both approaches would provide means for eliminating the "apparent drain" on departments and lessen the opportunity for unequal interdepartmental support. They would be an appropriate place to develop new guidelines for the professional evaluation of interdisciplinary program leaders. They would also provide a new arena in which to identify and deal with the sometimes unique problems and goals of interdisciplinary programs. For example, cooperative activity requires skills — in communication and sociability. These either are intuitive or should be obtained or improved by appropriate coursework and training. But how many individuals would seek and how many peers and administrators would support and reward this kind of professional improvement? Generally speaking, there

is need to improve the administrative support phase necessary for interdisciplinary program success. We cannot risk having mediocre educational programs that do not meet the needs of either students, faculty, or ultimately, society. Where can this be more true than in agriculture, the basis of civilization and the mainstay of human existance? Serious problems of world-wide dimension recently have shown the need to optimize and stabilize the production of our plant and animal crops. This realization in turn has led to renewed conviction for the need of holistic approaches (systems approaches) to achieve these objectives. Holistic approaches require integrative learning, thinking, and action. The development of interdisciplinary curricula in integrated pest management (IPM) has been one response to so prepare students to meet the agricultural challenges of these new decades. Evidence is that good graduates from good interdisciplinary curricula will meet these challenges quite successfully.

The Academic IPM Programs

At NCSU, the undergraduate IPM program (Pest Management for Crop Protection) was formalized in late 1974 from an earlier curriculum in Crop Protection. It was developed cooperatively among the Departments of Plant Pathology, Entomology, Crop Science, and Horticultural Science following several years of study by two ad hoc committees. The coordinator position, a nine-month appointment funded by Academic Affairs, was created and filled (by myself) in fall 1976. Duties are instruction, curriculum development, student advising, and program administration with the assistance of an interdepartmental advisory committee. The committee consists of one representative from each of the four cooperating departments. The coordinator is appointed in a home department and is administratively responsible to that department, but enjoys and shares some responsibility with all departments, their faculty, and students.

Students of course represent the "need" ingredient for interdisciplinary program success. They, in turn, represent an identified public need. Since spring 1976, there have been 25 graduates from this program. Their career choices include private crop consulting (3), farming (1), graduate school (11), chemical sales (2), Vista volunteer (1), research assistant (5), state government (1), and extension service (1). About 20 students are in progress in the curriculum.

Two options for IPM study at the Master' level, a Minor in IPM for the Master of Science degree program and a Concentration in IPM for the Master of Agriculture degree program, were developed subsequently. These new programs, presently accommodating 12-15 students, have helped strengthen interdepartmental associations and expand them to include numerous other departments and faculty. The academic programs actually have functioned as a fluid system seeking to utilize all appropriate University resources. The academic programs interface with a wide variety of interdepartmental teaching, research, and extension programs. Specific activities include interdisciplinary course development and instruction, undergraduate student work experiences and honor projects, graduate student advising, graduate research and internship experiences. As coordinator I have worked with The North Carolina Agricultural Extension Service, especially during the summer months. This helps to keep me current with situations in the field and also aids my teaching. About 40 faculty from 5-6 departments are formally recognized as the Graduate IPM Faculty. This identification reflects their particular willingness to assist with academic program affairs. I routinely contact this faculty for advice, information, and assistance with program activities. They and the countless other responsive faculty who assist me as program coordinator constitute the "people" ingredient in my formula for a successful interdisciplinary program.

The administrative structure at NCSU generally is supportive of interdisciplinary program success. Our University departments are administered by appointed department heads who respond to deans and directors. Each campus in the university system is headed by a chancellor assisted by a provost and vice chancellor(s). Our university has a strong mission-orientation for public service which certainly contributes to program success. Nonetheless, a successful program depends on serving some real need, and on the quality and dedication of its people.

Interdisciplinary IPM Courses at NCSU

With the exception of a 1-credit course **Introduction to Integrated Pest Management** that I teach, and a 3-credit course **Principles and Practices of Pesticide Application** taught by an agricultural engineer, the remaining IPM courses developed and offered by The IPM Curriculum at NCSU all are interdisciplinary in subject matter and method of instruction. To date, I both participate in and coordinate all of them.

PM405 Theory and Practice of Integrated Pest Management is a 3-credit course designed specifically for field practitioners such as county extension agents, agribusiness personnel, and private consultants. It is offered during a special three-week summer session for extension and adult educators. It provides basic theories and practices of IPM together with specific and up-to-date technical information for making sound IPM decisions and implementing IPM programs.

PM415 Principles of Pest Management is a 4-credit course taken by seniors and graduate students. The major portion of the course presents a systems approach to crop-pest problems. When enrollments are high (15 or more students), the final exam is often oral and administered in the classroom by a small group of interdepartmental faculty. It counts for a small portion of the course grade and is a valuable experience although dreaded beforehand but appreciated afterwards by the students. I feel that it lengthens the learning opportunities of the course.

PM490 Pest Management Seminar. In this 1-credit course, students develop a 2-3 year management plan for an actual farm, based on crop-pest histories. They work

in small groups, are provided with appropriate written resource materials, and are visited periodically during the semester by appropriate crop specialists. At the end of the course, students defend their final management plan orally before a panel of interdepartmental crop specialists in addition to providing a written report.

PM495 and PM590 are Special Topics Courses (undergraduate and graduate, respectively). These courses provide opportunity to earn credit for IPM research or internships and permit the offering of new courses on a trial basis. One such course, PM590C, was offered during spring 1981 and is expected to become a permanent course.

PM590C Colloquium in Integrated Pest Management. This 2-credit course consists of student-based discussions of IPM topics assigned and guided by an interdisciplinary team of faculty. It is designed to provide opportunity for graduate level dialogue among students and faculty. A second objective is to provide opportunity for graduate students to become acquainted with faculty not generally involved in their regular study programs.

An interdepartmental graduate course in **Biological Control** is currently under discussion and may be available in the fall of 1982. Additionally, excellent IPM oriented or related courses are available in the various crop production-crop protection departments, especially Plant Pathology, Entomology, Crop Science, Horticultural Science, and in the division of Biomathematics.

Internships

Field internships of a minimum 3-month duration are required of students seeking The Master of Agriculture degree with a concentration in Pest Management. The phrase "Pest Management" is printed on the transcripts of these students. Graduate student committees seek to promote internship experiences that complement students' needs and prior experiences. Academic credit is provided through PM590.

Undergraduate internships are highly recommended and undertaken by more than 90 percent of the students. Undergraduates work primarily as scouts and research aids, extension interns, and with the chemical industry. They receive credit for off-campus experiences through a course entitled ALS400 (Agriculture and Life Sciences, The External Learning Experience). Their work activities are planned in advance and written as a formal but non-binding contract. Students are checked on periodically by their advisors during the work experience, following which they submit a report.

Future Plans

At present, I feel that major educational emphasis in the IPM curricula at NCSU should concentrate on the refinement of existing courses and internship opportunities. New courses seem to develop as their need is recognized; but major effort must continue in providing as much actual work and field experience as possible for both undergraduate and graduate students, especially those planning applied careers. At NCSU, obtaining a "Teaching Farm" for the agricultural plant science disciplines, comparable to that which forestry and animal science students have always had, is viewed by many of us as an absolute necessity. This, of course, requires physical facilities and supplies, faculty, time, and money.

Conclusions

Only time will determine the success of interdisciplinary curricula including IPM curricula. Their degree of success may relate directly to the amount of intentional and accidental blending of need, people, and support. A simple model of my interpretations for interdisciplinary program success is the following:

$$IPS = Xi_1\,(NEED) + Xi_2\,(PEOPLE)\,(I)\,(C)\,(S)\,(A) + Xi_3\,(SUPPORT)\,(P)\,(AP)\,(AS)$$

Wherein IPS =	Interdisciplinary Program Success
Xi_{1-3} =	Variable Quanta
(I) (C) (S) (A) =	Interested; Committed; Supportive; Appointed
(P) (AP) (AS) =	Peers; Administrative Personnel; Administrative Structure.

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