Interdisciplinary Research: A Philosophy, Art Form, Artifact or Antidote?

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Abstract—Interdisciplinary research has many faces—a philosophy, an art form, an arti-fact, and an antidote. It is all of these things because interdisciplinary research attempts to ask questions in ways that cut across disciplinary boundaries. This is not politically correct and universities especially find it difficult to manage interdisciplinarians and their projects. The author argues that interdisciplinary research has persisted as an alternative when tradi-tional research approaches have failed to come up with answers to common problems. Interdisciplinary research will continue to survive as long as there are creative, risk-taking scientists who are dissatisfied with the political and organizational boundaries we establish around disciplines which limit our ability to learn about their commonalities.

> *Scientific research is not itself a science; it is still an art or craft.*
> W. H. George (1938)

OUR WORLD IS full of boundaries. Yet these boundaries do not occur in nature as physical entities. All of these boundaries exist only in our minds (Hartmann, 1991). Zerubavel (1991) points out that we transform the natural world into a social one by carving out of it mental chunks that we then treat as if they were discrete, meaningful entities. Wilber (1979) asks: "Have you ever wondered why life comes in opposites?" There were no opposites until we drew boundaries. Such is the case with academic disciplines. Distinc-tions between disciplines are often arbitrary and worn as badges of one form or another of a knowledge classification (Salter and Hearn, 1996). Disciplines are both categories of knowledge and a way of controlling or protecting categories (Salter and Hearn, 1996). Research universities vie for reputations gained from recruiting faculty who are discipline experts and attract funds and similar-minded colleagues to discover cutting edge knowl-edge in a specific discipline. Seemingly at the opposite end of the continuum of research typologies are faculty whose research crosses disciplines and who are therefore often perceived as "undisciplined" even though they use the methods and skills of disciplines.

Interdisciplinary research is outside the boundary drawn for valued research in most universities in the United States. Yet, interdisciplinary research has persisted throughout the twentieth century, (Salter and Hearn, 1996) and, as problems of living become more complex, has experienced recent upsurges in interest (Butler, 1998). Interdisciplinary re-search appears to survive but not flourish. This is because universities run hot and cold about where and how interdisciplinary research fits in a universe of tradition and rigid

organizational structures (Kash, 1988), and traditional scholars (who are in the majority) question the significance and quality of such research (Winkler, 1987).

The purpose of the present paper is to discuss what interdisciplinarity is, to examine what there is about interdisciplinary research that gives it continued life and, finally, to ask what is the future context for interdisciplinary research. The author should point out that the purpose of this paper is not to recruit or convert investigators, to criticize disciplinary research, to criticize the traditions and values of academia, or to offer interdisciplinary research as a panacea. Rather the intent is to try to understand why interdisciplinary research has not died and faded away in the face of overwhelming odds against it. Put in another way, the author examines why innovation and creativity are accepted only within narrow disciplinary boundaries, knowledge outside of these boundaries is suspect in quality and significance, and scientists who cross disciplines are often considered disloyal to their discipline.

Interdisciplinary Research: A Definition

For the purposes of this paper interdisciplinary research is defined as two or more persons from different disciplines who agree to study a problem of mutual concern, and who design, implement, and bring to a consensus the results of a systematic investigation of that problem.

This definition assumes that most interdisciplinary research occurs in teams. Certainly there are researchers who are educated in more than one discipline and therefore have an interdisciplinary *perspective*. Such an investigator may ask different questions or ask them in a different way, as well as use techniques and methods from more than one discipline, than an investigator with training in a single discipline. But it is the author's view that it is the *interaction* between researchers from different disciplines that leads to greater creativity and insights into tackling complex problems. Two or more heads are not always better than one and one multi-discipline trained scientist can make a discovery of major importance. Such scientists are few in number and cannot possibly serve as mentors or project leaders for the plethora of complex projects needing study. Finally, whether a team or a single investigator will be the champion for interdisciplinary research depends somewhat on the topic of research. Complex social problems cannot reasonably be solved with the viewpoint of one scientist whereas a problem that can be studied in a laboratory might only need a single creative researcher.

The Many Faces of Interdisciplinarity

There is little agreement on what interdisciplinarity is and how it should be carried out. Indeed, some authors consider interdisciplinarity *a false notion* (Dogan and Pahre, 1990), *an oversimplified dichotomy* of the rhetorical opposition of disciplinarity and interdisciplinarity (Klein, 1997); other authors note that interdisciplinarity has been considered *an ideal*, especially in universities (Kowalewski and Laird, 1990); others search for an unified theory of knowledge or, *an integrated multiscience* (Campbell, 1969) which would seemingly result from opening up disciplinary barriers.

Interdisciplinarity has been seen as both a challenge and threat to disciplines. Typically it is the function of a discipline to provide its researchers with its own problems and its own process for studying these problems. Watt (1991) notes that there is an establishment attitude in universities of remaining true to one's discipline. To engage in interdisciplinary

research as a non-tenured faculty member is a risk to one's career (Metzgar and Zare, 1999). Researchers who negotiate between two or more disciplines face difficulties finding shared theoretical and methodological commitments, a common language, or even avenues of where to publish (Journet, 1993). Therefore, there are strong incentives in universities for faculty not to engage in interdisciplinary research.

A Philosophy

What, then, is interdisciplinarity? It is a philosophy of integrative thinking (Wolf, 1998). Problems do not fall neatly within disciplinary lines and disciplinary tools limit the parameters in which problems can be studied and solved. As a result the same problem may be studied simultaneously, but separately, by several researchers from different disciplines resulting in differing if not contradictory conclusions, and gaps usually appear which were not addressed because they were "boundary intrusive" of another discipline. The essential ingredient for interdisciplinary research to happen is to ask the right questions. The insightfulness of the questions comes from people from several disciplines examining the same problem. Normal sighted, near-sighted and far-sighted researchers will each see the same object or phenomenon in different ways until they all can see with 20/20 vision. To approach a problem from the vantage point of several disciplines obviously requires some common premises in order to proceed. The first is to agree to the following propositions:

- phenomena have a history, are interactive, change, and can be observed from many vantage points.
- complete inquiry includes a respect for both qualitative and quantitative investigative tools and approaches.
- the key to arriving at consensual conclusions lies with an agreement on the clarity and structure of the research questions, freedom for researchers from different disciplines to utilize appropriate research tools to obtain data relevant to these questions, and an appropriate plan to integrate and analyze data.
- a rich dialogue during the entire research process involves all researchers in examining data obtained, data missed, and gaps in knowledge as a result of this collaborative effort.

Interdisciplinarity depends on the knowledge and skills of disciplines (Karki, 1996; Klein, 1996). Disciplines are needed to conduct interdisciplinary research. It doesn't discredit them or compete with them, rather interdisciplinarians ask questions in a different way about phenomena they see from various angles, and believe answers or solutions must come from common findings from these disciplines. In other words, interdisciplinarians believe that the search for knowledge to complex problems is transdisciplinary. Interdisciplinarity is a philosophy of integrative thinking.

An Art Form

Interdisciplinary research is an art form (Blade, 1963). Each research project is unique; its parameters determined by the nature of the problem and the questions asked. Each research project is a collage of perspectives and expertise so the form, texture and interaction of the variables being studied are flexible. Each investigator is an artist, bringing the knowledge and skills she perceives to have relevance to the problem. How each investiga-

tor adapts his/her disciplinary armamentarium to the project is a creative process (Ziman, 1981). Interdisciplinary artists have been found to be under 40 years of age and scholars without concern for tenure either because they already have obtained it or because they are not in a tenure track position. Most come from biological, medical, social, or engineering sciences (Birnbaum, 1981).

Qin and his colleagues (1997) analyzed a sample of 846 research papers to examine the relationship between collaboration and interdisciplinarity. They found some interesting characteristics of researchers who engaged in collaborative research. Collaborators were more likely to have a personal acquaintance with the other investigators involved; they favored interactive communication; and a majority had researched or taught at other institutions at least once in the previous five years (mobility among researchers' institutions can be a significant channel to communicate interdisciplinary information and develop interdisciplinary collaboration). Overall, Qin and his colleagues found that, collaboration mostly occurred in the same department and intradepartmental collaboration was especially prominent in industrial settings. Other factors that influenced collaboration were the topic or subject of the research, personal networking, and funding.

Interdisciplinarians tend to be hybrid scholars who are border crossers, whose research takes place at the periphery of two or more disciplines (Dogan and Pahre, 1990). They are more secure in their position in academia, tend to be young (under 40 years of age), and seem to be less anxious in high stress situations (Robertson, 1981). But, perhaps most important is the researchers' ability to take risks by asking questions and seeking answers in innovative and creative ways with colleagues whom they know personally.

Schrage (1989) refers to collaboration as the process of shared creation: two or more individuals with complementary skills interacting to create a shared understanding that none had previously possessed or could have come to on his or her own. Schrage (1989) notes, "The paints of the palette that color a new paradigm are mixed in a collaborative pot."

Asimov (1983) points out that art and science are intermingled. He states, "when people grow wise in one direction, they are sure to make it easier for themselves to grow wise in other directions as well. On the other hand, when they split up knowledge, concentrate on their own field, and scorn or ignore other fields, they grow less wise—even in their own field."

An Artifact

The research scientist is taught to observe, think and formulate – a linear approach to problem-solving. Each discipline has its own way of observing, thinking and formulating problems. Each discipline tends to notice only those things with which it is concerned and to be insensitive to others. W. H. George (1938) illustrates this point by citing the tired laboratory worker who hears the clock's chimes, decides it is late, and goes home. On another occasion, at the same hour, he is engrossed in some task that occupies his attention so he misses the chimes, and as far as he is concerned the clock has not struck. We take for granted the things that we are most familiar with, often becoming insensitive to the subtle changes in those things we seemingly know well.

Therefore, the attempt to integrate observations from several disciplines about a common problem is new, different and non-linear. Interdisciplinary research is an artifact, an unnatural approach to studying problems in the disciplinary-centered world of academia. This is why most interdisciplinary programs and projects are housed in institutes or centers

not directly in the mainstream of university organizational structures. Yet, there is evidence that an institute does not necessarily insure increased interdisciplinary activity (Birnbaum, 1978). Permanent research institutes do seem to facilitate interdisciplinary research—they provide more integrating devices.

Interdisciplinary research is recognized by university administrators as increasingly important: problems are interrelated; problems are more complex to solve; disciplines are growing more specialized; and the very nature of interrelated and complex problems creates the necessity to integrate the efforts of highly specialized scientists in their solution (Birnbaum, 1982). On the other hand, interdisciplinary research and teaching are not natural to the university's organization and reward system (Saxberg et al., 1981). The findings of a study of twenty research organizations and universities by Cravens et al. (1976) were that university administrators needed to take a more active role in coordinating interdisciplinary policy development and provide general direction for interdisciplinary research, that more attention should be given to combining interdisciplinary research and teaching programs, that universities needed to develop better measures of effectiveness of interdisciplinary research, and that there should be more aggressive, innovative approaches to help interdisciplinary research succeed in universities. Rossini and Porter (1981), Heberlein (1988), Russell and Sauer (1983), Heathington et al. (1978), and Pignataro and McShane (1979), also endorse these findings from their observations. While individual faculty interest is critical in initiating interdisciplinary research activities, the availability of funding and the tone of the organizational environment are also critical factors for the success of these efforts (Laughlin and Sigerstad, 1990).

Gleick (1987) dramatically points out how artificial separate disciplines have become. He states "Chaos poses problems that defy accepted ways of working in science. Now that science is looking, chaos seems to be everywhere . . . because (chaos) it is a science of the global nature of systems, it has brought together thinkers from fields that had been widely separated."

Interdisciplinary research has been an artifact of make-do organizational structures and processes in universities. However, the funding sources (public and private) to study and seek solutions to complex problems have exerted direct pressure on universities to reexamine how interdisciplinarity can become more central to the mission of universities (Salter and Hearn, 1996).

An Antidote

Interdisciplinary research has been encouraged by private and public funding organizations to gain insights into complex problems whose etiologies are obviously multifactorial. Two or more heads are often thought to be more cost effective and efficient than the traditional single problem approach by individual investigators (Crow, 1992). Funding agencies, politicians and others may encourage the interdisciplinary approach when there has been frustration with the results of traditional research approaches or pressure from the public to get quick answers to problems. Often the expectations of interdisciplinary research are unrealistic. For example, many research projects are funded in five-year cycles. This permits little time for the follow-up of subjects to assess change. Interdisciplinary projects, because of their more complex start-up and refinement of methodology, barely have enough time to be implemented before a progress report is due to determine whether funding will be continued. Qualitative or descriptive data are sometimes the only available data. Interdisciplinary projects, therefore, may not be refunded because they have no

quantifiable short-term outcomes. Indeed, we know little about the effects of interdisciplinary projects and their interventions because funding usually is not long enough to conduct follow-ups or assess long-term change (Ricketts and Koluzny, 1987).

In many large clinical trials, such as asthma, epidemiological approaches omit the involvement of behavioral and social scientists when it is well known that asthma has strong behavioral characteristics that effect its clinical course. Therefore, opportunities are often missed, by chance or choice, to study the control of multi-discipline diseases by excluding certain disciplines. Ironically some disciplines "claim" certain diseases as "their" territory when the reality is that the disease is multi-factorial in most respects.

Also, where findings from interdisciplinary projects can be published is limited to certain journals. Seemingly the investigators who write for these journals are also their major readership. So there is little dissemination of interdisciplinary projects and their outcomes beyond the readership of a few disciplines.

Finally, many of the decision-makers who set policy or allocate funds promote a certain ethos of research which attracts investigators who form teams composed of scientists like themselves. Therefore, the opportunities for interdisciplinary research can be encouraged or discouraged by the disciplinary rigidity of those who control the purse strings (Bruhn, 1995).

Interdisciplinary research is often tried as an alternative when other approaches have not yielded expected results. It is usually inadequately funded and is not supported over a long enough period of time to permit a good assessment of its effectiveness. Its scope of influence is often a limited audience. In this way interdisciplinary research can be considered to be an antidote administered when traditional research approaches fail or prove inadequate.

Why Does Interdisciplinary Research Persist?

As seen in the previous discussion, interdisciplinary research serves personal, social, political, and professional needs. Each interdisciplinary project is unique and novel. Interdisciplinary research seems to periodically gain prominence when problems pursued by individual disciplines yield no new results; interdisciplinary research seems to hold out hope that enough minds and money can resolve any problem. The government encourages the periodic rise in interest in interdisciplinary research by dangling large dollar amounts for specific research initiatives. Even universities, which do not welcome interdisciplinary research, are wooed by the money. Therefore, there are many factors which impinge on the lifespan of interdisciplinary research. It is, after all, the only alternative to traditional research approaches.

But, the major impetus that keeps interdisciplinary research alive is creative scientists who refuse to let their creativity be politically controlled and departmentalized. Interdisciplinary research is risky; traditional research is safe. It is easier to explain failure to one's peers when you did research in an accepted way. Interdisciplinary scientists defy the crowd (Sternberg and Lubart, 1995), but in universities they are only free to do this after they have been awarded tenure. Usually the leader of an interdisciplinary research project is a senior scientist who attracts colleagues in a similar situation and perhaps a few risk-taking junior scientists.

Creativity does not happen because there are a few creative researchers; there must be a creative environment that supports creativity. Even in organizations that do not support creativity a group of scientists may talk and work together to keep their creative spirit

alive. One way universities retain their creative scientists without disclaiming interdisciplinary research is to create research institutes or centers which are largely self-supporting. If funding opportunities dry up the university can show that they at least provided minimal resources for the effort. As long as there are creative people who refuse to have their creativity curtailed they will continue to attempt to create an environment of creativity in a culture of conformity.

Too Many Answers, Too Few Good Questions

Sternberg and Lubart (1995) suggest our problems of the present and future are not due to the lack of intelligent people, but to the lack of creativity in asking the right questions. Usually we are fixated on a solution to a problem, rather than looking at the problem in new ways. When solutions do not come quickly and easily we often throw more money at the problem, thinking that declaring "war" on it will intensify the seriousness in the search for a solution.

Researchers like to replicate the methods they learned from their teachers. As a result persistence is valued more than risk-taking. Obstacles often call for the reduction of ambiguity, repeating the experiment in even more exacting ways to reduce the risk of error. Most of our contemporary problems affecting the health, longevity and quality of life of people around the world can be traced to lifestyle, environmental and behavioral factors. How to reduce the risks of these combined factors will not be discovered by more restrictive and localized research. There needs to be a broad brush across disciplines to discover what the commonalities of these problems are.

Too often questions and answers are the result of a few experts who meet to issue a global white paper on a topic. Good questions come from the creativity of interaction (Sternberg and Lubart, 1995). Too often a few people "frame" or structure the questions and answers so that any research project that does not fall within stated guidelines will not be funded. This is one way to keep questions in line with expected answers. Creativity is not a unity concept. We often limit creativity to a few people or disciplines and therefore the questions and answers change little over time.

Schank and Childers (1988) discuss the perils of script-based·thinking, upon which most research is based. Script-based research is what we do without thinking too hard about how we will do it—it becomes routine and repetitious. The method stays the same, only the problem changes. When scripts (answers) break down we look for alternatives. We need to modify our scripts in research and become more open to creative thought. This is easier said than done, especially within script-based academic disciplines, where script-based thinkers are in the majority and in power positions.

The Future of Interdisciplinary Research

The future of interdisciplinary research is bright but blinking. It is bright because the bedrock of interdisciplinary research is creative, risk-taking role models, who will always be around. The future of interdisciplinary research, however, will be uneven. It will not be seen as a mainstream research methodology, and bureaucratic organizations will discourage it because activities that cross boundaries are politically and economically difficult to manage. In many respects interdisciplinarians are seen by administrators as difficult people who don't learn the rules and ask "why" a lot. Universities need more faculty like this.

The future of interdisciplinary research is also based upon what I call "social trust."

Until scientists and researchers respect each other's work across disciplines there will always be a distrust of the quality and validity of another's work. This lack of disciplinary civility especially discourages young, untenured scientists from research or teaching outside their department. The realities of what is important to survive and flourish in academia are too powerful for interdisciplinarians to overcome. The choice is often to conform or to leave. The only hope for change here is if decision-makers change the rules regarding promotion and tenure.

Interdisciplinarity is a philosophy, an art form, an artifact, and an antidote – it is a synchronicity of questions, of viewpoints, and methods, focused on a problem of common concern. It is more than sharing views or coordinating methods: rather, it is a process which begins with an explicit plan in which investigators from several disciplines agree on what questions are to be asked, how answers will be sought, and what outcomes are to be expected. Interdisciplinary research is more than an agreement to cooperate, it is a commitment to work through disagreements and barriers in concepts and methods and reach some degree of consensus as to the meaning of the data obtained.

Interdisciplinary research recognizes that boundaries are illusionary and with the opposites they create they have become our impassioned battlefields (Wilber, 1979). "Most of our problems—are based on the illusion that the opposites can and should be separated and isolated from one another. But since all opposites are actually aspects of one underlying reality, this is like trying to totally separate two ends of a single rubber band. All you can do is pull harder and harder—until something violently snaps (Wilber, 1979)." The need for coherence and connectedness is everywhere (Klein, 1996). Yet, interdisciplinarity will continue to be embraced, rejected, and reformulated. The politics of science has not changed significantly in the past several decades. Without the benefits of both disciplinary and interdisciplinary research, all of science loses.

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