Wicked Problems? Wicked Answers!
Initiating Innovative Culture In Organizations

"Deeply held beliefs are learned and relearned over time but are typically anchored on some initial belief that makes them difficult to change" (Krueger, 2007)

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Abstract

Innovative activity in organizations is characterized by disciplinary specialists working creatively, in concert on complex problems. Among the keys to successful execution is the degree to which the problem solvers are comfortable and adept at interacting creatively with other disciplines. This essay describes a means, based on the user-centered approach advocated by constructivist theories of learning, of initiating the development of that state. The discussion traces the reasoning behind the adoption of the approach and concludes with a description of the means employed to address difficulties experienced at the very earliest instance of exposure to the process.

Introduction

Although the evangelical messages of the 80s and the 90s concerning innovation and its positive impact in the workplace and the classroom have been replaced by more measured and thoughtful discussions, the advocacy of innovation as necessary for organizations to survive let alone succeed continues unabated. Publications across the spectrum from the popular press to academic journals dissect, describe and prescribe strategies directed toward instituting and improving innovative activities in organizations. Whether it be Hargrave and Van De Ven's "*A Collective Action Model Of Institutional Innovation*" (Academy of Management Review, 2006), Junkunc's "Managing Radical Innovation: The Importance of Specialized Knowledge in the Biotech Revolution" (Journal of Business Venturing, 2007) or Chhatpar's "Innovate Faster by Melding Design and Strategy" (Harvard Business Review, 2007), innovation continues to be seen as an appropriate response to immediate threats or as a means of devising strategies to achieve long term goals. Unfortunately, even with cautions and advisories concerning the considerable impact resulting from the adoption of such strategies, the literature fails to communicate fully the daunting nature of the effort.

In the circumstances discussed in this essay the daunting character was encountered in the preparation of multidisciplinary graduate student teams in the faculty of Environmental Design at the University of Calgary to undertake complex problems. The students, representing many disciplines from the humanities, social and natural sciences and professions, were assembled in groups to address multi-dimensional environmental design problems. Even with training in group dynamics and leadership and the employment of various group problem-solving techniques, the experiences of the students were less than satisfactory, presenting a perplexing problem for instructors. This essay provides an overview of the examination of and response to that perplexing problem.

The examination began with a characterization of innovative activity in organizations: disciplinary specialists working creatively in concert on complex problems (O'Grady and Henderson 2005). It was found that, whereas each of these points when engaged individually gives rise to considerable stress, when all are engaged in unison they present almost insurmountable barriers. Each of these will be discussed, beginning with complex problems. Following that, insights from literature on various theoretical perspectives and practices concerning innovation, creativity, and teamwork will be developed. The essay will conclude with a description of an approach to the enhancement of the very earliest efforts to introduce a culture of innovation to organizations, followed by recommendations for further work on the topic.

Disciplines and Complex Problems

The problems that workplaces or classrooms face that require innovative solutions are often beyond usual work patterns (Dunne and Martin 2007) and arise from two principal sources: immediate crisis or investigations of future potentials. Whether requiring a reactive or proactive response, the problems can be characterized in three ways: (1) magnitude of the effort required, (2) complexity of the circumstances confronted, and (3) degree of novelty reflected in the sufficiency of the problem-solving algorithms available (O'Grady and Henderson 2005). Regardless of the magnitude and/or complexity of a problem, if there is a low degree of novelty, problem solvers can invoke techniques that are part of the usual work patterns of the organization. Those techniques, with more or less difficulty, allow effective and efficient articulation of the problem and the provision of specifications for the various disciplines and resources required, the processes to be employed, the schedule to be achieved, and the outcomes sought. Such problems have been labeled tame by Rittel and Webber (1973).

Although this routine approach is effective when problems are tame, it is not an appropriate strategy for complex, interconnected problems, also known as wicked problems (Rittel and Webber 1973). Rittel and Webber's (1973) definition of a "wicked problem" can be captured as follows: it resists definition, has no final test, has many alternate solutions reflecting differing perspectives on the problem, and never achieves closure but only another, newer problem. It is interesting to note that this iterative model parallels Karl Popper's (Magee 1974, 65) problem-solving formula in which an initial problem (P1) leads to a trial solution (TS) followed by error elimination (EE) and finally problem number two (P2), which begins the cycle once again. Consequently, wicked problems present problem solvers with a set of circumstances that, with little regard for the magnitude and/or complexity of the problems, exhibit high degrees of novelty that do not submit readily to available problem solving techniques (Pacanowsky 1995).

Consider the following excerpt from a recent project description provided to a senior, graduate student team:

> The consultant team should consider all aspects of sustainable and green building. In particular the client would like the team to examine the feasibility of minimizing resource consumption and waste from the construction and operation of the facility; the generation of power on site using geothermal or other alternative sources and/or the design of a district energy system to serve the development and surrounding neighbourhood, with the potential to provide power to the municipal utility; the use of local materials; and identification and mitigation of wildlife issues that may be associated with the development. The proposed design must be functionally sound in addition to demonstrating an appropriate and appealing aesthetic dimension. The development must also be appealing to the citizens...from an aesthetic and economic perspective.

For example, even though similar projects have been undertaken in the past before by multidisciplinary teams of architecture, planning, environmental science, and engineering students, the evaluation of the combination of environmental, social, technological, and economic issues involved in the construction of habitations and transportation corridors in formerly undeveloped lands present wicked problems with each new instance. In addition, whereas conventional problem-solving approaches begin with the implied optimal finality embodied in the instruction "define the problem," wicked problems defy that instruction because there are few, if any, existing useful techniques that can be employed to achieve the definitions (Pacanowsky 1995). In those circumstances, characterized by ambiguity and uncertainty, new techniques must be devised that will enable the finding, recognition, identification, classification, and manipulation processes that lead to problem resolution.

In order to engage these perplexing circumstances, Pacanowsky (1995) suggests an approach predicated on the initiation of inquiry-based explorations by interdisciplinary teams prepared to work outside the usual work patterns of the organization. Their efforts would be directed to the generation of many questions about the problem processes and states providing new perspectives, variants, theories, and concepts leading to the design of techniques that are appropriate to the characteristics of the problems being confronted.

When undertaking this process Wake (2000, 2) suggests that, both consciously and subconsciously, participants will variously call upon their accumulated knowledge of techniques, mechanisms, and relationships to construct

the many needed strategies. Consequently, for those not skilled, by training, experience, or predilection in interdisciplinary processes, the suggestions evoke a risky state outside their normal work patterns. That state is seen to be chaotic, ambiguous, uncertain and, most disturbingly, fraught with the potential for error. The natural response is to seek refuge by either ignoring the problem or invoking proven responses that are associated with tame problems.

Disciplines Acting in Concert

A "discipline" has been defined as any distinct, organized body of learning in which there is a core knowledge set based upon training in a discrete body of concepts and theories (Long 2002). The use of the terms "core knowledge," "distinct," and "discrete" clearly indicate a degree of exclusivity and authority that allows for few inquiry-based intrusions or extrusions. Treffry (2001) reflects the consequent restricted view by defining a discipline as "the practice of imposing strict rules of behavior on other people; the ability to behave and work in a controlled manner; and a particular area of academic study." With the growing realization of the complexity and interconnectedness of problems confronting the world today, the reductive, exclusive processes embodied in a mono-disciplinary approach have been found to be wanting (Brewer 1999). According to Brewer (1999) that is because disciplinary specialization results in "more fragmented knowledge...which informs realistic problems only with great difficulty" (Brewer 1999, 327). Sandercock (1999) observed that the fragmentation resulting from disciplinary approaches and the problems associated with it also exist in disciplinary-based education. She suggests that the professional boundaries that exist in practice derive in part from the system of educating professionals that focuses on discrete, mono-disciplinary issues at the cost of larger, interconnected systems of disciplines. This exclusivity is captured in Martin's (2006, 514) observation that "We teach a very narrow form of collaboration, which is to find somebody who thinks like you and then work together."

In team settings the knowledge and expertise of multiple disciplines are usually juxtaposed additively (Klein 1990). Although team members share information, attempts to synthesize and implement common approaches are avoided, thereby isolating knowledge and practice in the pursuit of risk reduction and accuracy of outcome measurement (Zeiss 1999). Such demarcation also results in individuals assuming responsibility for only the activity that relates directly to their own disciplinary specialty with little regard for issues related to other disciplinary areas, including overall group function (Zeiss 1999). The fragmentation can discourage the free flow of ideas, resulting in less being known (and shared) about the project.

Interdisciplinary groups go beyond those mono- and multi-disciplinary strictures to encourage excursions, either out of or into disciplines (Hansson 1999). Groups who act in an interdisciplinary fashion will collaborate in a non-hierarchical organization in which all participants are considered colleagues. Responsibility, leadership and information are often shared among members and distributed according to the issues being considered (Zeiss 1999). The collaboration can extend to connections between the physical and social sciences as was pointed out by Skirbekk (1994), who observed that "although the description of an environmental problem may be considered the privilege of the natural sciences, the knowledge used in the analysis of the causes of and solutions to environmental problems is derived from a much wider variety of disciplines ranging from the social sciences to the natural sciences." Furthermore, as Hansson (1999, 341) points out, that "even if full scale penetration of one discipline by another is not possible the communication is useful" in the creation of new hypothesis, theories, and concepts.

Unfortunately, as Martin (2006) has observed, the culture within many professional organizations, including the education process required to achieve entry to the discipline, forges a sense of exclusivity that runs contrary to the kinds of collaboration that interdisciplinarity requires. According to Nissani (1997), although groups operating in an interdisciplinary fashion are an appropriate means to deal with wicked problems, the adoption of such a position by organizational cultures would require a significant shift in the conception of disciplinary practice and education from exclusivity to inclusivity. This presents a significant barrier to the achievement of the concerted effort required to address wicked problems.

Disciplines and Creativity

When considering the generation of creative responses to wicked problems, various myths concerning creativity present significant barriers. One such myth concerns the outcomes of the process. To many the expected outcome of creativity is originality (De Winter 2002). That perception has resulted in the perceived requirement that the new, the unique, the novel, the never-before-seen are the only acceptable outcomes of creative efforts. Unfortunately that is quite often at the expense of evolutionary improvements that are more appropriate responses to problems. Consequently many individuals with useful insights into the complexities of wicked problems avoid participating because they are not confident that, given the pressures of the problem state and the perceived demands for originality, they are sufficiently inventive to deliver the originality that is believed to be required.

A second myth, which is related to the first, suggests that creative process is the exclusive realm of the uniquely gifted individual wrestling in solitude with uncooperative muses. This conception, which is foreign to the experiences of most, presents many subtle and not-so-subtle hurdles to the development of knowledge and skill at creativity and innovation. For example if an individual believes that he or she does not possess this unique ability then it is not likely that he or she will seek to engage in situations that are perceived to require it. Conversely, as Krueger (2007) has observed, "If we see ourselves as competent we are more likely to see a course of action as feasible..." (128).

A third creativity myth is the belief that to be creative one must adopt a role and associated behaviors that run contrary to one's assumed or assigned role in the organization. A person's role is inculcated as part of the process of preparing for, joining, and participating in particular social groupings, including disciplines and organizations. In western culture the role for a creative person is perceived as including license to act beyond the accepted norms and values of most organizations. As McClaren (1999) points out, those behaviors are viewed in many organizations as aberrant and outside the normal work patterns of the organization. Consequently, many do not pursue that route for fear of censure.

The first two myths concern one's sense of self-efficacy and the third one's role identity conception. According to Krueger (2007) self-efficacy and role identity are manifestations of deeply held beliefs that significantly affect one's decisions. The three myths are only a small sample of the myths regarding creativity in western culture and organizations. Whether it be the belief that one does not have the ability to do something or one's perception that it is not a proper role, the myth-holders are forestalled from assuming even the appearance, let alone the practice, of creativity.

Responses to Wicked Problems

In both the workplace and the classroom, readily available and apparently simple off-the-shelf techniques such as brainstorming (Osborn 1963), lateral thinking (de Bono 1990) and mind mapping (Buzan 1991) are commonly among the first responses to the difficult circumstances presented by wicked problems. Of the various techniques that these approaches employ, two are paramount: 1) simple rules of engagement such as "criticism of other people's ideas is not allowed," are designed to both neutralize confrontation and facilitate positive, constructive interactions and 2) accurate definitions of what is believed to be the problem at hand. Although the simple rules of engagement are useful they are often confounded by the requirement for problem definitions that, as has been pointed out, are not possible in the case of wicked problems due to the very nature of the problems. Consequently the team often finds itself engaging the problem with a functional process in the absence of a definition. Additionally, even with their apparent simplicity, the off-the-shelf techniques do require preparation and practice to execute to their full potential. Such preparation is usually seen as time-consuming by many groups in search of immediate results, who employ them without much preamble only to find that the outcomes are unsatisfactory.

Taking a step away from the many off-the-shelf techniques, one finds the services of consultants who market programs consisting of lectures, seminars, and workshops that they claim measurably improve the ability and propensity of a client's team to work creatively and in concert on complex problems. Although popularity cannot be equated with the team's success, the industry seems to be quite profitable and the experiences apparently provide participants with a much-appreciated break from their normal work patterns.

Taking one more step away, some recent discussions about and investigations into the concepts that underpin the establishment and maintenance of innovation cultures have turned to a constructivist cognitive approach in which modes of thinking and user centeredness play critical roles. The modes of thinking approach include reflection and visual thinking (Schon 1987), design thinking (Buchanan 1992; Dunne and Martin 2006), effectual reasoning (Saravasthy 2004), and entrepreneurial thinking (Krueger 2007). Martin argues that abductive logic underlies these desired thinking processes, pointing out that whereas "deductive and inductive logic are the logic of what should be or what is" and are the dominant form of logic employed in business schools, abductive logic concerns the logic of "what might be," thereby reaching for possibilities that inductive and deductive logic cannot entertain (513).

Gaglio (2004) provides an example of an operationalized "what might be" approach. Employing mental simulations that allow a re-processing of the past and anticipation of the future and counter-factual thinking that enables alteration of the conditions that apply to the simulation, Gaglio encourages her students to break the means-ends framework and consider "what might be" in the search for entrepreneurial opportunities. Gaglio observes that "it would seem likely that a major point of difference between those who identify innovative opportunities and those who do not can be found in the kinds of counterfactuals they construct in order to account for the exceptional or the unusual" (Gaglio 2004, 542).

The highlighting of a user-centered focus, which is a central concept in the constructivist approach to learning (Krueger 2007), has two significant outcomes. First, it shifts the problem-space focus from the organization to the thinker, thereby emphasizing the development of knowledge and practices related to self-directed learning, a key element of the constructivist approach and that which Gaglio's (2004) work focuses on. Second, it also shifts the problem-time focus towards the earliest acquisition of deep beliefs (Krueger 2007). This second shift in focus is critical because, as Krueger points out, "Deeply held beliefs are learned and relearned over time but are typically anchored on some initial belief that makes them difficult to change" (Krueger 2007, 127). Consequently, if the objective is to create a culture of innovation, it is important to devise means to either instill critical initial deep beliefs that respond positively to the concepts that subtend innovation—disciplinary specialists working creatively in concert on wicked problems (O'Grady and Henderson 2005), or attempt to change already instantiated negative deep beliefs so that they respond positively to the concepts.

In the examination of the student performance, among the many perspectives from which the issue of the critical exposure, initial or otherwise, was considered, two were found to be practically useful: threshold theory (Meyer and Land 2003; Cousin 2006) and learning styles theory (Felder and Silverman 1988; Dunn, Dunn and Price 1984). Threshold theory holds that when learning, students enter a liminal or "betwixt and between" state (Turner 1967) in which they "oscillate between old and emergent understandings" towards a state of mastery (Cousin 2006). It is in this state that deep understanding or mastery is achieved and subsequently revised. As well, in this process, it is critical that the mastery developed be coupled to inquiry (Meyer and Land 2003). That coupling insures that the mastery so achieved will be subjected to inquiry and not "congeal" (Cousin 2006). Therefore for instructors a threshold perspective requires that attention, as well as being paid to the deep understandings sought, must also be paid to the many potential sources of equally deep misunderstandings that can occur. That realization points to the need for further consideration of the user and his or her various ways of acquiring, storing and using information and that leads to a review of learning styles.

Learning styles theory argues that, since students exhibit highly differentiated ways of perceiving, receiving, organizing, processing, and understanding information and that instructors equally exhibit great differentiation in the style and content of the preparation and delivery of the material, greater correspondence between the senders and the receivers must be sought. Of the many variants proposed the author has found that one devised by Felder and Silverman at North Carolina State University (1988) provides very useful insights and outcomes. Although this theory, as well as the balance of theories in the learning styles field, has been subjected to much criticism on many grounds (Coffield et al 2004) it has proven to be an effective pedagogic tool in guiding the preparation and delivery of learning experiences for groups of students from diverse disciplinary backgrounds. Beginning with consideration for the balance between abstract and concrete content through concern for sequential and/or global understanding, the Felder and Silverman perspective assists in the preparation and delivery of the needed information toward the goal of achieving the desired positive orientation to innovation.

To summarize, the discussion has suggested that the preparation of problem solvers to be comfortable and adept at involvement in the kind of interactive creative environment that innovation demands may be best achieved by enabling them to think of "what might be." The discussion further suggests that a way to improve the potential of achieving that objective is to adopt a user centered approach that carefully considers the threshold experiences and the learning styles of the students. Considering these issues, the objective becomes one of structuring the critical threshold experience to accord with the student's unique learning styles, with the goal of improving the potential of the initial exposure to the problem state contributing to a satisfactory learning outcome. This tripartite relationship is illustrated in Figure 1.

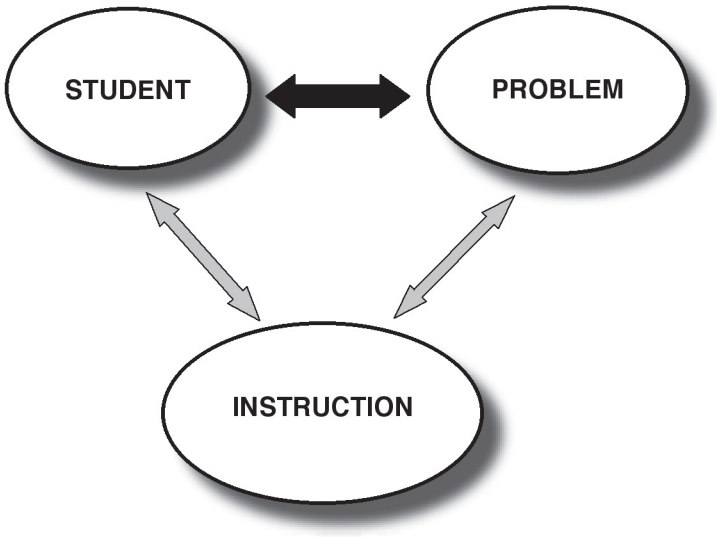

Figure 1. Student, problem, instruction relationship

In Figure 1 the relationship between the student and the instruction concerns the development of an understanding of the predilections of the student toward learning. Indicators include prior or concurrent disciplinary preparation, e.g., engineering or fine art, as well as interactions between the student, his or her peers, and instructor(s) as well as experiences beyond the academy. An initial profile of the student's learning styles can emerge from those considerations. As well as noting that the initial assessment will probably change as more information is captured, it is also kept in mind that, while all students exhibit aspects of all learning styles, some students exhibit a dominant preference and others appear to be equal in all style dimensions.

As with the student/instruction relationship, initial understanding of the student/problem relationship is based on capturing an impression of the student's experiences and existing perceptions concerning problems that require innovative approaches. Some students revel in the extemporaneous, intuitive, and ambiguous whereas others demand exacting descriptions couched in fact-based, cause-effect relationships.

Understanding of the instruction/problem state relationship emerges in part from the understandings arrived at in the first two relationships discussed and from a more general understanding of appropriate problem/states for the delivery of initial experiences. For example, insofar as possible, initial problems should be discipline-neutral in content and format while capable of generating sufficient interest to engage the students entirely.

Finally the ultimate objective of these efforts is to reduce the role of instruction in the relationship by encouraging the students to shift their focus from concerns about performance, i.e., finding the answer that they believe the instructor or their peer group wants, to concerns with their own self-directed learning process in relation to the problem.

The balance of this essay will outline an approach based on those observations, beginning with a list of initial conditions, principles, and practices based on the literature discussed earlier and experience gained in running the program. The presentation will go on to offer and discuss three projects that reflect the insights.

Initial Conditions, Principles and Practices

1. all participants are graduate students
2. participants have arts, sciences, and professional degrees
3. average age of participants is twenty-six
4. participants have average of 2.5 years workplace experience
5. most participants claim prior involvement in innovative activity
6. coaching, facilitation, and web-based blended-learning are employed
7. extensive literature, mixed media, and web resources are made available
8. self-directed learning is encouraged
9. multiple, small, high novelty projects are employed
10. immediate, relevant feedback and reinforcement is provided
11. projects are discipline, context, and subject neutral
12. useful, proven techniques are borrowed from existing algorithms
13. seek many alternative designs (fail often to succeed sooner, Kelly 2001)
14. participants focus on process rather than products

Three Projects

Following are three project statements based on the above listed conditions, principles, and practices. They are single class introductory projects for sixty-five to seventy first-term graduate students representing the broad variety of disciplines that has already been described. The students are randomly grouped in teams of six to seven and given the problem statement that is in an intentionally understated, ambiguous form to encourage the students to take control and introduce their own elaborations. They work in a large room with sufficient pin-up space and tables. They are provided large sheets of Kraft paper, various markers, tape, push pins, visual references, and access to web sites.

A VILLAGE FOR

MATHEMATICIANS

The year is 2050.

The world is ruled by mathematicians.

They all live in one village.

What are the implications of that?

Presentations are due in one hour.

SUSTAINABILITY FOR PRE-SCHOOLERS

IN THE MANNER OF DR. SEUSS

Devise a written and illustrated guide

in the manner of Dr. Seuss

for five-year old children

about sustainable shelter.

Presentations are due in one hour.

HYDRATION POLICY

IN THE STYLE OF RUBE GOLDBERG

Prepare a policy statement in the style of Rube Goldberg

on how to open a bottle of water.

The statement will be a minimum of fifty steps.

The presentation should appear to be by Rube Goldberg.

Presentations are due in one hour.

Many variations on these themes including Monte Python, Gilbert and Sullivan, lawyers, poets, and politicians have been used. In these small initiation projects, most of which are based on simple shifts of subject, time, place, and role identity, the objective is to remove the participants from the comfort of their disciplines and have them enter a realm dominated by chaos, novelty and intuition. At least two and preferably three projects, each with different purposes, subjects, and objects, are run in successive class meetings. The projects, which are easily completed at one sitting, allow immediate in-class feedback. It is intended that the students will converge at a point where they can comfortably and in concert confront the chaotic, novel nature of the exercises and that the interaction, generation, and reporting functions that emerge are fluid and unrestrained. The project presentations, which are usually standing room only and generate much laughter, provide a final lesson by further demonstrating, in the range of the alternatives presented, the power of the "what might be" approach when engaged from multiple disciplinary perspectives.

Discussion and Conclusions

This essay has described a constructivist theories-based, user-centered means of initiating a positive conception of innovation in students from a broad range of disciplines working in multidisciplinary teams. Partly based on activities in courses in the faculty of Environmental Design at the University of Calgary (O'Grady and Henderson 2005; O'Grady 2006, 2007) and partly on pertinent literature, the discussion traced the reasoning behind the adoption of the approach and provided a selection of introductory projects based on that reasoned approach.

Beginning with a review of problem states, the discussion arrived at the conclusion that novel problems, also called wicked problems, whether or not they were large and/or complex, called for innovative solutions and that led to an examination of interdisciplinarity, response types, and creativity, culminating in the adoption of a user-centered approach. That adoption shifted the focus from the problem to the user and highlighted the importance of the critical earliest threshold events experienced by the user. It was reasoned that those earliest threshold events, if carefully constructed, would influence innovation experiences by providing neutral grounds upon which teams made up of many disciplines including engineers, political scientists, architects, industrial designers, etc., can experience the consequences of reasoning abductively and in concert without the burden of disciplinary presumptions. It was further reasoned that that would encourage the instigation and development of either negative or positive responses to the creative, concerted efforts required when confronting progressively more difficult, discipline-laden wicked problems.

Finally, the train of reasoning was assembled into a preliminary list of conditions, principles, and practices that were employed to prepare simple introductory exercises which, by focusing on the earliest exposure of the users to the processes, sought to either avoid the creation of new barriers or begin overcoming existing barriers, leading to a positive conception of the potentials, means, and abilities to address wicked problems when working in teams.

These simple exercises are given to student teams at the beginning of the term. Following that, the teams are introduced to projects that embody progressively greater scale, complexity, and novelty culminating in the student's senior year with the sort of exercise described earlier involving mixes of social, environmental, economic, political, and technological issues requiring considerable and innovative responses. Discussions with students, past and present, suggest that the insights provided in these introductory projects have provided them with a better understanding about the relationship of creativity and interdisciplinarity to innovation and facilitated their dealing with the increasingly difficult projects. They also report that the conceptions so developed transferred easily to other endeavors that they have engaged in both in and out of school. This confirmation, anecdotal though it may be at this time, reinforces the perception that the direction is worthy.

Further development of this approach is directed to three immediate goals. First is the development and incorporation of a better "deep understanding" of the purposes, processes, dynamics, and outcomes of interdisciplinary and creative responses to wicked problems. That leads to the second goal, which is the identification of all aspects of the emergent approach and constituting those aspects in an empirical fashion. The third goal is to test the approach with a wider audience. Even though the make-up of the current student group is quite diverse, it remains a self-selected group and as such cannot serve as surrogate for a wider audience.

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