Session 3151

Environmental Security and Its Engineering Component

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Abstract

This paper provides background related to a study of the concept of Environmental Security (ES) and makes recommendations for a possible curriculum which includes an environmental thread. The original study focused on curriculum development at the United States Military Academy. However, since environmental security encompasses both broad definitions and broad avenues for national decision making, it is the view of the authors that the model should be given to a wider audience. While a notional curriculum for the Military Academy is provided, modifications according to the mission and intentions of academic institutions would render the model useful in a non-military environment. A final point to be emphasized is that there is a need for an engineering component to such a curriculum as well as an engineering proponency.

I. Introduction

The domain of 'environmental security' is complicated, loosely defined, and often misunderstood. Yet, the topic has implications critical to our national security and to international stability. Competing nations and organizations, population growth, varied cultural backgrounds (and, thus, perspectives) and the technological gap between developed and underdeveloped nations have all exacerbated the instability of world politics. As environmental stability degrades, the risk of international conflict increases. Certainly, from a military viewpoint, there is great need to understand environmental security (ES). The authors believe that it is important that all sectors involved with international events must understand that environmental security is an 'interdisciplinary' requirement.

II. The Military Model: West Point

A 1998 study was undertaken to investigate whether a curriculum could be developed at the different service academies capable of producing graduates who could 'operate' comfortably in the ES arena. The pilot study focused on the United States Military Academy at West Point. Two critical concepts needed to be melded together in order to have a starting point for curriculum development. They were:

- The definition of Environmental Security
- The academic program goal for graduates of the United States Military Academy

Following an exhaustive literature review, the authors settled on the definition of environmental security proposed by Newberry and Grubbs[1] given below:

> ***Environmental Security: The response to perceived internal or transboundary threats to either the quality-of-life of the inhabitants of a state or to a reduction in quality-of-life policy options available to either private or governmental entities within the state.***

The 'flagship' academic goal of the United States Military Academy is[2]:

> ***That all graduates anticipate and respond effectively to the uncertainties of a changing technological, social, political, and economic world.***

Using the definition of ES and the academic program goal above as a backdrop, the authors studied the existing curriculum in terms of an assessment of what the graduates should 'look like' relative to an environmental security education. It should be pointed out that the United States Military Academy has some very stringent requirements for its unique mission of producing Army officers. Whereas some of the requirements constrained options for curriculum development, those same requirements forced the authors into 'boxes' that proved beneficial to the effort. For example, each cadet, regardless of major, must take an engineering component as part of his or her total academic program. Having a required engineering academic component resulted in the discovery that there was a major benefit in having graduates capable of considering engineering issues (problem identification, alternatives, solutions) to environmental security problems.

III. The Assessment-Based Product:

In may have been serendipitous, but the final notional academic program in environmental security was born out of an assessment model which has been in development at the Military Academy since the early 1990's[2]. A succinct, yet important, overview of the model reveals six principles addressing matters related to effectiveness, efficiency and measurement. Those principles are:

<u>Effectiveness</u>

- Goals-Based Assessment
- Responsiveness to Decision Makers

Efficiency

- Maximize Use of Existing Indicators
- Minimize Disruptions

Measurable

- Multiple Indicators
- Multiple Points in Time

Linked to the six principles were four processes designed to maximize the potential for integrating curriculum, instruction, and cadet (student) achievement. In sequence, they are:

(1). Learning Model Assessment. As the first step in curriculum design, articulation of a learning model for each program goal is paramount to success. The model describes the cadet learning process with respect to desired outcomes for each program goal. A learning model for environmental security was developed as part of the original study. It is given in the next section.

(2). Program Design Assessment. The program design assessment incorporates a process of peer review. The basic question to be answered is, "Does this group of courses satisfy a specific program goal?" Course content and interdisciplinary linkages are the basic criteria used to determine if the courses properly fit together in support of the program goal.

(3). Program Implementation Assessment. This process includes review of course syllabi, instructional materials, pedagogical practices, and student assessment methods. A vital component of the program implementation assessment is analyses of course products, real-time class assessment (classroom visitations) and end-of-course critiques.

(4). Goal Achievement Assessment. This process is the classic 'outcomes assessment.' Gathering of accurate data is the key to the process. Surveys (of both students and graduates), testing (e.g., the Fundamentals of Engineering examination), performance outcomes, and course products are analyzed.

IV. The Learning Model for Environmental Security.

As part of the study, the authors proposed the following learning model for environmental security. It is emphasized that the entire program goes well beyond engineering. The science and engineering related courses are given in bold print.

Learning Model for Environmental Security

Graduates use concepts in environmental security to
be able to make fundamentally sound decision in matters
affecting quality of life options to our society.

Amplification and Rationale

Concerns over degradation of the Earth's natural resources and of global pollution have grown exponentially since the 1960's. The first rallying cries from the 'fringes' of society preceded major scientific studies that did, indeed, indicate that Humankind was placing extreme stress on our planet. Increasing populations, unwise national policy decisions concerning the environment and greed have all played a part in the rise of environmental issues to the point that they now affect national strategy decisions. Transboundary conflict over air and water pollution, solid and hazardous waste (both military and non-military), deforestation and desertification have already begun to tear at the fabric of international cohesiveness. Because of its overarching significance, the concept of environmental security can no longer be considered in the context of 'other minor concerns.' Environmental security, just as computer science did over the last thirty years, has grown to a point that it is now, and always will be, a major player on the stage of international politics.

In its mission to serve 'The Common Defense' of our country, the United States Army must have strong leadership and a vision of the future in terms of environmental security. Whether in training or when deployed on an operational mission, our Army must respond to the needs of the populations being served; it must mitigate, not exacerbate, the effects of military occupation of key terrain. In order to accomplish its environmental stewardship mission, the Army must have leaders who have a firm grasp on national policymaking in terms of the environment, a sound understanding of the technology needed to assist in environmental sustainability, and an ability to apply tactical doctrine in a matter consistent with preserving the environment.

What Graduates Can Do

Graduates who have completed the program in environmental security can draw upon their fundamental knowledge of environmental policy, new and emerging technology, and environmentally sound warfighting doctrine to insure that the actions of the United States Army, in peacetime training or during operational deployments, are consistent with sustaining the environment. Depending upon their eventual career track, they will be able to expand their knowledge and influence in a matter consistent with serving both our Country and its natural resources. Those who go the technology route will still be able to understand the environmental policy implications of bringing forth new technology into the Army arsenal. For those who continue in command and operational staff positions, they will be able to understand where technology fits into the overall picture of national policy decisions in light of environmental concerns. In all cases, graduates will be able to insure that doctrine will not be made in an environmental technology vacuum.

The Learning Model

Structure of Cadet Experiences

Cadets will be able to make use of much of the core program to acquire needed knowledge in both the humanities and social sciences and in mathematics and the basic sciences. **They will then be able to draw upon the strength of the environmental engineering sequence** and courses in which the environmental component is the central focus of learning (law, ethics, geography, and international relations) to achieve a desired level of competence across the domains related to national security and technology. Finally, cadets will be afforded courses from a rich menu of electives allowing them to add some more breadth as well as specific depth in an area of special interest.

Process of Cadet Experiences

In order to gain knowledge across two major realms of academic endeavor (technology and humanities), cadets first develop an awareness of environmental issues via the core curriculum. **The technology component is built upon the core courses in mathematics, chemistry, and physics. They learn key elements of mathematical formulation, the fundamental laws of nature, and the basic elements of which all matter is made. Complementing the instruction is a strong foundation in laboratory techniques in chemistry and physics.** In the humanities the cadets are exposed to topics in ethics, international relations, environmental stewardship in a military context, understanding of human nature, and oral and written communication.

Once in the Environmental Security (ES) program, cadets encounter more complex levels of study. **They take the environmental engineering sequence** while simultaneously studying the implications of environmental sensitive decisions in courses related to ethics, law, cultural and political geography, and international relations. Cadet participation increases in terms of the sophistication of requirements. The environmental education process includes **engineering design projects**, group projects, major research papers, and individual presentations. **Complementing the experience are field trips to environmental facilities (water treatment, wastewater treatment, landfill, etc.) and, in many cases, participation in the Individual Advanced Development (AIAD) program in which a cadet spends three to four weeks working for a research or analysis agency in the federal government or military affiliated civilian entity.** For those cadets who desire, they may be able to complete a major research project under the auspices of an individual study course (XX489).

Content of Cadet Experiences

The key to the Environmental Security program is that it is interdisciplinary in nature. Multiple departments will play a significant role in each cadet's environmental education. While some of the coursework must make use of foundational prerequisites, **the environmental engineering sequence being the most notable**, much of the program

allows the cadet some flexibility in choosing course sequencing. Under the supervision of an academic counselor from the faculty, the cadet can tailor his or her academic program in a manner best supporting the learning process. In doing so, cadets will be predisposed towards having a 'hunger for knowledge' in environmental security. In pursuing their studies in an interdisciplinary program, they will learn more of the 'art and science' of working with members of other academic, military, and political communities. As concepts become more complex, cadets will be able to rely on their previous coursework and their developing desire for further study in order to master, at the undergraduate level, the basic framework allowing them, in an environmentally sensitive Army, to:

> **". . .anticipate and respond effectively to the uncertainties of a changing technological, social, political, and economic world."**
>
> ■ **General Education Goal, USMA**

V. A Notional Program for Environmental Security.

The program described below fits the requirements of the academic program for a cadet at the United States Military Academy. Because dialogue has been limited among civilian institutions, the notional program is presented unchanged. It is hoped that interest will be sparked among civilian universities, and among diverse disciplines, to the point that dialogue will be fruitful towards a 'civilian' model of the program. The initial research has been forwarded to the Dean's Office of the University College at Tulane University. Results of a study of the program's applicability (and, therefore, possibilities) at Tulane will be reported in the future.

Environmental Security Interdisciplinary Program

An interdisciplinary field of study in environmental security is available for cadets who desire to gain fundamental insights into the complex nature of environmental security issues. The environmental security field of study addresses three critical areas: national strategy decision making (policy); **technology needs for environmentally sustainable operations; and Army environmental stewardship**. The Department of Geography and Environmental Engineering is the proponent for the environmental security field of study.

FIELD TABLES: Environmental Security Interdisciplinary

- Complete the 26-course core curriculum.

- Complete the Environmental engineering core engineering sequence listed below:

Course	Course Title
EM302	**Statics and Dynamics**
EM362A	**Fluid Mechanics**
EV385B	**Introduction to Environmental Engineering**
EV401	**Environmental Systems Analysis**
EV402	**Environmental Systems Design**

- **Complete the five courses listed below.**

Course	Course Title
EP384	Environmental Ethics
EV365	Cultural and Political Geography
LW473	Environmental Law
SSxxx	Environmental Economics
SS357	Advanced International Relations

- **Complete four courses, selecting at least one course from each of the following groups.**

Science/Engineering

Course	Course Title
CH385	Biology
CH457	Microbiology
CH474	Instrumental Analysis
EV390A	Environmental Science
EV391A	Land Use Planning and Management
EV398	Geographic Information Systems
SE401	Introduction to Systems Design
SE421	Engineering Management Applications and Practices

Geography

EV371A	Geography of Russia
EV372A	Geography of Asia
EV373A	Geography of Latin America
EV374A	Geography of Middle East and Africa
EV384	Geography of North America
EV386	Geography of Europe

Environmental/National Security

SS387	Applied Economics and Public Policy
SS478	Olin Distinguished Professor Seminar on National Security
SS483	National Security Seminar
SS485	Politics of Developing Nations
SS486	International Security Studies

VI. Summary: The Engineering Component.

To most, the notional program for an environmental security curriculum might seem to belong to the social scientists. Such is not necessarily the case. Why should a social scientist impact the international realm of environmental security any more than the engineer should? The relief from the pressures of environmental degradation – which will certainly become the source of incalculable conflict in the future – is becoming more and more attainable only through the practice of engineering. The engineering courses, and the supporting mathematics and physical sciences, are as important to international stability as are any sequence of courses from other disciplines. Just as learning in environmental security is to be found in interdisciplinary academic programs, decision making must come as much from the engineering community and anywhere else. The authors believe that the proponents of environmental security education should come from the engineering community. Whereas engineers realize the importance of social scientists in solving environmental problems on an international scale, it is our opinion (and certainly, only an opinion) that the reverse is not necessarily true. If we, as engineers, don't take charge of a **total** environmental security program, then the engineering component will go the way of the Edsel.

Bibliography

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