Theology in Ecological Perspective: An Interdisciplinary, Inquiry Based Experiment

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Introduction: Core Curriculum and Theological Perspective Courses

Several years ago, on the heels of an extensive self-study for the purpose of re-accreditation, the University of Portland (UP) decided to re-evaluate its university core curriculum, a spectrum of courses required by all students. Anyone familiar with such a process, particularly in departments of theology or religious studies knows that this can be tense, even conflictual, as faculty and departments vie for a limited number of core credits. The Department of Theology at UP maintained its 9 credit hours (3 courses) by proposing a Theology Core Program drawing heavily from the institution's Catholic mission and identity and a willingness to be more creative and flexible in its core course offerings. The short end to a long story was this: the Department of Theology would maintain its 9 credit role in the university core curriculum and begin offering a new series of courses called Theological Perspective Courses (THEP). THEP courses are upper division courses offered by theology faculty in conjunction with another department that has required core courses in the College of Arts and Sciences. THEP courses are intended to be interdisciplinary, with two faculty members from different disciplines collaborating on new course design and implementation. The rationale for this development was quite simple. THEP courses would assist students whose major was credit intensive—such as engineering majors who have credit requirements well in excess of 120 hours—to fulfill the university core and the requirements of their major program. THEP courses would allow students to meet two core curriculum requirements with one course. The interdisciplinary nature of THEP courses would model the kind of intellectual synthesis we are working to help our students increasingly achieve throughout their undergraduate career. This new configuration of UP's university core

curriculum led to the development of THEP 482, Theology in Ecological Perspective, one of two new THEP courses to initially come on line.

Discovery Learning, Interdisciplinarity and Community Development

While these changes were taking place at UP, a report from the Carnegie Foundation for the Advancement of Teaching by the Boyer Commission called *Reinventing Undergraduate Education* (1998) began making serious waves among universities in the United States. Even though the Commission's "Blueprint" targeted large research institutions, its ten recommendations for reforming undergraduate education are applicable to most colleges and universities. Many of the proposals—such as freshman year programs, capstone courses and embedded communication skill courses—were already appearing at the University of Portland. The document provides a compelling framework and context for discussing the pedagogical challenges of teaching an interdisciplinary core course between theology and science. We identified three relevant Boyer Commission recommendations that provide a backdrop for our reflections on teaching Theology in Ecological Perspective: 1) "Make Research-Based Learning the Standard," 2) "Remove Barriers to Interdisciplinary Education," and 3) "Cultivate a Sense of Community."

Inquiry-Based Learning

Making research or inquiry based learning—also called discovery and/or experiential learning—the standard at research universities, where science and technology tend to dominate, makes perfect sense. Anyone familiar with pedagogical theory over the last century knows that this is not a new phenomenon. Nearly a hundred years ago, John Dewey, the great American theorist

argued in true progressive fashion that education should be focused on "the reconstruction of experience." In an entirely different social and cultural context during the 1960s, the great Brazilian educator, Paulo Freire, re-invented literacy campaigns for impoverished communities by discarding reading primers and developing literacy curricula based on thematic investigation—inquiry into a people's lived experience for the purpose of linguistic "decoding" and a "problem-posing" approach to learning. This development in Brazil paralleled the emergence of liberation theology in Latin America, producing a novel shift in theological method—one that arises out of the praxis of faith. More recently in the U.S. the insights of Dewey and Freire have been bought to the foreground in religious education by Thomas Groome and his approach of "Shared Christian Praxis" (Groome 1980). His pedagogical process takes learner centeredness seriously by providing a great deal of focus on the learners' inquiry into their lived experience of faith. The pedagogical innovations advocated by Dewey, Freire and Groome illuminate a fundamental insight into the nature of learning—that learning is enhanced, and made more meaningful through inquiry and discovery based pedagogies. In this way learning—defined here as the internalization and reconstruction of knowledge by the learner—is accelerated and made more exciting than an exclusively transmissive approach to education.

In the area of undergraduate education, movement toward inquiry based learning has been a trend in the sciences and social sciences for longer than a decade. Reports like *Reinventing Undergraduate Education* have maintained the focus on the continuing need for inquiry based learning. The role and place of inquiry based learning is more difficult to assess in the humanities, although it is clear that there is significant interest here as well. For example in undergraduate theology and religious studies programs it is not uncommon to see departments offering courses that link theological reflection with community involvement and service

learning opportunities. Reflecting on her service learning course, "Catholic Social Teaching: A Living Tradition" offered at Notre Dame, Margaret Pfeil comments that

> If our educational journey had been confined strictly to classroom learning, I am certain that the bishop's call for economic justice would have been summarily dismissed as an unattainable utopian ideal. But, through the experiential learning component, students almost inevitably found themselves grappling with the implications of the bishop's call to embrace the option for the poor (Pfeil 1998).

As a form of experiential education there is no doubt that service learning—if done well—can enhance the undergraduate learning process, however, our challenge in THEP 482 is not solely an issue of creating an experiential learning opportunity but using that learning experience as a nexus for integrating two different academic disciplines.

The impetus toward combining interdisciplinary and experiential education in the arena of environmental issues is threefold. First and most obvious, is the enormous complexity underlying environmental challenges. Using an example from the Pacific Northwest of studying estuarine restoration in a degraded salt marsh, the biological challenges of restoring a native plant and animal community combines with the physical and chemical challenges of altered water quality, flows and salinities. In addition to the scientific challenges, there are social and ethical complexities of appropriate economic development for growing coastal populations interacting with the traditional values and beliefs of Native Americans who have both a history of occupancy and treaty privileges for subsistence activities. All of this is very hard to hold in one's mind at once, until one feels the marsh mud sucking at your boots, smells the ocean and hears the nearby traffic

on a coastal highway, while a Tribal biologist and a Soil and Water Conservation District biologist lead you through the experience. The richness of the moment and its sensory elements combine to create a vivid memory that students can draw upon later as a resource for reflective analysis of the situation. A great deal has been written over the last decade or two about the importance of experiential and active learning in science education and more broadly in undergraduate curricula (Kolb 1984, 2001; Jacoby, 1996; Bean 1996, McNeal and D'Avanzo 1997; Doyle 2000) but too little has been made of the power of combining smell, taste, and touch with material appropriate to numerical analysis. We talk about the need for systems thinking in striving for solutions for complex environmental challenges, but an important underpinning of systems thinking is first engaging in systems smelling, systems walking, systems looking, and systems hearing. Only then can an intuitive sense of the complexity of the consequences in question become real for the systems analyst, whether professional or student.

A second and related impetus is that research by developmental psychologists indicates that in our society children raised in urban settings have significantly impoverished mental maps of the natural world that alter their cognitive processes. Comparisons by psychologist Peter Kahn of the cognitive responses of children raised in Houston, Prince William Sound, the Brazilian Amazon, and Portugal make it chillingly clear that as we degrade the natural world around us, we impoverish the internal mental lives of our children as well (Kahn 1999). In an increasingly urbanized world, educators must take an active role in helping students achieve a connection to nature that would have been considered commonplace two generations ago. Telling city bred students about a salt marsh is so distant from their experience of life that the words lack referents, and in

fact the mental processes that they use to relate to those words are impoverished compared to students who have had significant experiences with the natural world during their upbringing. Standing in a salt marsh will not immediately provide students with a comprehensive view of what the natural world is like, but it does provide them with stimuli that will insist on later mental integration. In this sense an experiential field activity strives to be remedial for many students, giving them a taste of something that an urban upbringing in a human-constructed environment has denied them. This is consistent with the mission of the University of Portland and the charism of the Congregation of Holy Cross, the founding order for our University, which is education of the heart as well as the mind. This is more relevant today to environmental field education for urbanized students than could have been imagined to be possible a century ago.

The third impetus is that we live in a world of shifting baselines (Pauly 1995) in which each generation is developing a idea of "a normal world" with less birds in the air, less fish in the rivers and oceans, less trees and even less insects scurrying around our feet. Each generation takes for normal what they see about them. Even people with experiences of the natural world gradually come to expect less and less abundance and wealth in nature as they examine an increasingly diminished version of our planet and the goodness that still remains. In our own Columbia River Basin, salmon runs numbering in the hundreds of thousands, often comprised of 90% industrially produced hatchery fish, are seen in the regional press as success stories pointing out that our efforts in salmon recovery policy are bearing significant fruit. Historical salmon runs in the Columbia, however, numbered in the millions with sufficient habitat existing for all of those fish to

naturally spawn. The marine nutrients brought inland by the bodies of the spawning adult salmon that subsequently die and decay far from the ocean, were the nutrient foundations of great forests far taller and more widespread than what the region contains today. The only way to prevent baselines from creeping ever downwards is to refresh our intellectual and experiential map of the world, to walk in remaining rich areas and see their biological wealth, to walk in environmentally degraded areas and imagine their potential, and to listen to recollections of what the region used to be like. Experiential and interdisciplinary education is a powerful tool in helping students reset their mental baselines so that they understand what remains and what could be restored.

The three impelling forces towards interdisciplinary experiential education already described converge at the point where nature is necessarily objectified in the scientific process, but the process of subsequently reclaiming an ethical perspective is too seldom achieved. The unique aspect of our collaboration lies in the theological-ethical component of our analysis of environmental issues and, consequently, a few comments are in order. First, we recognize the delicate and sometimes contentious and ambiguous relationship between environmental science and environmental policy. For scientists who work for and in Tribal, Federal and State agencies in particular, we understand the necessity of maintaining a distinction between the scientific analysis of what "is" and the policy objective of what "ought" to be done regarding environmental conservation and environmental restoration. Readers should understand, however, that government bureaucracy is not our institutional context; given the interdisciplinary nature of our collaboration, the *is-ought* dichotomy is less distinct. In fact our point of view is shaped in part by the recognition that scientific analysis often generates the valuation of nature.

According to Holmes Rolston III, a pre-eminent environmental ethicist, "The transition from *is* to *good* and thence to *ought* occurs here; we leave science to enter the domain of evaluation, from which an ethics follows" (1988). This can be likened to science providing an increasingly intricate and accurate map of the physical world, in which biological, chemical, and physical processes interact realistically in complex patterns that mirror natural events. Even an extremely accurate and realistic map can only tell one what the terrain *is*, it can't tell you which way one *ought* to go. Combined theological-scientific analysis is needed to provide a compass pointing to the *ought* that our policies and actions need to seek.

Interdisciplinary Education

The Boyer Commission accurately identified the difficulty of initiating interdisciplinary learning opportunities for faculty and students when it stated that "The principal barrier to interdisciplinary research and study has been the pattern of university organization that creates vested interests in traditionally defined departments" (*Reinventing Undergraduate Education*, 1998, 23). Our experience suggests that this is true for many, if not most, colleges and universities because interdisciplinary formats challenge the typical institutional structure of academic disciplines. Moreover internal "nitty-gritty" issues such as scheduling, academic credits, faculty-students loads and FTEs tend to militate against interdisciplinary experimentation. Nevertheless in spite of these real difficulties progress—albeit slow—has been made at UP. A good example is the Environmental Studies Program which was, from the beginning a collaborative effort within the College of Arts and Sciences. Our new re-organized Social Justice Program is also an interdisciplinary endeavor. As previously noted, the offering of Theological Perspective Courses has created even greater opportunities for interdisciplinary

learning. The emerging view of our institution as well as the present authors is that many national and world issues are simply too complex to be adequately viewed and analyzed through the lenses of a single discipline. Faculty and students benefit from dialogue and collaboration between disciplines, and these learning formats directly enhance learning outcomes such as critical and holistic thinking on contemporary issues.

In the area of science and theology any number of challenging and exciting possibilities for interdisciplinary exchange exists. In our course, Theology in Ecological Perspective, we begin by providing students with a baseline for understanding historical and contemporary ways science and religion have interacted. Ian Barbour's classic typology is helpful in is this regard, as is John Haught's version of the typical models of science-theology exchange (Barbour 1997; Haught 1995). According to Barbour's excellent typology, four types have defined the spectrum of interaction between the two disciplines: conflict, independence, dialogue, and integration (77-105). Haught on the other hand slightly alters the interaction into 4 Cs: conflict, contrast, contact and confirmation (9-26).

Conflict is the relationship of hostility between science and theology and the holders of this position—be it the scientific materialists or the biblical literalists—see a great chasm between the two disciplines with any rapprochement unimaginable. Haught's view of the conflictual level of interaction between science and religion is that level suffers from irreconcilable differences. Independence is characterized by the view that science and theology have their own unique fields of inquiry, as well as their separate methods and presuppositions, and by the sentiment that "each party must keep off the other's turf." According to Barbour, the separation of science and theology "into watertight compartments is motivated, not simply by the desire to avoid unnecessary conflicts, but also by the desire to be faithful to the distinctive

character of each area of life and thought" (84). Haught's notion of contrast is quite similar because "science and religion are responding to radically different questions" (9). This position, like conflict, forecloses the possibility of interdisciplinary collaboration.

At the other end of the spectrum is dialogue characterized by openness to conversation with the possibility of meaningful exchange that may be guided by such interests as disciplinary presuppositions, methodological similarities and convergent public policy issues. Within this position the public policy debate over environmental problems provides a framework for dialogue and potential collaboration that centers on such common concerns as values, ethics and policy formation and implementation. Haught's language of contact is akin to Barbour's notion of dialogue because the posture of contact seeks dialogue and interaction between science and religion and affirms that "consonance" is possible between the two disciplines.

Integration carries dialogue to the next level of exchange and is characterized by the actual effort to integrate the contents of science and theology. Barbour sees three versions of integration: natural theology, a theology of nature, and systematic synthesis where "science and religion contribute to the development of an inclusive metaphysics" an example of which is process theology (98). Haught prefers the notion of confirmation meaning "that religion is in a very deep way supportive of the entire scientific enterprise" (21). It is within the framework of dialogue/contact and integration/confirmation that interdisciplinary collaboration between science and theology can occur. Consequently it is out of this position of openness and mutual respect that the collaboration between theology and the natural sciences, as expressed in our THEP course, has emerged. In fact our teaching-research collaboration has resulted in a fifth permutation of Barbour's and Haught's typology, what we have named *strategic interdisciplinarity*. Strategic

interdisciplinarity may be defined as the collaborative attempt to address a complex problem utilizing scientific and theological-ethical analysis with the aim of proposing ethical solutions and policy guidelines. While this interdisciplinary approach has some basis in Barbour's category of dialogue and integration and Haught's notion of contact and confirmation, in so far as those positions are pre-conditions for interdisciplinary collaboration, strategic interdisciplinarity is also unique because its focus is contextual, not theoretical or abstract, and its outcome is practical—or praxiological—seeking to shape ethical praxis and public policy. The pedagogical result of our learning curve through the experience of strategic interdisciplinary has been the creation of an inquiry based research/learning process, what we call the Iterative-Praxiological Method (ITPM). This method, discussed is some detail below, seeks to integrate scientific and theological-ethical analysis of local, regional, even global environmental issues. As an inquiry based learning option in our THEP course, the ITM is combined with what we call an eco-plunge (also described below), a three-day immersion experience assessing Oregon mid-coast ecosystems. One important by-product of this learning/credit opportunity is its capacity to create a greater sense of community among faculty and students.

Creating Community

Cultivating "a sense of community" was identified as the tenth recommendation by the Boyer Commission. Recognizing the challenges large research universities face in promoting learning communities, the commission rightly observes that "A sense of community is an essential element in providing students a strong undergraduate education. . . "(34). Given its mission statement, UP considers itself "a community of scholars" and the Department of Theology—as do most theology and religious studies

programs—sees the creation of community as an important element of its own academic mission. Moreover smaller undergraduate institutions like UP do not face the same challenges as larger universities, yet the creation of collaborative learning experiences rarely occur on their own, particularly as essential components of programs or courses. For THEP courses this is an important issue due to the fact that for the course to "fly" (meaning to be have a typical faculty: student course ratio) it must have between 50-60 students. This is not the ideal pedagogical situation. Consequently, in Theology in Ecological Perspective, all students participate in a discussion-presentation group wherein they collaborate on a group project that involves research on a specific environmental topic (e.g. climate change and hurricanes, wind power in the Pacific Northwest, etc), utilizing and assessing library, journal, and website information, and presenting their findings to the class. While these are essential opportunities for collaborative learning and community building in a large class, they do not have the same lasting impact as our off-site field experience, where over the span of several days students have the opportunity to interact with one another, faculty, and key resource people in a unique situation on Oregon's coast. In fact the eco-plunge can be likened to a mini-capstone experience (also recommended by the Boyer Commission report) where the goals of experiential learning, interdisciplinarity, and community are combined to provide a culminating experience to the course.

With the insights from the Boyer Commission Report as moorage for our new teaching and learning excursion, the primary pedagogical issue that we face in teaching Theology in Ecological Perspective is not simply how to design inquiry based opportunities for students but how to integrate in true interdisciplinary fashion the methods, assumptions and languages of two

different disciplines like science and theology. What we have discovered through the experiment of teaching a THEP course is that experiential learning options are key pedagogical ingredients in promoting interdisciplinary integration in areas of research, teaching and student learning. Moreover they are important tools for fostering critical thinking and systems thinking, particularly in the area of ecological literacy because experience based learning immerses students in a physical reality where they will naturally engage at a deeper level with environmental issues. Finally and perhaps most important is that experiential learning options provide opportunities for service learning and ethical engagement. This is an essential consideration given the theological dimension of the course and the mission of UP that "Central to the daily life of the University is a concern with issues of justice and ethical behavior."

Course Design and Method: Theology in Ecological Perspective

The primary purpose of Theology in Ecological Perspective is to explore contemporary Christian theology, Catholic Social Teaching and how this body of reflection and discourse has been impacted by ecological issues and the environmental crisis. The course has five major goals, two of which are: 1) Investigating the science of ecology and the related field of environmental science with the aim of introducing the fundamental principles of ecology and the most pressing environmental problems of today, and 2) Examining the current attempts to reformulate the Christian theological tradition and Catholic Social Teaching (CST) from the perspective of ecology, which includes studying several Church documents written specifically in response to the environmental crisis. To the degree possible, the course seeks to develop a complex integration of scientific, theological and ethical responses to key ecological issues. Pedagogically the

actual interplay between the instructors (both instructors are present for all classes) is designed to invite students into a conversation and dialogue on ecological and environmental issues from the perspectives of two different disciplines—science and theology. On the science end students are required to engage the fundamental principles of ecology—biogeochemical cycles, trophic levels, ecosystems and their ecological services, etc.—and the most pressing environmental problems the planet faces. In other words students are required to deal with the basic biology, chemistry and physics of complex bio-physical interactions. On the theology end students are invited to evaluate and interpret the meaning of these ecological and environmental processes through the lenses of a faith-based world view. They are required to engage the moral and ethical ramifications of environmental problems—what was referred to in CST by Pope John Paul II as the "ecological question."

As noted above, one major outcome of our interdisciplinary collaboration in research and in teaching Theology in Ecological Perspective was developing the Iterative-Praxiological Method, an interdisciplinary process for analyzing ecological conditions, specific environmental problems, and their underlying social context with the aim of moving toward the ethical horizon of action and policy formation. The goal was to produce an integrative method while at the same time preserving the integrity of scientific and theological disciplines. In THEP 482 students who opted for the eco-plunge were required to use the ITPM in their analysis of the plunge experience.

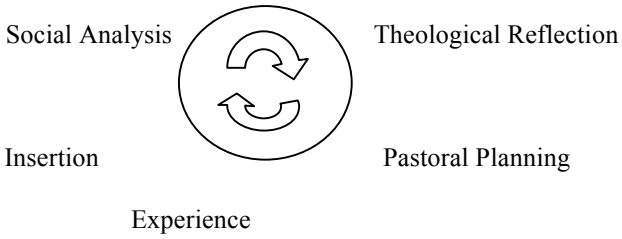
The basis for this method is an adaptation of a model for contextual theology called the praxis model that surfaced during the 1960s and 1970s in Christian theology associated with liberation movements—what came to be known as liberation theology.

This model of theological reflection arose out of a specific socio-cultural context and was oriented toward ethical engagement and social transformation. According to Stephen Bevans, the "central insight" of the praxis model "is that theology is done not simply by providing relevant expressions of Christian faith but also by commitment to Christian action" (Bevans 1992). Bevans claims that

> The praxis model is a way of doing theology that is formed by knowledge at its most intense level—the level of reflective action. It is also about discerning the meaning and contributing to the course of social change, and so takes its inspiration neither from classical texts nor classic behavior but from present realities and future possibilities (63-64).

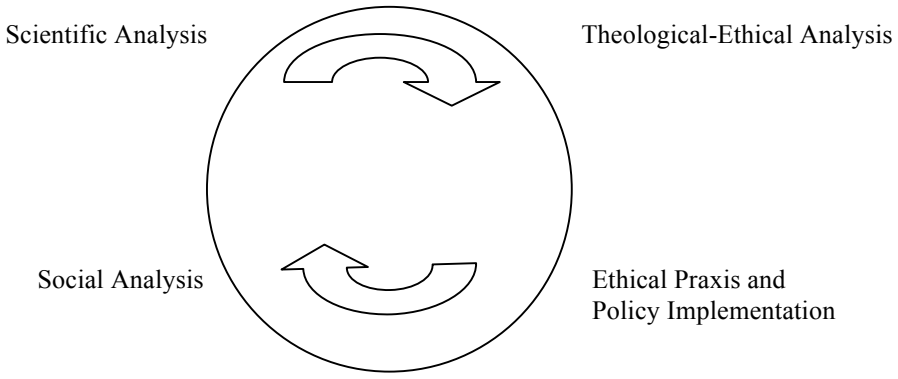
In their book, *Social Analysis, Linking Faith and Justice*, Joe Holland and Peter Henriot, S.J. proposed a compact description of the praxis model calling it the "pastoral circle" or the "circle of praxis," which they envisioned as a circular (iterative) process with four components (Henriot and Holland 1983, 7-9).

Figure 1. The Pastoral Circle.



Using this model as a prototype, the ITPM is also composed of four components or movements that unfold in an iterative dialectical manner. Sequentially the four movements are: social analysis, scientific analysis, theological-ethical analysis, all of which are oriented toward a culmination in ethical praxis and policy implementation.

Figure 2. The Iterative-Praxiological Method.



Once the focus for analysis has been determined, social analysis becomes the first movement of interrogation. According to Holland and Henriot, "Social analysis examines causes, probes consequences, delineates linkages, and identifies actors" related to the issues under investigation (8). Moreover, social analysis interrogates the historical, institutional and structural aspects of the problem, seeking to unmask the economic, political, cultural and social subtext of environmental conditions.

Scientific analysis, the second movement, employs the scientific method as an essential source of knowledge. This moment in the cycle also seeks to preserve the integrity of the scientific investigative process. Scientific analysis involves critical scrutiny of theories, models, and evaluation of real-world data that can be used to disprove testable hypotheses. The scientific approach of successive approximation bears a convergent relationship with the concept of iteration that is inherent to this method and requires a brief explanation. In science, successive approximation is used to define an approach to problem solving. In successive approximation a problem is articulated, and cycles of evaluation are conducted in which initial attempts at a solution are

progressively refined as data from each attempt is compared to the desired end result. The existence of an endpoint toward which research moves is a key characteristic of successive approximation. Within the analytical process, approaches that don't move towards the desired endpoint are discarded in favor of ones where empirical results more closely correspond to the goal. Successive approximation is therefore empirical, iterative, goal oriented, and heuristic.

Successive approximation is a component of scientific modeling, when seeking solutions to bring current conditions into line with desired criteria for habitat restoration, species preservation, or pollution remediation. An example of successive approximation in salmon recovery is modeling risk predictions over time for 1 local salmon population, 2 populations, etc., eventually narrowing to a solution that matches the assumptions for sufficient risk reduction (i.e. how many local populations are required to reliably prevent extinction)(Kolmes and Butkus, 2006, 346). In relation to THEP 482 and the eco-plunge, such modeling is the foundation of efforts to restore estuarine habitats, protect endangered salmonids, and improve the health of all the inhabitants of the Oregon coast.

The third movement is the application of theological-ethical reflection, which is the attempt to analyze the problem from the perspective of the Christian theological tradition. This is an explicitly hermeneutical task whereby the meaning and context of the problem are interpreted and scrutinized in light of lived faith, biblical theology, and CST. A key resource for this component of the process—particularly in the Pacific Northwest—is the pastoral letter written by the Catholic Bishops within the Columbia River Basin called the *Columbia River Watershed: Caring for Creation and the Common Good* (January, 2001). Within the Roman Catholic Tradition in Canada and the U.S. this

is a unique ecclesial statement because the project was defined by an ecological region—one of the largest watersheds in North America, not by political boundaries. Moreover with two scientists on the steering committee, the project sought to integrate a scientific perspective within the theological framework of Catholic social thought with the overall objective of establishing general ethical norms for social and ecological justice within the Columbia Basin. Consequently the *Columbia River Watershed* statement incorporates an ecological analysis of the health of the Columbia River as well as an ecological vision for its restoration. Combined with central aspects of CST (e.g. human dignity, common good, social justice, etc.), this creative document signals an interesting trend towards an interdisciplinary method in applying CST to specific and complex contemporary issues. Within the context of the eco-plunge, students utilize this pastoral statement in their theological assessment of the situation on Oregon's mid-coast ecosystems. The overall objective of the third movement is to create a theological framework for ethical action and may involve the articulation of specific norms intended to shape and guide the work of stewardship in a very specific ecological region.

The fourth movement of the ITPM is the overall goal—to promote committed ethical engagement and political action with the aim of creating and implementing policy within the personal, private and public sectors. It is here that the ethical horizon of sustainability might be achieved. According to the U.S. Catholic Bishops, "The overarching moral issue is to achieve during the twenty-first century a just and sustainable world (*Renewing the Earth*, 1991). The aim of the fourth movement is to emphasize that authentic Christian faith must become expressed in ethical action on the personal and social dimension of human existence defined by the specific social-

historical context within which one lives. With this in mind, Theology in Ecological Perspective invites all students to assess significant environmental issues from the iterative-praxiological approach and, in addition, students are offered the option of taking the eco-plunge and a hands-on opportunity of applying the iterative-praxiological method.

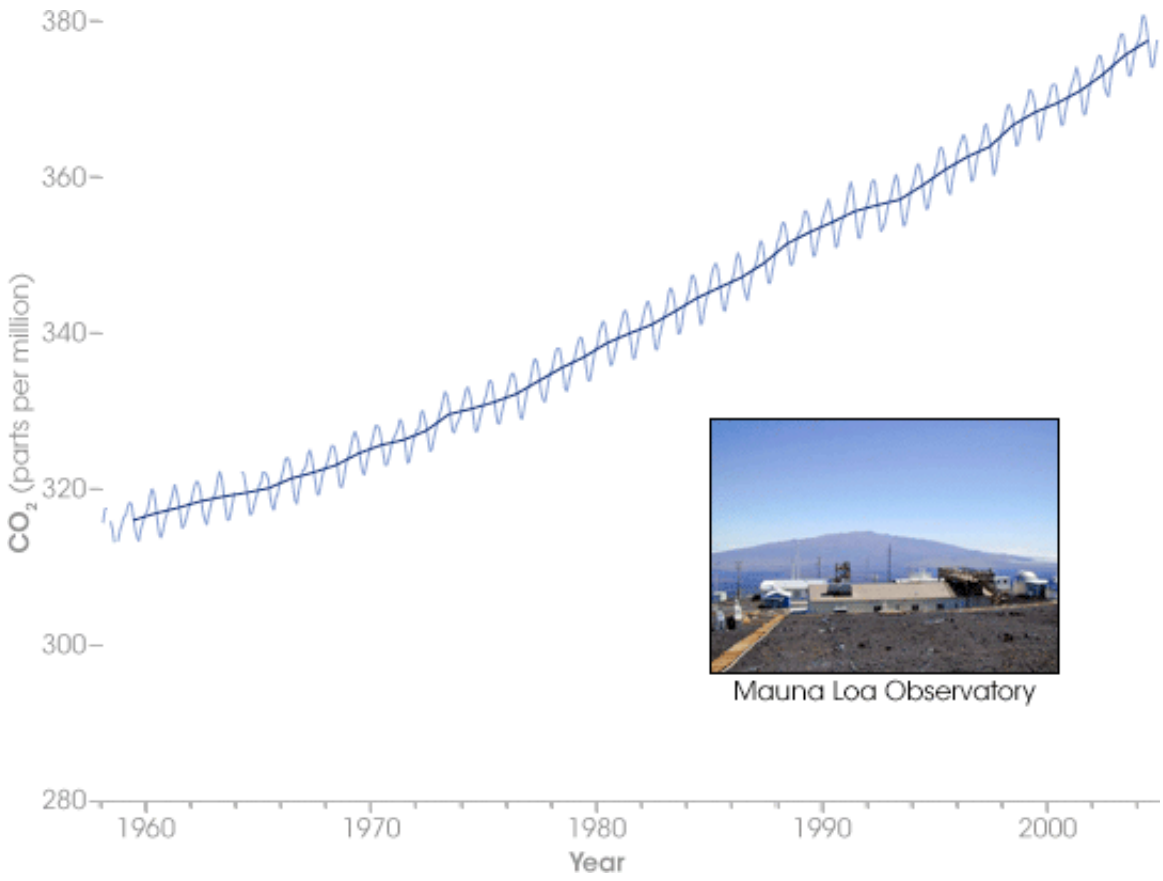
An excellent in-class example of this method is the treatment of global warming, climate change and the bio-physical and social implications of this inexorable process. The treatment of global warming begins with the acknowledgement that our society—and the entire global community for that matter—is based and dependent on a fossil fuel economic infrastructure. Consequently nearly everything we do directly or indirectly produces carbon dioxide and other greenhouse gases. The social, scientific and economic complexity of the issue is highlighted and presented to the students—in video and lecture formats. Scientific background information; the thorny social questions that typically emerge when discussing the science of global climate change and its policy implications are treated. Having provided students with an introductory level of information, a group of four or five students are provided with suggestions and resources to prepare a class presentation on the topic for the following week. The student group presents a multimedia presentation on one aspect of global climate change that inevitably answers some questions and raises others for the class.

At this point the instructors highlight the questions that have been raised, and refer to the consensus findings of the scientific community released in 2007 as *The Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (IPCC). In addition, because research on global climate change is rapidly developing, our pedagogy

always utilizes the most recent scientific articles and policy reports to build upon the IPCC's scientific foundation. The "Summary for Policy Makers" of *Climate Change 2007: The Physical Science Basis*, released in February 2007 expresses an increased level of confidence in the major findings of the *Third Assessment Report* and that "Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global mean sea level" (4). In addition, this new "Summary for Policy Makers" reports a "*very high confidence*" that global climate change since 1750 is due to human activities.

We make certain that students are familiar with changes in atmospheric carbon dioxide (CO_2) the principle gas driving global climate change and the major combustion product of fossil fuels. We describe how the ever (and still) accelerating rate of fossil fuel consumption over the last 150 years, combined with extensive burning of wood, has raised average atmospheric CO_2 levels from 280 parts per million (ppm) to roughly 385 ppm (as reported by the National Oceanic and Atmospheric Administration's Mauna Loa Observatory website). This increases global heat retention, since CO_2 allows solar radiation to reach the earth's surface from the sun, but blocks the natural escape of infrared radiation re-radiated from the earth's surface to space. More energy arriving and less energy escaping results in a steady buildup of energy on the planet, which we experience as climatic destabilization and overall warming (See Figure 1).

Figure 3. Recent atmospheric CO2 concentration change measured at Mauna Loa Observatory, "the Keeling curve", courtesy of NASA (http://earthobservatory.nasa.gov/Newsroom/NewImages/images.php3?img_id=16954).



If only the CO_2 (and to a lesser extent methane) we released was driving global climate change, the prospects would not be so frightening, but additional processes exist that make global climate change a self-accelerating de-stabilization of our planet. THEP students are familiarized with feedback loops connected to global climate change. The best understood of these is that as the planet warms, ice melts to expose dark surfaces beneath it on mountain ranges and in Antarctica, and the dark surfaces absorb more heat than the ice did, which causes further warming and melting of additional ice.

Additionally, as the oceans warm, more water evaporates from them into atmospheric water vapor, which is another greenhouse gas. This begins a self-perpetuating cycle of warmer air making more evaporation occur, making moister air, which increases the greenhouse effect. By understanding these (and other) feedback loops, we are able to bring THEP students to a level where the distinction between critical uncertainties and lack of understanding is comprehensible, and this distinction can be generalized by them for other conversations about science.

According to Working Group I (WGI) of the IPCC, "Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations……Discernable human influences now extend to other aspects of climate, including ocean warming, continental-average temperatures, temperature extremes and wind patterns." (*Climate Change 2007: The Scientific Basis, "Summary for Policymakers"* 2007, 10) The following Table lists the degrees of scientific certainty that the IPCC Fourth Assessment Report ascribes to various climate change related phenomena.

Table 1. Global Climate Change Impacts, Likelihood.

Table SPM.2. *Recent trends, assessment of human influence on the trend and projections for extreme weather events for which there is an observed late-20th century trend. {Tables 3.7, 3.8, 9.4; Sections 3.8, 5.5, 9.7, 11.2–11.9}*

Phenomenon[a] and direction of trend	Likelihood that trend occurred in late 20th century (typically post 1960)	Likelihood of a human contribution to observed trend[b]	Likelihood of future trends based on projections for 21st century using SRES scenarios
Warmer and fewer cold days and nights over most land areas	*Very likely*[c]	*Likely*[d]	*Virtually certain*[d]
Warmer and more frequent hot days and nights over most land areas	*Very likely*[e]	*Likely (nights)*[d]	*Virtually certain*[d]
Warm spells/heat waves. Frequency increases over most land areas	*Likely*	*More likely than not*[f]	*Very likely*
Heavy precipitation events. Frequency (or proportion of total rainfall from heavy falls) increases over most areas	*Likely*	*More likely than not*[f]	*Very likely*
Area affected by droughts increases	*Likely* in many regions since 1970s	*More likely than not*	*Likely*
Intense tropical cyclone activity increases	*Likely* in some regions since 1970	*More likely than not*[f]	*Likely*
Increased incidence of extreme high sea level (excludes tsunamis)[g]	*Likely*	*More likely than not*[f,h]	*Likely*[i]

Table notes:

[a] See Table 3.7 for further details regarding definitions.

[b] See Table TS.4, Box TS.5 and Table 9.4.

[c] Decreased frequency of cold days and nights (coldest 10%).

[d] Warming of the most extreme days and nights each year.

[e] Increased frequency of hot days and nights (hottest 10%).

[f] Magnitude of anthropogenic contributions not assessed. Attribution for these phenomena based on expert judgement rather than formal attribution studies.

[g] Extreme high sea level depends on average sea level and on regional weather systems. It is defined here as the highest 1% of hourly values of observed sea level at a station for a given reference period.

[h] Changes in observed extreme high sea level closely follow the changes in average sea level. {5.5} It is *very likely* that anthropogenic activity contributed to a rise in average sea level. {9.5}

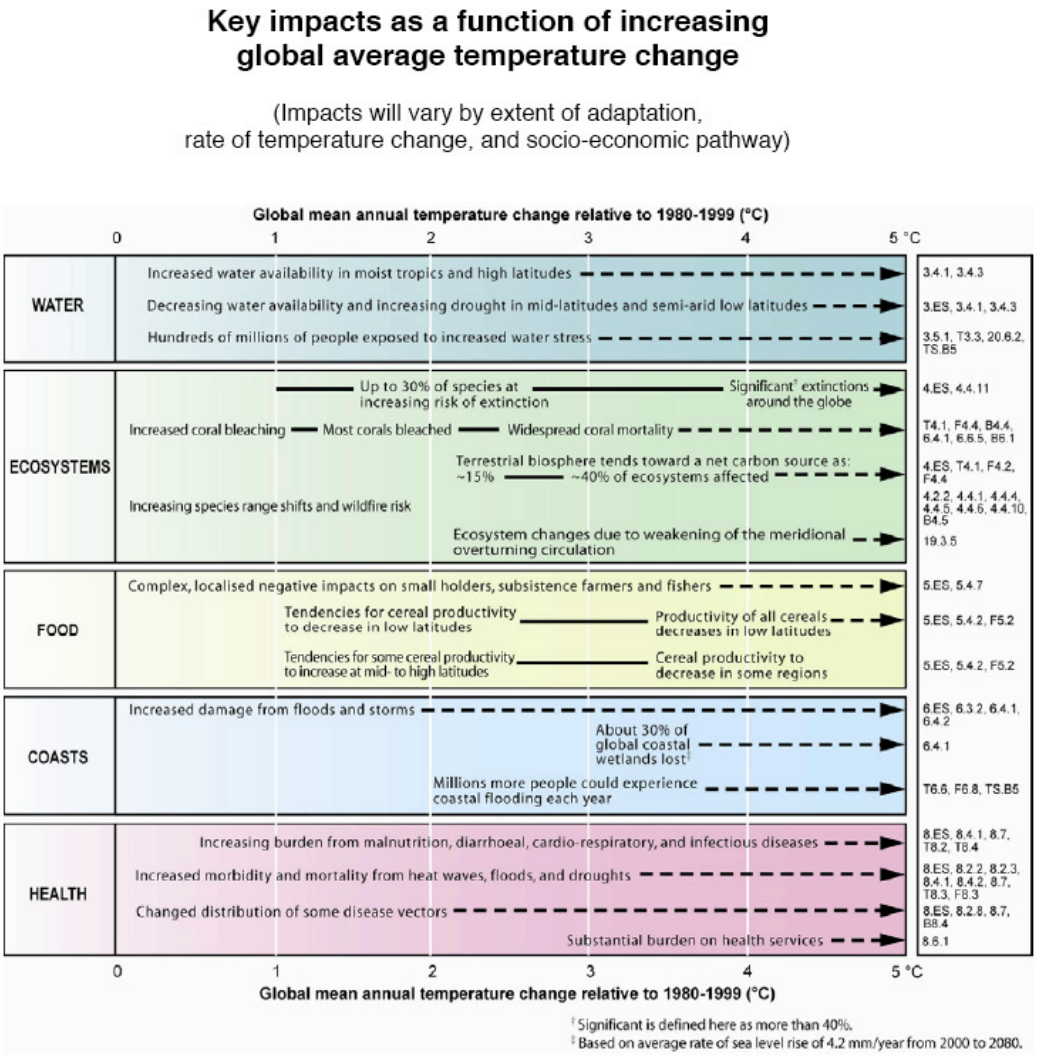
[i] In all scenarios, the projected global average sea level at 2100 is higher than in the reference period. {10.6} The effect of changes in regional weather systems on sea level extremes has not been assessed.

On the issues of impacts and vulnerability, the IPCC is clear that the negative impacts will affect the most vulnerable populations (human and non-human) on the planet. In its *Summary for Policymakers*, Working Group II (WGII) states that those with the least resources have the least capacity to adapt and are the most vulnerable. Specific trends highlighted include significant reductions in drinking water supplies due to decreased river runoff and glacial melt; decreases in global food production above a 3 degree temperature increase with immediate decreases in food production at lower

latitudes; increased coastal flooding worldwide; negative health effects in developing countries; and decreased productivity of global fisheries (*Climate Change 2007: Impacts, Adaptation, and Vulnerability*, *"Summary for Policymakers"* 2007, 5-7).

The following table is a list of key impacts discussed with THEP students.

Table 2. Global Climate Change Impacts



Regarding this assessment of vulnerability and adaptive capacity among developing nations, four points are raised for THEP students 1) Increases in average global

temperature will produce net economic losses in many developing societies and the greater the degrees of increase the greater the potential for economic damage. 2) The expected economic impacts of climate change will exacerbate the existing disparity between developed and developing nations, and global mean temperature at the higher end of the projected spectrum will greatly increase economic disparity. 3) Due to weaker resources for adaptive capacity, developing countries will suffer more adverse impacts than developed nations and within developing nations more people are expected to be harmed rather than benefited from climate change. 4) Finally it is projected that developing countries will suffer the greatest in terms of loss of human life.

The movement from scientific to theological-ethical analysis occurs at this point in our treatment of global climate change. While we, given the nature and mission of UP, deal specifically with the Roman Catholic response to the environmental crisis and global climate change in particular, there is nonetheless a rich body of theological reflection and analysis from within a spectrum of religious and denominational statements and resolutions on climate change. It is interesting to note that formal Christian statements and testimonies made before the Senate Environment and Public Works Committee in June 2007 were virtually unequivocal in their support and ratification of the IPCC's *Fourth Assessment Report*, in their assessment that it is primarily a matter of social-global justice, and in their call for an adequate U.S. policy response to the crisis. Representative of these statements is the one issued by the National Council of Churches which states

As watchdogs for justice, we have a duty to protect vulnerable communities

> around the world. We already know that global warming will have devastating implications for God's planet, but it will also severely impact God's people. As Christians we are called to protect the vulnerable and minister to those in need (Matthew 25:40-45). Christian tradition proclaims an unmistakable priority for those living in poverty, and calls for justice for the oppressed and marginalized. (Leviticus 26:34-35). Especially when we as a nation are contributing more than our fair share to the global warming problem, it is our responsibility to respond faithfully to the demands of God's justice (National Council of Churches of Christ in the USA, 2007, 2).

We begin our theological analysis by introducing the letter of the U.S. Catholic Bishops titled *Global Climate Change, A Plea for Dialogue, Prudence, and the Common Good* (2001). We emphasize the fact that this pastoral letter takes the IPCC *Third Assessment Report* as its starting point for considering the issues involved, and makes a plea for prudence that is explicitly related to the difficult topic of critical uncertainty in scientific modeling. Within the scope and range of U.S. Catholic statements this is a unique church document. To our knowledge it is the first of its kind, wherein a pastoral letter by the U.S. Bishops devotes significant space to science and specifically to the "Science of Global Climate Change" (see19-24). The nuanced and well informed discussion in this pastoral letter models what can happen when scientific analysis is used to inform theological-ethical reflection. In a more recent statement (February 2007) in response to the Fourth Assessment Report, the U.S. Bishops reiterate their moral position on global climate change but also argue that the "new report demands urgent action." Bishop Thomas G. Wenski, chairman of the U.S. bishops international policy committee,

stated in a letter to congressional leaders that the *Fourth Assessment Report* "has outlined more clearly and compellingly then ever before the case for serious and urgent action to address the potential consequences of climate change as well as highlighting the dangers and costs of inaction" (http://www.usccb.org/comm/archives/2007/07-029.shtml).

In addition to the documents' importance in highlighting the science of climate change, the bishops' pastoral letter is also used as a springboard for discussing how Catholic Social Teaching has expanded and evolved in response to the ecological crisis. After establishing the key principles of CST, such as human dignity, rights, social justice, etc. we spend some time showing students how the key concept of the common good has evolved from its use in *Rerum Novarum* (1891), wherein it was applied anthropocentrically to the well being of a nation-state to the more recent document, *Renewing the Earth: An Invitation to Reflection and Action on Environment in Light of Catholic Social Teaching* (1991) where it is referred to as the "Planetary Common Good." Speaking of the "Universal Common Good," the U.S. Bishops in *Global Climate Change*, state that "Global climate is by its very nature a part of the planetary commons. The earth's atmosphere encompasses all people, creatures, and habitats" (7). The point is to emphasize how a key theological-ethical principle such as the common good has been re-defined and expanded to encompass an ecological perspective. The overall objective of the scientific and theological analysis of global climate change is to propose to students the questions: "Do we know enough to act?", "What kind of prudent ethical and policy action is required in response to what we know about global warming?", "What specific personal and social measures can be implemented to reduce greenhouse gas emissions?"

This analytical process is a concrete expression of the interdisciplinary method that this article has defined as strategic interdisciplinarity.

Taking the Plunge: A Pedagogical Strategy for Interdisciplinary Teaching and Learning

The Eco-Plunge

Succinctly stated, the eco-plunge is a three day inquiry based field experience that provides students with the opportunity to investigate the complex and interrelated social, economic, environmental-ecological, and ethical issues that have surfaced in many of Oregon's coastal communities (See Appendix A). In the context of course requirements the plunge is offered as one of three final credit options. Because many students can not afford time away from school, home or job, more traditional credit options—such as a final exam, are also available. Nonetheless, in spite of the obvious constraints of leaving campus for several days, the eco-plunge option typically attracts 25-30 students or approximately half the class. Students who choose the plunge are also charged a modest "lab fee" to offset the cost. The remainder of the cost is subsidized by available departmental and program funds.

The design and objective of the plunge is framed by three important factors. The first is ecological. The Oregon coast is an ideal candidate because it is a local micro-cosmic example of many environmental and ecological trends occurring nationally and globally. Geographically the Oregon coast provides students with first hand experience of the interrelatedness of several ecological zones, which in this case are the coastal/ocean zone, the estuarine zone, and the upland zone that encompasses land between estuaries and the coastal mountain range.

An important element of the plunge is to allow students to traverse the variegated terrain of these zones and encounter the bio-physical relationships between them. As noted earlier the direct sensory encounter with Oregon's mid-coast ecosystems—whether it is beach, estuary, river or upland forest—is a key ingredient of the plunge that holds the capacity to impact consciousness, which for many students has been overly "urbanized." For those students who approach the plunge from a faith-based perspective, the plunge can become a spiritual encounter and a re-awakening to the theological identification of the natural world as creation. Additionally the plunge challenges students to "ground-truth" key ecological concepts and issues that have emerged during the course or, in other words, the plunge, is an example of experiential learning, and about students traversing the physical terrain that corresponds to the intellectual terrain of Theology in Ecological Perspective. In our effort to drive home this point, student "plungers" are required to read several sections of the Pew Oceans Commission Report, *America's Living Oceans*, to discover how Oregon's coast exemplifies the specific ecological issues addressed in the report on U.S. coastal waters.

The second important factor in designing the plunge is to allow students to become immersed in the social and economic issues that are prevalent on Oregon's coast that adversely impact surrounding ecosystems. Typical of many coastal communities is an interesting and often conflictual mix of natural resource extraction economic activities (e.g. logging, fishing, etc.), tourism, and increased population density that continually stresses community infrastructure. Consequently the plunge itinerary is developed in such a way to provide students with access to key people and groups trying to grapple with and solve their environmental issues. This cadre of contact people usually includes

representatives from Federal agencies (e.g. EPA, USFWS), state and/or local government, watershed councils, NGOs and Tribal representatives (See Appendix A). This component of the plunge provides vital input for social analysis and a "snapshot" view of the primary social and economic issues that impact ecosystemic degradation and restoration.

The third important element in plunge design is theological and ethical. Students are expected to "apply" key aspects of Catholic Social Teaching to their learning experience on Oregon's coast. Many types of CST (e.g. papal encyclicals, pastoral letters, etc.) are very general and often overly abstract. One exception described earlier is *The Columbia River Watershed: Caring for Creation and the Common Good*. Unlike most pastoral letters, *The Columbia River Watershed* applies CST to a specific ecological region—the Columbia River Basin and the very specific environmental, social and economic issues that impact watershed ecology. Consequently, as noted above, this document is a primary theological resource for students who are expected to critically assess their plunge experience—the people and issues encountered—through the lenses of key aspects of CST (e.g. stewardship of creation, common good, subsidiarity, etc.) Moreover students are expected to propose several specific ethical norms that follow from their theological reflection that directly relate to their social and ecological analysis of Oregon's mid-coastal region. The intended outcome is to give students the experience of theological method and content that arises out of discovery learning.

The plunge concludes with a working dinner at one of the instructor's home. It is the community building "capstone" to the plunge. In addition to the camaraderie it provides, students appreciate the opportunity to visit an instructor's home, not to mention

the great food—an experience not lost on hungry undergraduates. On the academic side the evening is intended to be a focused reflection process wherein faculty assists students in making connections between the field experience and the ecological-theological components of the plunge. The specific framework for the reflection process—that is, the heuristic model, is the ITPM. We walk students through the four-fold method helping them make linkages between the general categories of social analysis, scientific analysis, theological-ethical analysis and policy recommendations with the specific people, organizations and issues they encountered in three intense days on Oregon's mid-coast. There is a very practical side to this process—assisting students in clarifying their plunge experience and helping them understand the expectations and requirements of producing a major term paper, which we hope captures the significance of inquiry based learning in an interdisciplinary fashion. Based on faculty and student assessment of the eco-plunge, it is our judgment that this is a very valuable and atypical learning experience in our student's undergraduate education and a significant option to offer students in Theology in Ecological Perspective.

Analysis

In his text, *Engaging Ideas* (1996) John Bean makes the case that undergraduate pedagogy "should create cognitive dissonance for students" (27). Bean bases his assessment on the structural developmental theories of Jean Piaget, shared by others such as Lawrence Kolhberg and James Fowler, who argue that cognitive dissonance is an essential ingredient in promoting cognitive, moral and faith development. Bean suggests that one way of creating dissonance is to provide students with "decentering" tasks that will challenge them to see things from an unfamiliar viewpoint. In part the plunge is

designed with this in mind. For example students are shocked to hear that many coastal communities discharge untreated effluent and sewage—often legally—directly into the ocean where a "mixing zone" occurs. They are disturbed to hear that some who take recreational advantage of the coastal zone, such as members of the Surf Riders Foundation—an NGO that voluntarily monitors coastal water quality—suffer fairly common maladies like eye, ear and urinary tract infections. Students are disturbed to see that over time pristine estuarine, riparian and forest habitat has been lost to numerous forms of human activity. While these direct contrast experiences are essential to challenge student assumptions and raise critical awareness of coastal ecological degradation, we do not believe that it is sufficient. It is also necessary to provide students with direct experience with people and projects that are positively responding to the coastal scenario. Consequently it is equally important for eco-plungers to walk the Ten Mile Creek restoration project in the midst of quality riparian and ancient forest habitat and hear from committed people who collaborated to restore a salmon bearing stream.

It is also important for students to participate in restoring Beaver Creek, a service learning part of the plunge, where students work alongside residents of Lincoln County to improve and stabilize the riparian area of a small Coho salmon stream by planting native trees and vegetation. It is our view that the experiential dialectic between cognitive dissonance and cognitive resonance on the plunge creates in students the potential for a critical and ethical praxis to arise.

The design and process of the eco-plunge and the ITPM is also consistent with and strikingly similar to what has come to be called Experiential Learning Theory (ELT). David Kolb, a major contributor to ELT, defines experiential learning as "the process of

learning whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping and transforming experience" (1984, 41). Building on the insights of John Dewey, Jean Piaget, Kurt Lewin and, to some degree, Paulo Freire, Kolb conceptualizes ELT as a four part circular process that moves from concrete experience to reflective observation to abstract conceptualization and finally to active experimentation (42). Kolb notes that in this iterative "four stage leaning cycle"

> immediate and *concrete experiences* are the basis for observations and *reflections*. These reflections are assimilated and distilled into *abstract concepts* from which new implications for action are drawn. These implications can be *actively tested* and serve as a guide in creating new experiences (Kolb et al. 2001, 228).

The dialectic between action/experience and reflection is, of course, the essence of praxis. In our iterative model reflection is intentionally guided by three underlying interests—social, scientific and theological analysis—through which we hope that reflection will be critically discerning of the underlying social (economic and political), scientific and ethical issues in students' experience of the eco-plunge. In our design of the plunge we explicitly chose experiences that will assist students in "ground truthing" abstract concepts that have been previously proposed to them in course lectures, readings, etc. And while we would certainly agree with Kolb and others, such as Barbara Jacoby's analysis of service learning, that an essential goal of experiential learning is the reconstruction and internalization of knowledge, our overall horizon in designing and using the ITPM is to highlight the ethical implications that ought to be tested in ethical

engagement and public policy formation. It is our objective that a significant byproduct of the plunge and the ensuing process will be the integration of ecology and theology resulting in an enhanced learning experience.

Based on student feedback and faculty analysis, we have concluded that the eco-plunge does enhance our students' learning and is a significant learning option for students in THEP 482. Nevertheless as part of our on-going process of assessment we have identified three aspects of the plunge that need adjustment. First the plunge is an intensive experience. Through their interaction with people and places, students are confronted with a great deal of knowledge that can be overwhelming, and while they have been urged to take notes we have found this to be inadequate in assisting them to organize and retain information. We are therefore, considering the use of data sheets, a format that is used in science lab experience such as marine biology. Our data sheets, however, would not solely be used for a field experience like walking in an estuarine restoration project, but would be designed to compile information about social, ethical, and economic concerns and serve as a pedagogical device for maintaining and organizing input from various places and persons. Students would be required to complete the data sheets at each plunge venue. We think this will assist in retention and function as a valuable resource for writing the plunge paper.

A second and related issue is the time spent in reflection. In the current plunge design reflection occurs naturally during the course of the process but the bulk of reflection occurs at the end of the plunge during the dinner-reflection event. While this is an important concluding and community building experience, more time for organized reflection is needed during the plunge itself. Consequently we are planning to insert a

formal reflection session into each day of the plunge perhaps combing this with journaling. This would allow students to stand back and consider their plunge experience and facilitate the assimilation of plunge knowledge. This record of reflection would also be an important resource for their papers.

The third issue is theological. While the theological reflection in the final papers is solid—in the utilization of the Columbia River Pastoral Letter—it needs to be better integrated into the plunge. To address this issue we are considering a major change in were we stay. In past plunges we have stayed at Oregon State University's Hatfield Marine Science Center in Newport, OR—an excellent facility for our purpose. But as a result of conversations with the new director of the Jesuit Retreat Center on the Nestucca River, and his interest in assisting us in the theological process, we are seriously looking into the feasibility of using the retreat center as our "home base." In addition to providing an improved space for reflection, it would also enhance the theological reflective process and allow students to become acquainted with Jesuit spirituality and the commitment to sustainability that the Society of Jesus has made in the Oregon Province.

Conclusion

Our conclusion is that the plunge experience provides a meaningful synthesis of the interdisciplinary strands comprised of inquiry-based learning common to the sciences and the utilization of a praxis methodology in contemporary theological reflection. Moreover, the three Boyer Commission recommendations of making research-based learning the standard, removing barriers to interdisciplinary education, and cultivating a sense of community all come together around the lasagna and salad bowl the final evening of the plunge. It is our belief that the design of the plunge is consistent with the

warnings inherent in Peter Kahn's description of the altered cognitive maps of youth deprived of intensive contact with the natural world, and with the charism of the Congregation of Holy Cross that founded our University. Hearts and minds can be touched by the smell of a salt marsh, the tug of estuarine mud on your boots, the winds off the Pacific, and the bread and pasta broken together that we call our plunge. The plunge provides in a small but meaningful way "the reconstruction of experience" that John Dewey called for nearly a century ago, and we believe that it does so in a way that makes theology particularly relevant to the deep concerns facing the current generation of students.

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