

Interdisciplinary Research and Education in Rhetoric and Reality

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Interdisciplinary Research and Interdisciplinary Education (IR/E) are elusive and elastic concepts.¹ Their meanings differ from person to person and from discipline to discipline, and the experience of any randomly chosen academic with either is likely to be limited. The reasons behind this state of affairs are themselves a complex amalgam and include at least: (1) the monopoly of the recognized disciplines in defining “quality”; (2) the difficulty, in any case, in obtaining judgments of quality when several disciplines come together to produce a course or a research report; and (3) the incentives implied by common systems of internal university finance.

Before trying to come to grips with the messiness of reality, however, it will be worth making some effort to define, at least informally, what IR/E is and is not. The latter question, as is so often the case, is the easier to answer. We all know, probably from direct experience, what does not qualify. For example, the classic example is a collection of papers, each written by one or more practitioners of several disciplines, and each dealing with the single topic of the collection, say water resources management, from the point of view of that discipline. In any particular paper, there might or might not be cross-references to ideas and insights in other chapters. But there will not be anything that could qualify as dialogue across disciplinary boundaries. At the same time, we can all cite examples to demonstrate how single disciplinary perspectives can be inadequate and misleading. Thus, environmental economists who did not understand the transportation and diffusion effects of natural systems on pollution discharges promote the message that a single level of emission charge for all dischargers, or a single market for tradable permits in a region, would lead ineluctably to the

attainment of a least-cost solution to the problem of meeting regional ambient quality standards. And engineers long ago picked arbitrary points on the distributions of rainfall or runoff and labeled them “safe yield,” without considering the effect of the word choice on the perceptions of lay people, setting the stage for much confusion and finger-pointing when serious drought takes a watershed further into the tail of the relevant distribution.

Examples of successful IR/E are much harder to find, exactly because serious and sustained efforts are so rare. A satisfactory general definition is, I would claim, even more elusive. But it does seem possible to produce the beginnings of a working definition of useful or satisfactory interdisciplinary effort by thinking about how to “fix” the examples of single-discipline failure. In the pollution-control case, it is not necessary that every environmental economist be able to construct mathematical models of the effect of environmental processes on pollution. But one could reasonably hope that at some point a would-be environmental economist would have been exposed to the reality behind and the general structure of such models. This ought at least to instill some sensitivity to the structure of the algebra behind policy instrument “theorems.” (That structure should reflect the environment’s role in translating and transforming discharges at various points into ambient quality levels at other points.) In the safe-yield example, the avoidance of future misunderstandings may require a more fundamental effort – an examination of the notion that any interaction of humans and the natural world can ever be “safe” for the humans. At a simple level, this is nothing more than an outcome from a course in probability. But, in order to make the point vividly, the would-be engineer should probably be exposed to some version of decision

theory, in which the limited world of dice and normal distributions is expanded and linked to decisions about spending money, to change the relationship of some human system to the vagaries of nature. A start for a definition of useful IR/E then might be activities that explore the territory just beyond the usual limits of any single discipline and return with material that enriches the insights and methods of the “home” discipline.

The good news, then, is that interdisciplinary education does not have to produce individuals who are experts in everything relevant to a given problem setting in order to be successful. The bad news is that deciding where a program can stop, short of that impossible goal, is something like choosing a way of talking about and planning for “safety.” A committee of five charged with designing an interdisciplinary curriculum for environmental economics or water resource management can be expected to start with five different prescriptions, each heavy on the knowledge and experience that its author brings to the table. The temptation, then, is to create something close to the union of the sets of recommendations. The much more difficult alternative is to work to define a minimally necessary scope of knowledge, which may not mean a scope of mastered techniques, so much as a sensitivity to the limitations of each discipline’s insights. The goal might be seen as producing graduates who have a firm grounding in the tools of at least one discipline, but who have broad enough exposure to other disciplines that they can see where those other ways of approaching a problem might be useful and understand how to “make room for” them. There is also the need to be at least minimally conversant with different vocabularies. To be really useful, of course, this sense of limits must be combined with a willingness to consult across disciplinary lines when those limits may be close at hand. This willingness, in turn, will only result where the effort is made to avoid training in the sort of disciplinary chauvinism that manifests itself in caricature and offensive labels.²

Barriers to Interdisciplinary Research and Education in the Real World

The above prescription may well strike some readers as hopelessly vague, others as akin to just another expression of opposition to sin and

preference for virtue. I prefer to think of it as modest. There are, in any case, many at least as qualified as I to specify the details of an interdisciplinary program relevant to the concerns of the readers of this journal. I am more interested in the question of why programs that aim to go in this general direction, and not just those in water resources, so seldom succeed and are sustained. In my effort to provide an answer I will be less modest. Indeed, my list of problems and suggestions for their solutions may strike the reader as seriously arrogant and reflecting nothing so much as ignorance. In my own defense I can only say that I have several times been lucky enough to find myself in the right place and the right time, with the right mentor or colleagues; and I have beaten my head against the walls I identify and have the bruises to show for it. So, about reasons for failure. One problem, and one that makes everything else more difficult to deal with, is the residual effect of the disciplinary socialization that is part of graduate training, even if not intentionally so. A second problem is practical: the limits on how much of any day, semester, or life can be devoted to the pursuit of knowledge and professional expertise. The third, but by no means the least important, is the way budgets are built, management skill defined, and overhead activities funded within institutions of higher education.

The Socialization of Academics

It seems to be true, and if true is more than a little sad, that, by the time you have earned a Ph.D. in a discipline, you have absorbed a big dose of disciplinary arrogance along with the tools, techniques, and theoretical insights. This takes the form of conviction that what you have learned is “better” (the logic more easily defensible and more “elegant,” the mathematics more sophisticated, and the validation by data more persuasive) than what others are learning in their disciplines. This is very much the human condition – the need to belong, and preferably to belong to an elite group. In my experience you don’t pick up the disease in any particular class but rather absorb it from casual, probably unthinking, comments made by your elders and betters. Escaping it is unusual, and its effect on the quest for interdisciplinary programs is pernicious and ubiquitous. In effect it erects a barrier to dialog and learning more fundamental and difficult to come to grips with

than even differing vocabularies and views of how the world does and should work. It validates the assumption that quality control is a huge challenge in the interdisciplinary context because every other discipline suffers from lower quality standards than your own and requires unremitting oversight to prevent that slackness from tainting your work.

Practical Limits on Educational Effort

As the corpus of human knowledge grows, within any discipline the set of core knowledge and competencies that must be mastered to qualify for the priesthood grows as well. But the time available for attaining the mastery does not grow. It has not been found practical to extend every level of education to allow for the increase in the size of the canon. Our children and their children face 12 or 13 years to get through to a high school diploma, four years of college if they go on, and at least four more years to attain the Ph.D., more or less as we did. Doctors of whatever will therefore have devoted at least 20 years to their education and will be getting on in their 20s when they finish; roughly a third of a lifetime will have been spent. There is no rule that says the educational experience should be limited to a third, and we all have known, or at least known of, professors who have made it their missions to require such wide knowledge that only by spending an additional two, three or four years could their students satisfy them. For the planning of new programs, that approach is generally frowned on, if only because starting out that way would probably guarantee failure. So interdisciplinary programs cannot just pile on the courses from all the disciplines involved, but hammering out which ones to keep and which to toss is a process that at least tests the limits of commitment of the participants. With strong leadership and good will all around, it can be done, but lacking those prerequisites, it will be much easier to produce something, whether an undergraduate major or a masters or Ph.D. program, that includes too much by way of prerequisites and required courses—a version of the proverbial committee camel, but with three or four humps. In the undergraduate setting, there is somewhat more slack, because the typical major requires perhaps 40 percent of the available course time in years 2 – 4. Adding requirements that bring this percentage to 50 may not seem to

be a high price for increasing the coverage, but there will almost certainly be a price, and it will likely take the form of lower enrollments. Some will see this as evidence that the program is attracting only the best and most serious students – as a reward for excellent planning rather than as a penalty for failing to force hard decisions. The problem with low enrollments is that they translate into low levels of support at the department and school levels. When there is a contest between the teaching demands of a department's standard major and what amounts to release time to teach a special course in the interdisciplinary program, the lower the enrollment in the latter, the more likely it is to lose the contest. And when core or otherwise required courses are postponed by a semester, students will be inconvenienced, and prospective students will see the program as a less reliable route to a degree than something more traditional.

University Finance and Budgeting

There seem to be two versions of this obstacle, one for each of the broad versions of university financial management: centralized and decentralized (often referred to as “each tub on its own bottom” or just “ETOB”). My familiarity is with the latter, and I will concentrate on how the problems of starting and sustaining an interdisciplinary program look in that setting, but I am confident that there will be similarities between the two, because at the heart of each will be the politics of trying to make sure that the unit you run “looks good” under whatever criteria are in operation.

In the ETOB system, each school within a university is credited with the tuition and research funding it brings in. Out of this, it pays the salaries of faculty and ancillary support staff; a notional rent on its buildings; other direct costs of its operation; and a tax to the central administration to pay the bills of centralized services, such as admissions, fund raising, libraries and athletics. A key detail for interdisciplinary programs will be how student course transfers across school lines are treated. As a general rule, something will be charged to the sending school and something credited to the receiving school. The devil here is how the amount of that transfer is calculated. At one extreme, the real marginal cost of the student to the receiving school is likely to be zero. The

person teaching the course is not paid more to teach an extra person. It is unlikely that one more student will imply the need for a larger room. But it is not unknown for the charge to be set at the other extreme, the average tuition per course in the undergraduate colleges. The difference between the two extremes in the incentive provided for the school deans to be more or less mellow about the prospect of adventurous students seeking a broader education across school lines is huge. Since it is common for interdisciplinary programs to require cross-school transfers, the choice of transfer prices may be seen as a good indicator of a university's commitment to encouraging such programs. Of course, the calculations that lie behind the positions of individual deans on the choice of these prices are more complex than implied by that statement. Each of them will have expectations about whether they will on net export or import students, and for the prospective importers, the higher average-cost price will look attractive.³ But seen from the center, opting for the zero marginal cost basis is a fairly painless way to encourage cross-university efficiency and cooperation, especially since, over time, the balance of trade is likely to be close to zero for every school.⁴ When an interdisciplinary program will require one or more courses tailored to its needs, the problem shifts to faculty teaching obligations. Teaching the "special" course will substitute for a course in the faculty member's home department, and that will create intra-departmental frictions. Required courses will have to be taught, and neither increasing section sizes nor requiring (usually junior) faculty members to teach more sections of these course rather than their specialties will be popular. The popularity of the moves will not be increased by the observation that the purpose is to accommodate students who had the bad sense to sign up for an interdisciplinary major rather than the department's own, excellent program. At the graduate level, the heat of the arguments about tuition and teaching seems to be less intense, possibly because so few graduate students are actually paying their own way. But the tensions are there, and fights over student stipends can be enough to kill interdisciplinary programs that are seen as in competition with something closer to the perceived mission of any participating schools or departments.

Are there Solutions?

What, if anything, can be done to lower the barriers and reduce the tensions surrounding interdisciplinary education and research? While nothing is easy in academe, there are strategies that can make it easier for students to take their own routes to interdisciplinary experiences or facilitate the startup and maintenance of interdisciplinary courses and programs. In the extreme, and at a great cost in time and energy, the interdisciplinary part of the problem can be done away with, either by obtaining recognition of a new discipline that folds together parts of two or more existing ones or by creating a new school, with its own faculty and students.

Facilitating Student Choice

As already discussed, a good start on this can be accomplished simply – by fiat from the center that imposes a zero price rule on student course transfers unless a special case can be made for a positive price. (Special cases may well exist, as when all engineering students are required to take their English and history from the faculty of Arts and Science, or when large numbers of Arts and Science students wish to take a course in the school of education to prepare them to seek a teaching certificate.)

Slacking the Budget Constraints to Give the Center More Flexibility

To the extent that a rigid ETOB system seems to be discouraging interdisciplinary experimentation at the level of course or of programs, it can be modified through the tax system to provide more funds that can be used by the central administration for starting up new programs or for encouraging the creation of courses that are taught by groups of faculty from more than one school. There are at least three problems with this general prescription, however. Most obviously, once the center starts to tinker with the ETOB model, accountability starts to slip. If the center creates deficits by adding to tax burdens on the schools, some of which are bound to be struggling at any one time, running a deficit is no longer automatically a terrible thing, and the questions may implicitly become, How big a deficit can I get away with? A second problem

is roughly the obverse of the first. Once the center has tasted the delights of greater control, it is likely to be tempted to push further in that direction. But third, once the center has the power to start and stop things, the politics of innovation becomes the politics of playing the center's games. This is unlikely to be obviously healthier than having deans negotiating within the ETOB constraints, in the light of their clear responsibility not to run deficits.

Providing a “Tub” with an Explicit Charge to Encourage Interdisciplinary Research and Teaching

At the graduate level it seems that, at least in some universities, such a tub already exists. It is called the graduate school, and at my former university I watched over the course of several years as two determined faculty, one from the business and one the engineering school, transformed a small program of research and executive education into one offering a masters and a Ph.D. in “Environmental Management.” The course work for these degrees is taken in at least four schools: law, business, engineering and arts and science, and the speed with which the transformation occurred was breathtaking. The success appeared to owe a great deal to the relative autonomy of the Graduate School Dean and to the fact that the initiators were able to raise a considerable amount of money to pay tuition and graduate stipends to the few students. Still, I cannot offer a detailed history or a how-to section, though I can say that the route deserves exploration by any person or group seeking to start an interdisciplinary graduate program.

A second anecdote involving the same university concerns its Institute for Public Policy Studies, established in the late 1970s as a home for interdisciplinary, policy-related research. The institutional design took into account the tensions inherent in the ETOB model by making the institute a tub, symmetric with the schools, though lacking students and faculty. The director reported to the Provost and so could talk to the school deans as an equal. It even had a small endowment and the license to raise general support money with the help of the development office. The key to its long-term success, however, clearly would be its success in attracting faculty research effort,

which would lead to overhead to pay the costs of providing the infrastructure that made it attractive to do research there in the first place. For roughly a decade and a half after its beginnings, this institute had the support of the key deans of education and arts and science, so faculty were not discouraged from participating. The splitting of overhead on faculty research projects was, on the other hand, a continuing source of tension, but in the late 1980s, with the encouragement of the then-provost, a treaty on overhead splitting was negotiated with the Arts and Science dean and eventually imposed for all inter-school research. This was expected to make for long-term sustainability. But such optimism reckoned without the vagaries, not to say the importance, of human nature. In the natural course of things the population of deans turned over, and while some new deans were more supportive than the old, the key deans went in the other direction, as unfortunately did the new provost. The executive summary is that by the early years of the 21st century, the objections to any splitting of overhead had become sufficiently vociferous that the unique structure was clearly about to be abandoned and the institute made into a library-like service provider, with a budget determined not by success in encouraging interdisciplinary research through “selling” itself to faculty, but through success in selling the deans. The lesson would seem to be that even a carefully thought out institutional design, if it depends in the end on the good will of other players on the university stage, will be vulnerable to the random personnel changes that have to be expected. But the good news is that this design lasted for roughly 25 years, and provided a home for a substantial amount of interdisciplinary research in education, physical and mental health, juvenile justice, and the environment. Short of the “nuclear option,” discussed below, this may be as good as it gets.

The Nuclear Option: Establishing a School

Schools of public policy, which are now close to ubiquitous, are excellent examples of this route to the long-run fostering of interdisciplinary education, albeit a route that is limited to the social sciences. Casting a wider net, we find schools of agriculture and of forestry, of public health, and of the environment, in which scientists and

engineers rub elbows with social scientists in the context of a particular set of concerns. This sounds straightforward, but of course it is not, generally requiring years of effort to lay the political groundwork within the university and to identify and cultivate sources of the all-important funding. Taking the money part first, at least within a private university, a substantial endowment is almost certain to be a necessary, though not a sufficient, condition for success. The political challenge includes the need to make an intellectual case for the value of organizing an educational enterprise around a particular theme, often to a skeptical audience quite satisfied with current arrangements. (A general notion of the virtue of interdisciplinarity will not suffice.) Other parts of the university are likely to be threatened by a new enterprise, particularly if it has an undergraduate component, for undergraduates pay the bills, and their total numbers may be limited by space or other constraints. Other sources of threat exist as well, such as the possibility that valued faculty will want to transfer to the new school and the potential attraction of the new opportunity for established donors to other schools. In short, while a school, assuming it is well funded, staffed and managed, finesses the many obstacles to successful interdisciplinary education enumerated above, many forces will exist that do not want to see the finesse work, not because they are in principle opposed to the interdisciplinary ideal but because they can see more clearly how success can hurt them than how it can help them.

Concluding Observations

In the long view, current travails in interdisciplinary education may be seen as simply the latest manifestations of historical “churn” in the definitions of disciplines themselves. Once-monolithic labels, such as “natural philosophy,” have disappeared as the fields of knowledge they stood for became better understood and the need for deeper specialization to extend that understanding became obvious. Another variety of change comes from the realization that, as in microeconomics, for example, better work can be done on many applied problems if the facts surrounding the problems can be incorporated into the applied

mathematics that constitutes much of the theory. At this point, it seems that highly fragmented sub-disciplines should be drawn together in a quite natural way, and perhaps would be were it not for the obstacles outlined above. But, in the context of the modern university finance and organization, the only permanent solution to the challenge of allowing for truly interdisciplinary education seems to be the creation of another school, organized around a problem setting such as public health, the environment, or public policy generally. This means that permanent solutions don't happen very often because of the formidable political and resource costs of breaking the bonds of inertia that are fortified by the conviction on the part of administrators that there really are no positive sum games in their world. In the context of this issue, it may well be that the best attainable outcome for a relatively small problem setting such as water resource planning and management may be the organization of integrating seminars for undergraduate majors or masters program students.

Endnotes

1. I am lumping education and research together here, even though this journal issue is devoted to education, because the claim in academe is that the two activities are too interdependent to be neatly separated. They feed off each other, and certainly the impediments affecting one affect the other.
2. For a more formal discussion of the difficulties of one sort of interdisciplinary dialog, that between ecologists and economists, see the chapter by Russell and Sagoff (forthcoming).
3. Sometimes “quality control” reasons are adduced for discouraging course-shopping across school lines. At the University I know best, the position of the faculty of Arts and Science was that, as a general rule, the courses in the college of Education were second rate intellectually.
4. The same sort of incentive-based hurdle faces faculty members who want to do interdisciplinary research when that implies inter-school research teams. In this setting, the money involved is the overhead paid by the funding agency, and the issue is how it should be split between the schools to which the participating faculty members belong. The negotiations may be ad hoc for each proposal that goes out, but this favors the unscrupulous

negotiator who threatens to hold up the entire enterprise unless his/her demands are met. Or there may be general “treaties” put in place that cover all proposals. Those may in turn be imposed by the central administration or negotiated between individual schools. In any case, the arguments behind the positions of the “contestants” involve both real costs (such as research space and computer support) and rhetorical “risks,” as in, “I pay x’s salary and am therefore “at risk” if s/he does not pull in research funding, with overhead, to help me meet my obligation to run a zero-deficit operation.”

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