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ABSTRACT

Two major sections, one dealing with the practitioner's perspective and the other addressing research and evaluation, comprise these proceedings of the 1980 Conference of the National Association for Environmental Education (NAEE). Section I contains 10 essays which describe programs, approaches, and issues of interest to the environmental education community. The 22 papers which make up Section II present analyses of significant environmental education research problems; many are based upon original studies. Also included is NAEE President A. Clay Schoenfeld's inaugural address entitled "Earth Day '70, '80, '90." (WB)

CURRENT ISSUES VI:

The Yearbook of Environmental Education and Environmental Studies

Selected Papers from the Ninth Annual Conference of the National Association for Environmental Education

Edited by

Arthur B. Sacks
Lei Lane Burrus-Bammel
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with a Foreword by
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ENVIRONMENTAL EDUCATION INFORMATION REPORTS

Environmental Education Information Reports are issued to analyze and summarize information related to the teaching and learning of environmental education. It is hoped that these reviews will provide information for personnel involved in development, ideas for teachers, and indications of trends in environmental education.

Your comments and suggestions for this series are invited.

John F. Disinger
Associate Director
Environmental Education

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Publication sponsored by the Educational Resources Information Center of the National Institute of Education and The Ohio State University.

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PREFACE

The Ninth Annual Conference of the National Association for Environmental Education (NAEE) was held 23 May through 29 May 1980 on the campus of the University of New Mexico in Albuquerque, New Mexico. One hundred ninety-nine individuals from forty states and two foreign countries participated. In general, the Conference was highly successful. The sessions developed around invited papers went particularly well, as did the "Poster Session" which served as a vehicle for describing individual programs and approaches to environmental education.

The essays contained in this volume represent the best of the submitted Conference papers. As in the past, this volume of Current Issues has striven to provide both environmental education applications--the practitioner's perspective--and the results of scholarly analysis and integration--the researcher's perspective. Our goal has been twofold: (1) to present to our diverse readership a high quality yearbook which presents the researcher, the scientist, and the student of environmental education and environmental studies with the current year's exploration of issues and problems facing educators and environmental education; and (2) to provide both the practitioner and the scholar with a selection of the year's production of environmentally-related research and scholarship.

To insure that the goals of the Current Issues series are reflected clearly in the design of the volume, at its fall meeting (27 September 1980) NAEE's Board of Directors authorized the present format. The first section, "Environmental Education Applications--the Practitioner's Perspective," replaces the "Notes and Commentaries" section found in last year's Current Issues volume. The second section, "Research and Evaluation--Refereed Papers," is a renaming of last year's section entitled "Refereed Papers," We have also chosen to reverse the order of the sections.

This year, Current Issues also has seen the expansion of the editorial staff to include broader representation and expertise to accommodate the range of papers submitted to Current Issues. Two editors, Dr. Arthur Sacks and Dr. Craig Davis, were responsible for papers broadly termed "environmental studies," while Dr. Lei Lane Burrus-Bammel and Dr. Louis Iozzi were responsible for papers broadly termed "environmental education." All of the editors reviewed the papers for the "Environmental Education Applications--the Practitioner's Perspective" section, and, based upon this review, selections were made. Before papers were selected for the second section, "Research and Evaluation--Refereed Papers," they were carefully reviewed by the respective editors and submitted for peer review by at least two additional experts in the field (see "Reviewers," page vii). In all, 40 papers were submitted. A total of 32 were accepted (80 percent), 10 for section one and 22 for section two.

The editors are especially pleased that Current Issues VI has continued the approach adopted last year of soliciting an invited "Foreword" from a distinguished member of the environmental community. This year's "Foreword" was written by Dr. Lynton Keith Caldwell, Arthur F. Bentley Professor of Political Science and Professor of Public and Environmental Affairs at Indiana University. Professor Caldwell, best known for his role in establishing the National Environmental Policy Act (NEPA), has published widely in the environmental policy and citizen action areas. He is also represented as a contributor to section two of the present volume.

We have also included Professor Clay Schoenfeld's inaugural address as he assumed the NAEE presidency at the Ninth Annual Conference. We hope the inclusion of the president's annual address too will become a standard practice for the Current Issues series.

Once again we wish to acknowledge the effort put forth by the ERIC Clearinghouse for Science, Mathematics and Environmental Education, and, particularly, Dr. John Disinger, ERIC's Associate Director. ERIC's consistent support of the Current Issues series has been an essential element in its progress, while Dr. Disinger's rigorous professionalism and his kind words and helpful advice have helped make a complex task go smoothly.

Finally, we would like to offer our deep appreciation for the substantial support provided to NAEE and to Current Issues by the Institute for Environmental Studies of the University of Wisconsin-Madison, the Division of Forestry of West Virginia University, the Environmental Studies Program of Iowa State University, and the Institute for Science, Technology and Social Science Education of Rutgers-The State University of New Jersey. By volunteering staff time and facilities, and by absorbing many of the incidental expenses required for editing a volume of this scope, these institutions have been able to extend their educational roles beyond the borders of their states. Without such assistance, Current Issues VI would not be a reality.

Arthur B. Sacks
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October, 1980

CURRENT ISSUES VI:

The Yearbook of Environmental Education and Environmental Studies

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FOREWORD

AN ENVIRONMENTAL AGENDA FOR THE 1980s: PRIORITY AMIDST DIVERSITY

One of the enduring values of The Yearbook of Environmental Education and Environmental Studies is, and will be, its record of the diversity, direction, and underlying principles of the environmental movement. In a larger sense, it records the conceptual and intellectual transformation that must occur generally if the quality of life on earth is to be maintained or enhanced. Degrading conditions of life are risked in a broad range of prevailing attitudes, assumptions, and behaviors. A major transformation in people and institutions will be required if the civilized world is to avoid self-destruction.

The Yearbook--Current Issues reports an important part of the evidence of how this transformation is proceeding. The substance of Current Issues, however diverse, represents a common effort to move people toward an awareness, understanding, and appreciation of the world, consistent with what we now know regarding ecological realities. Other periodicals report other aspects of environmental concern, but those dealing with environmental education are concerned with the one aspect of social transformation that is absolutely fundamental. This aspect is the internalization of environmental values and respect for the laws governing the living world. Without this internalization of values, all other aspects of environmental protection are holding actions and ultimately lost causes. Unless those tendencies working to the destruction of our society can be transformed into self-renewing behaviors, our efforts toward environmental protection will fail. Unless an ecological conscience is internalized in a critical mass of mankind, no amount of informing, lawmaking, regulating, or preserving can be counted upon to safeguard the quality of the environment.

The Yearbook--Current Issues provides a continuing record of diverse approaches to this goal of transformation through internalization. In many instances the goal is implicit in the substance of the findings or experience reported. For example, it is the consequence sought through "A National Strategy for Environmental Education" reported in Current Issues V. Figure Three of this article (page 103) might be taken as a model for a process by which environmental values could be internalized throughout society. But it is what happens to people in this process that determines whether internalization in the sense of deep comprehension and commitment really occurs or whether the result of education is no more than enlarging the number of individuals exposed to environmental information.

It seems evident from studies of the attitudes of people toward risk that knowledge is not enough to internalize value commitments and patterns of behavior. An ecological way of life is comparable to religious belief. No one has stated the difference between knowledge and belief more eloquently than John Henry Cardinal Newman when he wrote:

> First comes knowledge, then a view, then reasoning, and then belief. This is why Science has so little of a religious tendency; deductions have no power of persuasion. The heart is commonly reached, not through reason, but through the imagination, by means of direct impressions, by the testimony of facts and events, by history, by description.... Many a man will live and die upon a dogma: no man will be a martyr for a conclusion.[1]

It is belief that must be the ultimate goal of environmental education. Knowledge marks the beginning of attitudinal and behavioral change, but the human response to information is not necessarily automatic nor progressive. Negative reactions to new knowledge are common. Those who doubt this should consider the relationship between scientific knowledge and the smoking of cigarettes, or the pertinacity of people who rebuild in floodplains.

Among the diversity of perspectives on environmental education published last year in Current Issues V are two that have something especially important to say regarding the way in which environmental values may be internalized. Their message reinforces the point that I wish to make in the Foreword to this year's Current Issues.

The first perspective, at least in method, is retrospective--Thomas Tanner's "Formative Influences in the Lives of Citizen Conservationists." Tanner's exploratory study asked: What makes a conservationist? What influences lead to internalized environmental values in individuals so that their behavior and response in relation to issues affecting the environment and the living world evidence a deep internal dedication to an ecological way of life? Tanner's study was not conclusive (he described it as preliminary), but it suggested that personal experience

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[1]"Knowledge and Faith," Readings in English Prose of the Nineteenth Century, Part II. Edited by R. M. Alden. Boston: Houghton Mifflin, 1917, p. 413.

greatly outweighs scientific knowledge in inducing an ecological perspective. Tanner seems to corroborate Newman. His article points toward a route that research should take if we are to discover what ways are most effective in achieving the ultimate goal of environmental education. This should not suggest that there is a one-best-way to internalize environmental values--only individuals internalize environmental values, each person for himself--but further pursuit of Tanner's inquiry could give us a kind of cost-benefit calculus regarding the respective elements of environmental education. We might learn where the probabilities for internalization are greatest.

The second article, "Life Styles, Behavior, and Future Environments" by Gene Bammel and Lei Lane Bammel, takes a positive and creative view of the future. Its thesis exemplifies Newman's assertion that "The heart is commonly reached, not through reason, but through the imagination." If this is indeed true, the conclusion reached by the Bammels represents a high priority for environmental education and research. They say (Current Issues V, p. 40):

> While it is provocative to have scenarios for the future that paint disturbing pictures, it is imperative to have images of a golden age, for people may be moved to work to bring that about. Every human being stands in need of having an image of the future that he or she wishes to bring about; it is the task of the environmental educator to invent and propose images that are ecological, self-realizational, and promote the cultivation of the nobler, less materialistic, less consumptive aspects of human personality.

I may be less optimistic about probable futures than Gene Bammel and Lei Lane Bammel, but I believe that a vision of our best possibilities is a defense against the probability of the worst. Images of the future have been powerful motives in all of the great religions, and they have fired the drive of revolutionary movements. Without a vision of the future our present laws and policies are disjunctive and incremental--unlikely to transform our society in ways that will enhance its quality and increase its prospects for survival. Yet it must also be understood that pursuit of "a golden age" may exact a price, perhaps, in Robert Heilbroner's words, "a fearful price." The "golden ages" of history commanded heavy and perhaps unavoidable costs in human domination and deprivation. And so, concomitant with a vision of our best possibilities, we need an exploration of strategies for getting there, and for being sure that there is where we really want to go.

The 1980 Conference of the National Association for Environmental Education initiated an agenda for the decade of the 1980s. No one would surely wish to diminish its diversity. But, unlike our national motto E Pluribus Unum, the strength of the collective effort will be greatest if unified by an all-encompassing principle. I believe that the internalization of an ecological way of life inspired by a realizable vision of our best possibilities could be this unifying force. I am myself a hopeful pessimist, yet I do not regard an effort to formulate such a unifying principle and strategy as utopian. The costs of achievement should be honestly faced and choices made between one cost as against another. But I am convinced that without the driving power of a vision realizable through practical strategies, our achievements in environmental education will fall short of our hopes and mankind's needs.

Lynton K. Caldwell
Indiana University

June 1980

PRESIDENT'S ADDRESS TO THE 1980 CONFERENCE: EARTH DAY '70, '80, '90

A. Clay Schoenfeld[1]

Earth Day '80 has just come and gone. Where are we and what time is it--in relationship to Earth Day '70 and Earth Day '90--with respect to environmental education?

In the fall of 1969, a half-dozen people sat around a kitchen table in Madison, Wisconsin, outlining something conceived as a national environmental teach-in. One was U.S. Senator Gaylord Nelson, who had earlier discovered the political potency of environmentalism as Wisconsin's Governor. The other five of us were professors and students eager to capitalize on current campus activism to try to help project an ecological conscience into American mores.

As a writer (Cotton, 1970) in Audubon was to report, Earth Day, 22 April 1970, became "the largest, cleanest, most peaceful demonstration in American history." An estimated 20 million people of all ages and shades participated (NSEA, 1970). Nearly half of the four-year colleges in the country sponsored demonstrations, double the number that experienced anti-Vietnam protests (Astin, 1971). Two distinguished sociologists concluded E-Day elevated "environmental quality" overnight into the general public ken as a "social problem" (Dunlap and Gale, 1972). Eric Sevareid pronounced the invocation on the CBS evening news that night: "We are now dealing with final facts....This is the big test."

1970-1980 TRIUMPHS

How well has environmental education met "the big test" in the 10 years just past? From one perspective, I would say, "Very well." To document that assessment, let me cite some objective and subjective data.

First, what has happened to the young Earth-Day activists? Are they now upwardly mobile in some traditional career, co-opted by "the System?" Or have they dropped out in university ghettos or rural communes? The answer is, "Neither of the above." A national survey (Schoenfeld, 1979) has shown that almost without exception yesterday's campus environmental leaders today remain committed to environmental action, albeit typically now in institutionalized modes. If

[1]President, National Association for Environmental Education.

anything speaks to a viability of environmental education, it is this evidence that, for many young people, Earth Day was not a momentary fling but an introduction to life careers in environmental action.

Second, what has been the impact of the environmental era on colleges and universities? A national survey (Schoenfeld and Disinger, 1978) has indicated that, barring English composition and math, few university subjects are being offered today in so many diverse ways and places, by such a mixture of schools, departments, and professors, as that complex of cognitive content and affective process known, precisely or not, as environmental studies. It is striking the depth to which environmental studies concepts have penetrated a not particularly pliable academic structure--wholly new instructional curricula and organizational arrangements at the undergraduate level, wholly new master's degree programs, wholly new cross-discipline Ph.D. research arrangements, wholly new extension configurations. While in some cases the changes may prove to be more semantic than surgical, the university-environmental movement marriage would seem in general to be beyond divorce.

With respect to the impact of the environmental movement on the public schools, given the American tradition of local autonomy, it has ranged from the impressive to the picayune.

Third, what do public opinion polls or expert assessments show? In 1970, only 6 percent of the respondents in a national Gallup poll volunteered "pollution, environment" as "one of the most important problems facing the country" (Funkhouser, 1973). By 1977 a similar national poll (Mitchell, 1978) indicated that "support for environmental protection is strong and unwavering, and sympathy with the environmental movement is at a high level." After contacting opinion leaders around the country in 1978, Edward K. Delong of the United Press agreed in a series of newspaper dispatches that "the environmental establishment may turn out to be the single most powerful force shaping the lives of Americans for years to come." A 1979 study (Cutler, 1980) concluded that "most Americans believe more soil and water conservation is needed, and they are committed to a conservation ethic." David Brower (1980), dean of environmental activists, says, "My crystal ball tells me the environmental movement will pick up steam." Gladwin Hill (1980), dean of environmental reporters, believes "the environmental movement is...a bell that can't be unrung."

Are these opinions really in evidence on the ground? The National Earth Day '80 Executive Director (McCabe, 1980) believes the environmental movement "has produced major improvements in the quality of life for all Americans and created a valuable legacy." As high points, he lists cleaner water and air, action on environmental contaminants, growing recycling and energy conservation, healthier and safer workplaces, more public participation in resource policy decision-making, and other advances.

Fifth, has reportage of this progress penetrated the media? A study of environmental coverage in two representative dailies (O'Meara, 1978) revealed that while total column inches had slipped somewhat from a 1970-71 peak, in 1977 it was far above a 1962 base-point. If it did nothing else, the National Environmental Policy Act (NEPA, 1969) and its "102" statements gave the press manifold news pegs on which to hang coverage of environmental issues. A recent national survey (Schoenfeld, 1980) indicates that increasingly the daily press is staffed with a cadre of environmental reporters that "adapts professional responsibility and craftsmanship to the construction of a threatened environment as a social reality." Meanwhile there has been an irruption in specialized environmental periodicals (Schoenfeld, Meier, and Griffin, 1979).

Sixth, has environmental education achieved any professionalism? We have acquired some essential trappings: an international journal, a national association, a central computerized data bank, an array of evaluated K-12 curricular materials and methods, various sects and sections with competing and complementary philosophies, in some states a certain credentialing, in federal registers official position descriptions, an approach to a code of ethics, a national alliance.

1970-1980 TRAGEDIES

Yes, from one perspective we in environmental education have passed "the big test." But from another perspective, we have flunked.

For one thing, we tend to be WASPs. We have certainly not penetrated the urban inner core, for example. Little wonder that Faramelli (1972) and others have called environmentalism "a cop-out, a flight from social realities, and a digression from dealing with the real issues of racism and social injustice."

Second, we tend to practice U.S. colonialism. The Secretary of the Organization of American States, Alejandro Orfilia (1980) recently reminded a World Conservation Strategy Conference that the use of natural resources must be related to the long-term development objectives of the so-called emerging nations, and that "we must pursue conservation so as to improve the lives of people" around the globe and not just in this country.

Neuhaus (1974) and others have labeled environmentalism as elitism run wild if not downright "fascist" in nature. We have sponsored laws that are as undemocratic as they are unecological. The Endangered Species Act of 1973 comes tomind, calling as it did for "a strict mandate of conservation of endangered species over all other criteria" (Stromberg, 1979). That Act was hardly in keeping with Commoner's (1971) dicta that "everything is connected to everything else," and that "there's no such thing as a free lunch." The Act led directly to the Tellico Dam backlash (Schoenfeld, 1980), which in turn led to 1978 Congressional amendments that restored some sanity to the Endangered Species Act. Interior Secretary Andrus (1980) recently drew on that fiasco to offer some advice to us. "Environmentalists," he said, "must learn to forego the dubious battles for lost causes, and concentrate instead on the big opportunities to win new ground and defend gains already won" if we expect to retain public support as public concerns mount about energy, inflation, social injustice, and national defense.

I personally am dismayed, for example, by the extent to which the environmental movement has been used by the anti-nuclear power lobby, by the advocates of "no growth," by the opponents of a reasonably technological agriculture, by wilderness preservationists who ignore the concomitant need for a broad multiple-use land base, and by those who try to make "capitalism" the whipping-boy for all our ills. Indeed, "environmentalism" is in real danger of becoming a dirty word in circles whose support we desperately need. Rex Resler (1980), Executive Vice President of the American Forestry Association, even believes we ought to go back to the "conservation" label and "strengthen the understanding that the term encompasses a fundamental regard for the environment as well as a concern for economic and social considerations."

Fourth, past progress on the ground may prove illusory. The latest annual report of the President's Council on Environmental Quality (1980) carries a long laundry list of continued environmental deterioration: groundwater contamination from improper disposal of toxic wastes, the pervasive pollution of surface waters near large cities, closure or reduced production from millions of acres of coastal waters, acid rain, overloaded sewage treatment plants, loss of prime farmlands to urban sprawl, severe erosion that reduces farm productivity and silts streams, the problem of finding disposal sites for hazardous waste, overcutting of privately held forest land, the loss of millions of acres of tropical forests annually--the list goes on.

Fifth, with all its emerging professionalism, the environmental education community has not produced a credible body of research literature in terms of either theory or methodology. Attitude research dominates, and it has an inherent weakness: its presupposition that communication is something that a person or an agency or an institution does to get other people to do what the communicator wants them to do. Attitude research has a simple appeal for agencies with a fixed model of how others should behave and who look at communication as a "quick fix" for eliciting that behavior. According to the theory, communications change attitudes which in turn program people's behavior. Grunig (1979) calls this attitude model the "domino model" of communication or education. If we can just communicate with people, according to the model, the communication domino will topple the attitude domino and that will topple the behavior domino. In fact, social psychology research suggests the attitude theory has little explanatory power. One message seldom leads to one attitude and one behavior. The dominos don't always fall in the same direction. People have free will. They control their communication, their attitudes, and their behavior. We cannot control all three with a quick education fix.

Tichenor, et al. (1973), Sharma, Kivin, and Fliegel (1975), Bowman (1977), and Stamm and Grunig (1977) have all found environmental behavior to be "situational"; that is, a pro-environmental stance is easier to take when it doesn't "bite" the individual decision-maker directly, regardless of environmental education input. While communication research generally shows a relationship between communication exposure and level of knowledge, research also suggests that level of knowledge about a resource management issue may be inversely related to an ecological attitude on that issue when economic self-interest or some other stance intervene. If attitudes are not necessarily related to knowledge, long-term communication research also indicates that (a) salient attitudes are usually not subject to manipulation through short-term communication programs, and that (b) attitudes are unreliable predictors of actual behavior (Bowes, et al., 1978).

I suggest we in environmental education research kick the domino model habit and explore more fruitful theories, employing more rigorous methodology. Grunig's (1981) studies may provide some promising azimuths. An incipient National Environmental Education Research Assessment may contribute both inspiration and focus.

While indeed environmental education has made some progress in the past ten years, it probably has not kept pace with the forces of environmental degradation. At no echelon of government has there been an adequate commitment of public funds to environmental education. Nor is environmental education sufficiently on the agenda of the educational research agencies or the foundations. The performance of the U.S. Office of Education under the Environmental Education

Act of 1970 particularly can be called inept. The USOE was slow to implement the Act, never pressed for full funding, and tended to sprinkle peanut grants over the landscape to ad hoc groups with neither staying power nor professional competence, meanwhile totally ignoring the largest and most effective public education instrumentalities in the country, such as the Cooperative Extension Service. The 1978 Renewable Resources Extension Act could redress the ills of the deceased Environmental Education Act, but one cannot be sanguine about Congress funding the RREA in an era of budget-cutting.

Seventh, as an Army reserve officer of 33 years' standing, it would be uncharacteristic if I did not conclude this look at Earth Day '80 with words about <u>the impact on environmental education of imminent demands for a strengthened posture of national defense</u>. Nothing is so destructive of so many natural resources and so much environmental quality as is war, and nothing is so destructive of a conservation conscience as is war or even rumors of war. TR's first wave of conservation foundered on World War I, FDR's second wave on World War II. Will a third wave founder on a World War III?

Yet nothing is so destructive of human resources and freedoms as is the alien ideology against which America is arrayed. Today, in the name of environmentalism in my state, public sentiment continues to block the U.S. Navy from building a communication system capable of transmitting secure messages to Trident submarines stationed submerged at strategic spots worldwide. Where does environmental protection end and the protection of American lives begin? Such, in the words of the song, is indeed "a puzzlement." As a combat veteran, no one abhors the thought of armed conflict more than do I. Yet if "the balloon goes up," as we say at Fort Sill, I know I will doff my environmental suit and put on a uniform. I pray I don't have to make the choice.

1980-1990 AZIMUTHS

So where will we be on Earth Day '90? I am neither an optimist nor a pessimist. I am a possibilist. It is possible we will all be six feet under. It is equally possible we will have achieved an entente with global humankind. It is possible that we will have as well achieved an entente among ecology, esthetics, engineering, environment, energy, and economics to the end that we will have learned how to maintain and even enhance environmental quality without degrading human justice, and how to enhance human welfare without degrading resource quantities. It's a tall order, but I simply can't believe that the last, best hope of earth has reached the end of the line.

As an old pupil of his, it would be uncharacteristic if I did not summarize this talk with a reference to a former Secretary of the Albuquerque Chamber of Commerce.

He said: "The practice of conservation must spring from a conviction of what is ethically and aesthetically right, as well as what is economically expedient." He did not say, "regardless of what is economically expedient." He was espousing a concept of integrated environmental management that must become the touchstone of environmental education in the decade at hand.

He went on to explain: "A thing is right only when it tends to preserve the integrity, stability, and beauty of the community, and the community includes the soil, water, fauna, and flora, as well as people." You will note he did not leave people out of the equation. He was defining integrated environmental management education.

He was Aldo Leopold (1947).

I propose we of NAEE dedicate ourselves to a decade of integrated environmental management education, participated in by all segments of society--a sober consideration of the challenges posed by the 1980s, marked not by the occasional stridency of the 1970s but by a reasoning together of ways that will help enhance environmental quality and energy conservation without jeopardizing human needs, and that will help meet human needs without jeopardizing the quality of our environment and our energy requirements. If I could capsule the theme of such an approach, it would be with the words: "There are no 'anti's' in integrated environmental management education." IEME looks ahead to new goals calling for a broad grassroots consensus that balances environmental concerns and energy conservation with human needs. The "we/they" syndrome is shopworn at best.

I propose also that NAEE examine carefully the implications of Evison's (1978) belief that it will be the covert ecological message imparted by the actual conduct of organizations such as ours that will override our overt environmental education voices. For example, how long in good conscience can we continue to afford the luxury of a national conference, given the conspicuous consumption of energy such a meeting inevitably entails? Should we not, rather, take the lead in considering a series of regional conferences as an alternative, meanwhile improving communication by mail? Mid-year board meetings may be expendable as well.

Together let us face breast forward, never doubting that clouds can break, that we are baffled to fight better.

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SECTION I:
ENVIRONMENTAL EDUCATION APPLICATIONS — THE PRACTITIONER'S PERSPECTIVE

SECTION I: ENVIRONMENTAL EDUCATION APPLICATIONS - THE PRACTITIONER'S PERSPECTIVE

This section contains ten essays which describe and report on a wide range of environmental programs, experiments, and issues of interest to the environmental education community. Authors have attempted to distill and report on their experience with environmental education projects and methods, with the goal of sharing new approaches, describing important environmental education programs, and developing further lines of inquiry. It is hoped that this material will help stimulate new directions for Current Issues readers and provide practical models which may be used in a variety of educational settings. Some of the essays represent efforts to comment on areas and issues pertinent to environmental education which have gone largely unnoticed, or, if noticed, undervalued. By bringing such matters before the eye of other practitioners, we hope to continue the educational dialogue initiated when these papers were presented.

BUILT ENVIRONMENT EDUCATION: POSITION STATEMENT

Ad Hoc Group for Built Environment Education[1]

In May, 1980 the Institute for Environmental Education, School of Architecture and Planning, University of New Mexico, helped to co-sponsor the National Association for Environmental Education Conference in Albuquerque, New Mexico. It was the first time that an NAEE conference had an intense focus on built environment education as a component of its total environmental program. Speakers in this group represented themselves as well as several national groups also interested in the built environment, including:

1. The American Institute of Architects (AIA);

2. Environmental Design Research Association (EDRA);

3. National Art Education Association (NAEA), and others.

The following comments summarize the panel's concern for built environment education, and they constitute a position statement for the NAEE mission of educating all people about the long-term consequences of our actions on and in the environment.

POSITION I:

A central focus for environmental education is the way in which individuals relate to environmental systems. In order to achieve an all-encompassing awareness of those relationships it is helpful to consider the environment not as two separable systems components, the natural and the built, but as a continuum ranging from a predominately natural to a predominantly built environment. Any given environmental system lies along this continuum and, thus, is a mixture of the built with the natural environment. Thus, an individual as builder is included within the boundaries of any environmental problem to be solved.

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[1]Anne Taylor, Wolfgang F. E. Preiser, Aase Eriksen, Alan Sandler, Ed Crittenden, Doreen Nelson, Don Wall, Joann Pratt, Kevin Rohane, Earl Mark, Mike Ivansic, William Siembieda.

POSITION II:

Built environment education and awareness includes the knowledge of what people as builders do to their surroundings, the quality of this life they build in personal and commercial settings, the impact that those settings have on their behavior, the aesthetic choices they make about "things" with which they surround themselves, and the consideration of themselves as a part of, and not apart from the total environment.

POSITION III:

Built environment education is a relatively new field of inquiry which coordinates many disciplines--architecture, art, education, engineering, construction, mathematics, science. Environmental education helps people to be consciously aware of space and the consequences of their actions and decisions in those spaces.

POSITION IV:

It is hoped that built environment education will sensitize persons of all age groups in artist-like fashion to appreciate, understand, care for, and improve the quality of their built surroundings. This in turn will foster reverence and understanding about the built and natural environment and to the delicate relationship between them.

POSITION V:

NAEE should support the following experiences in Built Environment Education:

a. Intelligently plan for the quality of the environment, with expectations for a high, instead of the present low, quality metaphor.

b. Educate architects and other designers to facilitate better communication with their clients in order to reduce the mystique of architecture, thus becoming partners in and being at one with the implementation process.

c. Train teachers to manipulate classroom space both in and outside of schools and to research the effects such manipulation have on learning and behavior.

d. Plan community programs on built environment education for citizens and adults and community leaders to understand the aspect of their decision making in this planning process, especially comprehensive long-range planning.

e. Promote aesthetic development of children and their ability to make critical aesthetic judgments about their surroundings.

f. Help architects act as educators in schools, museums and other community settings, to produce a new generation of concerned citizens as consumers and potential designers of their environments.

g. It is essential that blacks, Mexican Americans, native Americans, Asians, and other minorities participate in the design and decision-making process of their communities to insure the inclusion of vernacular art and architectural images which express the richness of all cultures. Minorities need to be educated and participate in the environmental design education process along with architects, planners, and educators.

h. Lastly, and perhaps most importantly, built environment education should not become a new subject overlaid on an already overcrowded curriculum, but should be an integrated force and manifestation of many disciplines combined.

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FOREST SERVICE-USDA: A DIVERSIFIED PROGRAM FOR ENVIRONMENTAL UNDERSTANDING

Jefferson E. Carroll[1]

The involvement of the Forest Service in public education can be traced to the formation of an independent Department of Agriculture in 1889. One of the duties of the new Department was to diffuse among the people of the country, general, but comprehensive and useful, information on agriculture and rural development. Since that time, many laws have expanded the original authority to include a variety of activities dealing with educational institutions, research organizations, state and local governments, and the general public.

With this background, public education has been a responsibility of the Forest Service of the U.S. Department of Agriculture throughout its history. Education in its broadest definition is a vital element in resource management and protection. Natural resources can be more quickly destroyed by an uninformed person than by insects, disease, or even fire. The American people want to be, and legally have the right to be, involved in making long-range forest management decisions on public lands. Without an understanding of environmental factors, the public cannot be intelligently involved in making these decisions.

The Forest Service has always engaged in research programs to provide professional and technical knowledge for better utilization and protection of forest land resources. In the past, these programs were often directed toward land managers, commercial interests and the field of technical education. Within recent years, however, an increasing emphasis has been placed on programs offering nontraditional forms of education. These programs develop a general public that has:

--an awareness of the biophysical environment,
--an understanding of the interrelationships that exist within the environment, and
--an ability to apply this awareness and understanding to solving environmental problems and planning long-range resource management.

To meet these goals, several different educational programs with different target audiences exist.

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1) Cooperative Forest Fire Prevention Program

Popularly known as the Smokey Bear Program, this is perhaps the oldest and best known of the specific educational programs. Smokey got his start in 1942 when forest fire control was critical due to shortages of manpower and equipment. The forest fire prevention program became one of the first public service campaigns sponsored by the Advertising Council, Inc. The bear with blue denim trousers and campaign hat is known throughout the world today for reminding us, "Only you can prevent forest fires."

To mobilize public support for the prevention of forest fires through education and develop understanding of the effects of fire on the environment, this successful program:

- --provides high-quality, low-cost fire prevention materials suitable for nationwide use for a variety of audiences;
- --serves as national clearinghouse for materials, ideas and contacts to promote public awareness of the forest fire threat;
- --uses donated public service time and space of television, radio, newspapers, magazines, and outdoor advertisers to carry the message.

2) Interpretive Services

In 1960, Congress passed the Multiple-Use, Sustained-Yield Act. This established, among other activities, the management of outdoor recreation resources as an important task of the Forest Service. Within the field of recreation management, the Interpretive Services Program provides on-the-ground orientation and interpretation activities in the National Forest System and at the other Forest Service facilities. The primary objectives are to orient visitors so that they can enjoy various recreational pursuits in a safe way and at the same time minimize their impact on the forest environment.

More than 100 million people used the Interpretive Services in the 154 National Forests last year. These forests, encompassing about one-tenth of our Nation's land area, have 24 large visitor centers, 308 information stations, 304 interpretative trails, 80 demonstration areas, 150 amphitheaters, and more than 1,000 interpretative signs.

3) Environmental Education Program

In the predominantly urban society of the United States, the majority of people are several generations removed from a close association with the natural environment. There is a need to re-establish, among all people, an understanding of the natural environment and its relationship with the urban community.

To aid in this understanding, the Forest Service created the Environmental Education Program in 1970. Its purpose is to assist the public in identifying and supporting wise resource management through understanding. Specifically, the Program seeks to develop the people's skills and knowledge to:

- --understand the interrelationship within the environment;
- --recognize and identify environmental problems and solutions;
- --predict the social, economic and ecological consequences to our solutions;
- --understand how to become actively involved in land-use planning and resource management decision making;
- --develop action plans to assist in implementing environmental programs.

To further this program, the Forest Service sponsors a wide variety of training workshops for educators, resource managers, and representatives of special interest organizations. There are also many lesson plans available through the "Investigating Your Environment" series and a number of publications and aids suitable for classroom use.

4) Youth Conservation Corps

Young people are often the first to grasp and use new ideas. They represent a major force today in the environmental movement and will be the decision-makers of tomorrow. To train these young people, Congress passed the Youth Conservation Corps Act in 1970. Its goals are to:

- --provide gainful employment during summer months to youth 15-18 in a healthful outdoor atmosphere;
- --offer an opportunity for learning, understanding and appreciating our natural environment and heritage;
- --insure the development of the natural resources by the youth who will be ultimately responsible for maintaining and managing these resources for the future.

Under the leadership of professional resources managers, boys and girls work and learn together to carry home a better understanding of resource management. The work they do is hard. There are streams to clear, trails to build, recreation areas to construct, wildlife habitats to improve, erosion problems to control, and hundreds of other projects. Last year, approximately 40,000 young people accomplished projects valued at $47 million by federal and state land management agencies. The same enrollees received about 3.2 million hours of environmental awareness training that helped to prepare them for their roles as citizens responsible for the quality of the environment.

5) Woodsy Owl Program

The success of Smokey Bear in forest fire prevention led the Forest Service to create a new symbol in the fight for environmental quality. In September 1971, Woodsy Owl and his environmental improvement campaign were launched as a cooperative venture between the Forest Service, the Public Service Council, and many other volunteer service organizations and agencies.

Woodsy's program materials and his message--"Give a hoot! Don't Pollute!" are designed primarily for children up to 14 years old. The basic objective is to promote wise use of the environment and to broaden public awareness so that even kids can participate.

Woodsy became an instant success. He appears on numerous television shows and his message is carried by radio, newspapers, and major magazines. The little owl with the green trousers and feathered cap is recognized in the United States by 80 percent of the children 10 years of age or younger. In addition to supplying teacher's kits to thousands of classrooms, Woodsy is now included in major school textbooks and each week receives from 800 to 1000 requests for campaign materials from children in the United States and abroad.

Public Information

The Forest Service's Office of Information in Washington, D.C., is divided into four working groups to support the educational programs. The Publication Group produces a wide variety of information and education publications ranging from reports of technical research to popular posters for classroom use.

The Current Information Group deals with radio, television, and the printed news media. Their responsibilities include timely release of news information and the preparation of fact sheets and speeches on critical issues.

The Audio-Visual Group develops a variety of films, displays, exhibits, tapes and slide programs. It also maintains the Forest Service photographic library.

The Public Involvement Group is responsible for all activities that inform and involve the public as groups or individuals in the management decision-making process.

The functions of these groups are duplicated in the nine Forest Service regional offices and within most states. Also, the Forest and Range Experiment Stations and the Forest Products Laboratory have information offices to disseminate research results and produce technical materials for educational purposes.

In many respects, every job the Forest Service performs contains an element of education. In the course of its work, it deals with homeowners and forest users; works closely with industrial managers, universities and politicians; and assists students, teachers, businessmen, and conservation groups. No matter who is involved, education is used as a tool of wise management to provide the greatest good to the greatest number in the long run. For further information on any of these programs, contact these addresses:

Cooperative Forest Fire Prevention Forest Service-USDA
P.O. Box 2417
Washington, DC 20013

Interpretive Services
Forest Service-USDA
P.O. Box 2417
Washington, DC 20013

Environmental Education Programs
Forest Service-USDA
P.O. Box 2417, Room 3233
Washington, DC 20013

United States Youth Conservation Corps
P.O. Box 2975
Washington, DC 20013

Woodsy Owl
Forest Service-USDA
Box 2417
Washington, DC 20013

ENVIRONMENTAL EDUCATION FOR DECISION-MAKERS IN RURAL VERMONT

Verne B. Howe[1]

Typically, environmental education relates to a school system or nature center. If environmental problems are to be adequately addressed, however, there needs to be a broader interpretation of environmental education. Decisions are being made every day that have an environmental impact. Often these decisions are made without the basic information necessary to assess the impacts. There are many groups of decision-makers that should be reached by environmental education methods. This paper deals with one such group, local planning commissions and boards of selectmen in Vermont, and the problem of land-use controls. It is an example of higher education involved with local people. The project, carried out in Vermont but applicable to any rural state, was funded in part by a grant under Title I of the Higher Education Act of 1968.

Vermont Land-Use Control Law

The Vermont laws relating to land-use control are the sections of Chapter 117, Title 24, Vermont Statutes Annotated concerned with town plans and the implementation of those plans, sections 4303, 4387, 4391 and 4410. Vermont has a statewide land-use control law, Act 250, Chapter 151, Title 10, Vermont Statutes Annotated. Recently Chapter 118, Title 24, Vermont Statutes Annotated was enacted enabling the formation of conservation commissions.

Needs Assessment

Chapter 117, Title 24, V.S.A. requires that Vermont towns prepare development plans based on surveys of existing conditions and future trends. It also directs that present and future growth be considered.

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The development plans of six towns were evaluated by the author. In only one case had the plan been based on a complete survey of existing conditions. In addition, most of the plans contained conflicting statements. For example, in one section of a town plan the statement was made that agricultural lands should be reserved for agriculture, but, in the same plan, the location for new industrial growth was shown, on the land-use map, to occupy prime agricultural land. The surveys of existing conditions were limited in most cases to roads, schools and existing industry.

The response of the towns to Chapter 118, Title 24, V.S.A. was minimal. Only 7 of the 256 towns of Vermont had formed conservation commissions and of these 7 only 3 were active.

The planning commission and the board of selectmen of a town are by statute parties in the Act 250 permit process. Other statutory parties are the state agencies and regional planning commissions. The planning commission's role is to confirm or to deny that the proposed development conforms to the town's development plan. Properly, the commission meets and discusses the development. One member, who then represents the planning commission, attends the hearing. In one case the environmental commissioners realized as the hearing progressed that each planning commission member present was saying something different. The hearing was recessed to determine why this discrepancy was happening. Questioning revealed that the planning commission had not met to discuss the proposal and that each person was responding as an individual without reference to the town development plan. Such testimony is not admissible under the Act. In the permit process the selectmen are also parties and are expected to deal with the criteria concerning the impact of the proposed development on the cost of town services.

Examination of printed materials available from state agencies indicated a need for simpler presentations and more information directed specifically to the local government bodies. Published books (Sinden, Worrell, 1978) (McHarg, 1969) on the planning process are designed for professionals in the field and assume a degree of sophistication in the process not to be found in small town government. Excellent materials for conservation commissions have been prepared by state conservation commission associations in Massachusetts (Dawson, Nickerson, 1978) and Maine (Connors, Dow and Bennett, 1975), where conservation commissions have been in existence for some time.

Interviews by the author with officials in state government, heads of agencies and departments, indicated that local officials needed more help than they were getting. In addition, a study by the New England Environmental Network based at the Lincoln Filene Center at Tufts University in

Medford, Massachusetts was reviewed (Langton, 1978). It showed that of the 10,000 planners and environmentalists surveyed, the first five of 27 needed skills ranked, were as follows:

Rank	Skill	Interest Percent
1	Drafting conservation ordinances	55.8
2	Developing citizen support and awareness	55.4
3	Drafting agricultural land preservation ordinances	54.2
4	Drafting growth ordinances	50.9
5	Drafting floodplain/wetland ordinances	48.0

This study also showed that the preferred learning method was through written materials. The need for understanding how to prepare town documents was not limited to rural Vermont towns but seemed to be a general need in the New England region.

These are a few examples taken from the author's study that show the need for information on the preparation of a development plan, the function of conservation commissions and the relationship of Act 250 to the town development plan.

Materials Developed

A series of booklets was developed for use by local planning commissions and boards of selectmen. The objectives of which were to provide a basic understanding of the planning process in Vermont and to show why planning was an important function of local government.

The first booklet introduced the planning process through a discussion on values and value systems that led into the preparation of a development plan. Vermont's law enabling local planning commissions and development plans was explained section by section with the concept of values carried along in the explanation. An extensive bibliography was included.

The second booklet covered the beginning of the planning process, the resource inventory that included natural, cultural and human resources. It described what they were, how to identify them and how to record them for easy access. The law, Chapter 117, requires this when it asks that the development of a town plan be preceded by a survey of existing conditions. This booklet also covered a method of determining the attitudes and values of a community by means of a public opinion survey. Several very simple methods were included. The appendix to the booklet included an extensive list of available publications of Vermont agencies.

The third booklet was actually a continuation of the first. It showed the relationship of the Act 250 permit process to the development plan of the town. Each application for a permit to develop is evaluated in accordance with the ten criteria of the Act. The booklet described each criterion and showed where in the plan each criterion should be addressed.

The fourth booklet provided an introduction to the concept of conservation commissions including the history of these commissions in the United States, the functions of such commissions and a discussion on the ways in which conservation lands may be acquired.

Outreach to the Towns

How to reach the local officials of Vermont towns was the final stage of the project. Interviews with local Vermont planners and the Lincoln Filene Center study indicated that many and long workshops were not appropriate. As a result, one evening workshops were held throughout the state during the spring of 1980. The materials that had been prepared were introduced by the author briefly. Colored slides were used to enhance the presentation. A reaction panel of planning commission members and select-men who had previously reviewed the materials then presented its evaluation of the series of booklets. A general discussion followed.

The reactions of those participating in the workshops have been interesting. Booklet I, dealing with values and the development plan has been well received by local planners, even though it is somewhat philosophical. The second booklet was welcomed by planners, selectmen, and concerned citizens. The materials in the appendix were appreciated as well. The third booklet also was accepted, by all who reviewed it as a needed addition to the literature pertaining to Act 250.

The fourth booklet was controversial. The directors of several regional planning commissions were not in sympathy with the concept of conservation commissions. Although such commissions have succeeded in all the other New England states, the directors did not consider such commissions to be important in land-use decision-making in Vermont. Because the towns have not been able to set aside conservation land to any extent, most local officials tended to disagree with the regional commission directors.

Conclusions

The workshops were, for the most part, well attended. Concerned citizens appeared as well as local government officials. The workshops, therefore, provided a public forum for discussion of the land-use decision-making processes.

Thus far, 300 copies of the series have been distributed either during the workshops or in response to requests made by planning commissions or boards of selectmen. Requests for the booklets have also come from planners in other New England states. Several institutions of higher education have indicated that the series will be used in appropriate classes.

The members of town planning and conservation commissions as well as boards of selectmen turn over comparatively rapidly. The learning process therefore can be ongoing with the materials updated whenever necessary. This type of educational program is new to Vermont towns. An institution of higher education has provided the opportunity for a different learning experience. This role of higher education initiates a working relationship between the people of the towns of the region and the educational institution, an example of environmental education moving outside the classroom to reach the nontraditional student.

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CONCLUSIONS AND RECOMMENDATIONS ON ADULT ENVIRONMENTAL EDUCATION PROGRAMS

David I. Johnson[1], Randall Champeau[1], Chris Newhouse[1]

Introduction

An extensive literature exists on adult environmental education programs. A review of this literature was completed in an attempt to identify trends and reasons for success or failure of the programs (Johnson, et al., 1980). A list and summary of the conclusions and recommendations that were compiled are presented here.

Conclusions

Review of the adult education literature produced seven conclusions. These are presented here with a brief explanation.

1. Education was viewed traditionally as a pre-work experience, but that view is changing to a continuous interactive model.

The major reason for the pursuit of youth as prime educational consumers is that society has traditionally been under the impression that life's major experiences follow a linear-sequential pattern (Figure 1).

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    Play ——> Education ——> Work ————> Retirement

Age------------(6-25)------(26-60)-------(61 and over)
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Figure 1. "Contemporary linear-sequential life patterning." (Murphy, 1976).

Today, education is no longer being partitioned off as a pre-work experience; it is now viewed as a life-long process (Figure 2).

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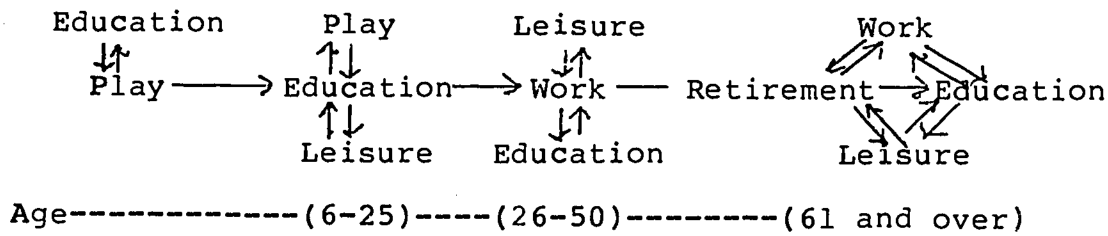

Figure 2. Modified linear-sequential life patterning.

In this context (Figure 2) education is recognized as a process that can enhance a variety of life's major experiences (i.e., play, work, leisure, retirement).

2. Adult participation in education has increased rapidly over the last 20 years.

Siegle (1978:3) reports that between 1972 and 1976, colleges saw an overall 22.5 percent increase in numbers. The under 25 age group increased only 13.9 percent while students over 25 increased by 44.6 percent "clearly indicating a shift in the overall age makeup of college populations." Total enrollment in adult and continuing education programs has increased by more than 50 percent over the past ten years (Richardson, et al., 1978). Further evidence of the change in age structure of college students can be found in Knoells (1976) and Munday (1976).

3. It is predicted that adult participation in education will increase in the future.

The reasons for past and present increases in older students can serve to support the hypothesis that the present trends will continue. First, "America is 'graying' at a faster rate than ever before." (Richardson, et al., 1978:41). In the next ten years the number of Americans over 60 will increase by 35 percent and those in the 50-59 age bracket will rise by 17 percent. By the end of the year 2000, it is estimated that half of the U.S. population will be over 50 years of age (Bergen, 1978).

A second reason for the increase in adult learners is the shift in the amount of leisure time presently available to adults. In 1945, the average work week was 43.4 hours long, today it stands at 37.5 hours (Bergen, 1978). In addition, people retire earlier and live longer than in the past. Thus, more people have more free time during both the working years and the postwork years.

Finally, the increase in adult learners is fostered by the growing need for personal and/or professional development imposed by an increasingly complex society.

4. Most adult education participants have a higher-than-average income and education level.

Fleurant's (1975) research indicates that the average income of participating adults was between $10,000 and $15,000 with "prime potential" in the $15,000 and up range. This premise is supported by Siegle (1978) who reports that professionals and persons in managerial positions are most likely to enroll in continuing education.

Educational background parallels the trend found in income vs. enrollment. As the level of educational attainment rises so does the potential for participating in adult education (Siegle, 1978; Fleurant, 1975).

5. Adults require a different educational approach than do traditional students.

The concept of adult-centered educational systems became known as andragogy. It can best be understood in its contrast with pedagogy--the traditional schooling system, or the total control of the content and learning strategy by the teacher. To use a pedagogic system for teaching adults is a paradox, a contradiction in terminology, yet it is attempted on a regular basis (Knowles, 1978).

Malcom Knowles, one of the primary proponents of andragogy, recommended a return to the androgogic teaching styles of Confucius, Jesus, and Aristotle. The teacher should help the learner, should act as an educational resource and should attempt to develop a learning process, rather than follow the traditional dictates of total control of the content and the learner (Knowles, 1978). Knowles further recommends that educators capitalize upon characteristics of adults; their ability for self-direction, their richness of experience, their readiness to learn, and their ability to apply their learning should be utilized to the fullest. Adults prefer short-term specific, application-based learning. It provides immediate reinforcement, benefiting both the learner and future educational programs (Simkins, 1977). Either Simkins (1977), or Srinivasan (1977) provides a wealth of material on nonformal adult education for anyone considering an adult program.

6. Although adult environmental education programs have followed established adult education program recommendations, many were unsuccessful in attracting and maintaining an audience.

The above statement is not meant to imply that the programs were not properly developed. For example, Presnell (1973) and Force et al. (1970) describe programs which the authors feel were of very high quality.

Nor have all programs been unsuccessful in attracting and maintaining an audience. In 1970, for example, the University of Wisconsin--Milwaukee implemented a TV course which had over 4,000 students enrolled and over 100,000 viewers. Their evaluation showed the program to be successful.

7. Vocational, technical, and general education certificate programs could offer opportunity for additional environmental education.

Technical training and general education (G.E.D.) has not been traditionally viewed by environmental educators as part of their domain. This literature survey indicated no infusion of environmental education within G.E.D. programs. However, the Moraine Park Board of Vocational, Technical, and Adult Education (1975) has developed a guide for integrating environmental education concepts into K-adult vocational-technical programs using the U.S. Office of Education cluster concept as a framework. The guide includes objectives, learning strategies, classroom materials and references for a variety of disciplines and suggests that problem solving has a potential role in the vocational curriculum. It demonstrates the potential for infusion of environmental education into other areas of adult education.

Recommendations

Clubs, organizations and institutions have participants who have already shown commitment. If we can identify which of their interests relate to environmental education and then provide appropriate education opportunities to facilitate these interests, we have the best potential for program success.

Once we have identified potential audiences, providing access to the education opportunities is a must. Regularly scheduled courses can be offered in a platooning system (8-4, 4-11 plus Saturday). This schedule will improve access for younger working students as well as older students. Allowing course registration without the entrance formalities of the traditional student has improved adult access to Michigan State University courses during the 1979-80 school year.

The teaching strategy for adults also needs modification. Adults participating in education have immediate expectations to be fulfilled. Therefore, our instructional objectives require greater specificity and immediate application to the work world or to their current interests. Most adult learning occurs in shorter time frames and is self-directed. Therefore, one-shot, evening, half-day or day-long experiences have the greatest potential. For the self-directed learner, library reference study guides, learning flow charts, and self study courses should be provided. To provide for social needs of the self-directed learner, learning webs and sharing groups are recommended by Illich (1970).

As Anderson (1978) has recommended, we must continue to infuse environmental education into the formal K-16 educational system where we have an opportunity to affect every student. But given the expansion of the adult educational market, we must utilize our knowledge, experience and commitment to broaden the environmental education emphasis.

A summary of recommendations based on the preceding discussions is presented below.

1. Program developers must identify group interests to provide programs which will meet group needs and meet environmental education goals.

2. Colleges and universities must provide easy access to current instructional programs.

3. Non-traditional students require scheduling which minimizes interference with primary commitments.

4. Adult students need application-based programs.

5. Social and academic needs of self-directed learners must be provided for.

6. Emphasis on complete infusion of environmental education into K-16 curricula must be continued.

7. Every opportunity must be used to meet the needs of non-traditional students.

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ENVIRONMENTAL EDUCATION AND HUMANISTIC EDUCATION IN THE 1980s: TREADING THE CONTENT-PROCESS TIGHTROPE

Jean MacGregor[1]

Whether we are environmental educators (teachers concerned with the environmental values and quality) or humanistic educators (teachers concerned with the dignity and integrity of people), we probably agree on the basic premise that the child, and society as a whole, can be fundamentally changed for the better through education . . . but that there are different ways of going about doing that. Some of the ways have to do with <u>content</u>: what learners are exposed to. Some of the ways have to do with <u>process</u>: how learners come to know what they do.

The tightrope analogy contained in the title of this essay comes from my sense that embarking into environmental education and humanistic education necessarily involves risk-taking, and requires a remarkable degree of delicacy and balance. And, the farther one goes in pursuit of either, the more balance is required.

Although many of us agree that environmental material and understandings can best be interwoven in existing curricula, it still involves substantially new content for most teachers. Further we often propose that this content be taught synoptically: that environmental issues facing the neighborhood, the community, the region, and world be addressed from a variety of disciplines at once.

Further still, the content--in terms of environmental issues--are subject to change, often rapid change. Who would have predicted ten years ago, for example, that synfuel development, fluorochlorocarbon regulation, deadly hazardous waste sites, or acid rainfall would be making front page stories today? The issues of the 1980s may well be these...or, they may be others. Perhaps new social issues will demand attention: those of equitable distribution of global resources...or the extent of the public's right to participate in rule-making and planning.

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And even further still, many of us concern ourselves with the processes of learning. I sense that this attention to process comes from a variety of quarters. First, environmental education, by its very nature, requires participation, and active involvement of learners in the natural and human-made environments at hand. Second, we environmental educators who arrived at the K-12 schools in the 1960s and '70s with this assumption observed what was happening (or, rather, what was not happening) in many teachers' classrooms, and perhaps fell into the role of the child who observed that the emperor was in fact naked. Many of us wondered if environmental education would not only solve environmental ills, but educational ones as well. Third, we began to piece together environmental education in the 1960s and 1970s, decades which one day may be regarded as the era of process education and humanistic education.

When the process of environmental education and humanistic education is discussed, it is essential to define what kinds of processes we mean, and what ends we have in mind. To name a few:

I. THE CONTENT PROCESS

To begin, there is simply the process of learning content. This is the age old emphasis of Dewey...I am not interested in what the learner knows, but how he comes to know it. Environmental education naturally embraces this view of process. Environmental educators, and outdoor educators before them, have long pointed out that one of the best vehicles for teaching anything is the real world--the environment at hand. Environmental education therefore is simply good educative process, or good education.

II. THE "SELF ACTUALIZATION" OR PERSONAL GROWTH PROCESS

A second kind of process, which humanistic educators espouse, has to do with self-development, with personal growth, with what A. H. Maslow termed "self actualization" (Maslow, 1968). The end is not merely the content learned' but the positive personal growth which has occurred. The emphasis is not just on behavioral objectives, but upon the freedom, value, worth, dignity and integrity of persons (Clute, 1978). As Don Michael (Michael, 1968) summarizes it,

> "...with regard to the education of the feelings, the self, the emotions: we must educate for empathy, compassion, trust, nonexploitiveness, non-manipulativeness, for self-growth, and self-teem, for tolerance of ambiguity, for acknowledgment of error, for patience, for suffering."

III. THE ENVIRONMENTAL ETHIC PROCESS

Still another set of processes has a different end in mind: that of environmental sensitivity with accompanying personal or civic commitment on the part of the learner. It is not enough that the student simply <u>knows about</u> the biophysical and social processes which make the natural and human-made environments tick. No. He or she must be exposed to learning experiences which engender attitudes of concern about environmental problems, and further still, a motivation to act on them (Stapp, 1969).

IV. THE INNOVATION--IMPLEMENTATION PROCESS

Lastly, because many of us teach teachers, we need to concern ourselves with the processes of introducing all these new emphases and ensuring that they meet with some effectiveness and success.

<u>But--where do the processes fit</u>?

I for one believe deeply in the value of an education that is experiential, and humanistic, and environmental, not only in traditional learning environments, but in the workplace as well. However, I would like to raise some questions that I feel we need to address if we work in public (K-12) education.

1. Do the humanistic and environmental ethic processes have a place in public education?

2. If so, how will they take their place?

I raise these questions because these processes are so very value laden. Try as we can to intellectually side-step this issue with the tenets of value-clarification, certain orientations cannot help but surface. To name just a few....

<u>Reductionist views</u> <u>Holistic views</u>

We attempt to depart from "hardening of the categories" and to view the environment and environmental issues by pulling together and synthesizing understandings from a variety of disciplines.

<u>Heirarchical systems</u> <u>Egalitarian systems</u>

We attempt to depart from Judao-Christian views of God-Man-Beasts-Earth, and to view ourselves (we and all living things) sharing a planet and in life processes on which we all depend.

<u>Nationalistic orientations</u> → <u>Global orientations</u>

We see that we can no longer just cope with environmental and social problems on a national scale, for so many affect the entire world. Further, problem-solving does not merely require the technical expertise of the industrialized world, but rather political and intercultural sensitivity and understanding of extraordinary proportions.

<u>Consumption assumptions</u> <u>Simpler living efforts</u>

We raise questions about the Madison Avenue formulae which say that "happiness/security = <u>things</u>" and "wants = needs," because economies built around nondurable and often faddish consumer goods have accelerated environmental degradation. We wonder (often vaguely) about simpler times, about "post-industrial" service-based economies.

<u>Public awareness</u> <u>Public participation</u>

We see that it is not enough for a citizenry to be merely informed of the workings of government; rather, it is fundamental that citizens who choose to be involved in policy formulation.

<u>Laissez-faire values direction</u> <u>Values clarification</u>

We feel that teachers should no longer avoid value laden issues, but attend to them with students with value clarifying exercises and explorations.

<u>Competitive learning</u> <u>Cooperative learning</u>

We in humanistic education raise questions regarding the assumptions (myths, to many of us) regarding the value of competition, and suggest some ways of learning which encourage cooperative behaviors among students rather than competitive ones.

Are these the processes that environmental education and humanistic education are <u>really</u> about? All this is pretty reformist stuff.

Admittedly, content and processes in public schools and in the educational world in general are already value-laden, I suspect with the processes noted above on the left. Yet, here we are with an agenda that espouses some rather differing ways of looking at the world and at ourselves as well. This is an agenda which could well come under increasing fire in the coming years of economic retrenchment and nationalistic fervor.

Each of us, I believe, needs to work out for ourselves, the ethics and the ends of the content and the processes we choose to use, and furthermore, to be able to articulate it to all comers. Are we EDUCATORS using the environment because it provides "relevant content" and "good process"? Or, are we venturing further out there on the tightrope, as humanistic and/or environmental REFORMISTS, using educational arenas to achieve our goals? Or, somewhere in between?

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A REPORT ON PROJECT EASE: ENVIRONMENTAL APPROACHES TO SPECIAL EDUCATION

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Introduction

At Murray State University in west Kentucky, a project is underway that was developed to utilize environmental teaching techniques with a special population of students, those with physical and mental disabilities. Project EASE, "Environmental Approaches to Special Education," resulted from the collaboration of environmental educators and special educators responding to the needs of many "regular" classroom teachers who now have handicapped students "mainstreamed" into their classrooms for all or part of the school day. This placement of handicapped students into regular classes is due in part to legislative mandate, P.L. 94-142, the Education for All Handicapped Children Act of 1975, which requires that handicapped children receive a free, appropriate public education in the least restrictive environment possible. For most mildly handicapped students the least restrictive environment is the regular classroom. Because of the relative newness of the "mainstreaming" process, most regular teachers have not had training in working with students who have handicapping conditions. Therefore, inservice projects like Project EASE have been funded by the Office of Special Education, U.S. Department of Education to assist regular educators in acquiring new skills. In Project EASE, environmental education is being used to orient teachers to "hands-on" learning processes and to provide them with new and exciting alternatives for teaching all of their students.

Project Design

The primary goal of Project EASE is to promote systemic change in Local Education Agencies (LEA's) in delivering

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services to handicapped children. This is accomplished by organizing leadership, support, and instructional teams in each participating school system. The teams are then trained through a two-week summer institute and a series of follow-up workshops. The instructional team, made up of the principal, three regular classroom teachers, and a special education teacher, all from the same school, develop goals and objectives for target children with special needs. To aid in the identification of these children and to serve as consultants in the development of additional instructional strategies, Project EASE field consultants visit each participating school at least once every two weeks. Team meetings involving administration and support personnel from the leadership and support teams, as well as instructional team members, are held during the site visits to discuss progress and problems occurring as a result of the teams' activities. Throughout the training sessions and school visits, personal development, as well as team growth, is emphasized.

During the second year of participation in EASE, school personnel develop and implement an inservice plan to assist other professionals in their system in serving handicapped students. The objective is to create a "ripple effect," i.e., a continually expanding base of specially trained educators.

Environmental Education and Project EASE

In Project EASE, environmental education is a teaching/learning process that has two main ingredients--people and the environment. Environmental teaching is centered around people interacting with one another and with the world around them. It is an interdisciplinary process that recognizes the wholistic nature of both the world and people. Therefore, environmental education involves learners in multi-sensory, hands-on, life-centered experiences that enable the learner to be involved in cognitive, affective, and psychomotor development.

One way to approach the wholistic nature of people is to recognize that each person has the potential to think, learn, and express himself in a variety of ways. These 'mental processes' vary in strength from person to person depending on genetic and environmental influences. Among these processes are analysis, abstraction from an image, time scanning, matching, transforming, manipulating elements, and using analogies, metaphors, and intuition. Through environmental education people can increase their use of these processes in solving problems.

In a classroom that is suffering from the "book and ditto sheet" syndrome, the environment is so limited that for many students only a few of their processes can be utilized; thus, the students are limited in what they can learn, as well as in what they can express. In a diverse, expanded learning environment that includes not only the classroom's resources, but those of the entire building, the school yard, and the community, students are offered the opportunity for more multi-sensory, multi-process learning experiences. Through environmental approaches, classrooms can become reflections of the greater world, where "chunks of life" can be used in teaching and learning.

For the mainstreamed "special education" child a diversified learning environment can be especially helpful. Most of the students being mainstreamed into regular classrooms are mildly handicapped, often diagnosed as Learning Disabled, Behaviorally Disordered, Educationally Handicapped, or Emotionally Disturbed. These labels do not indicate what the student's real instructional problems and needs are. However, the labels do indicate that these students have not been successful, particu' rly in classrooms that are typified by abstract, highly rational, and non-diversified teaching modes. Many special educators have long recognized that people have different learning styles (or modalities) and that honoring persons' preferred modalities (e.g., kinesthetics) increases learning and may even improve upon their less successful learning styles. Through environmental teaching, students are provided with opportunities to use different modalities, to get involved with the material to be learned, to process data in different ways, to really think about what they are experiencing and to later express what they did.

Using environmental education with children who have problems learning in traditional classrooms is an accepted idea, although not a widespread one. Many classroom teachers have had little or no opportunity to experience wholistic environmental education activities themselves, and it is very difficult to teach them in a manner never experienced. Therefore, Project EASE workshops are designed to provide participants with experiential, hands-on activities. In this way, Project staff serve as models to help participants find out what to teach and also how to teach in a way which better meets the needs of all students.

As Project EASE enters the third year of operation, the results that the teachers are experiencing in their classrooms are very encouraging. Many of them are finding that environmental education activities not only help their "special education" students learn better, but also benefit their "regular education" students. They report that with experiential, hands-on environmental approaches they are able to access many different learning modes in each student. The richness of using real life and real life experiences in their teaching is expanding the learning process for students who had previously failed under the "book and ditto sheet" syndrome. Project EASE teachers are discovering that environmental education materials, such as Project Learning Tree (PLT), Outdoor Biology Instructional Strategies (OBIS), and Acclimatization offer a wealth of choices in matching students' needs with appropriate instructional experiences. They are also realizing that many students are more motivated as they discover more of themselves (their mental processes) in their learning. Low self-concepts, often a problem with mildly handicapped students, are enhanced as these students experience success in learning.

Expanding the students' learning environment may create some management problems, both in terms of children's behavior and in instructional/materials management. Teachers begin to ask questions such as: "How do I know when a child is ready to do an individual exploration?" "How do I control 25 children who are exploring the school yard?" "How much diversity and freedom can Johnny handle?" "How do I organize three different learning centers?" "How do I evaluate such multi-faceted learning experiences?" In order to meet this need, Project EASE staff also assist teachers in discovering ways to manage an "environmentalized" classroom curriculum as well as to utilize behavior management techniques.

Many teachers also benefit in a very personal way from Project EASE. As they involve themselves in the workshops and site visits, they become more aware of themselves as persons, their potential in the classroom and their relationship to the world around them. In the final analysis, this kind of personal growth is the key to the Project's success.

CALIFORNIA WILD AND SCENIC RIVERS: A VEHICLE FOR PRESENTING THE ROLES OF ENVIRONMENTAL PROFESSIONALS TO UNDERGRADUATES

Richard L. Perrine[1] and William Dritschilo[1]

A recurring question within undergraduate education is the proper role for the professional (see Sagen, 1973, and references therein). In what ways can professionals, as members of a faculty, best contribute to the basic educational needs of undergraduates? What do undergraduates need to learn about the role and future of professions in society to best select their own future educational pathways?

It seems clear that in our present resource-dependent, environmentally conscious society, the influence of environmental professionals is pervasive. If environmental goals are to be properly selected and achieved, there is a distinct social need for the public to understand better the strengths and limitations of professional expertise. There also is a need to understand the background and experience the environmental professional requires and that he or she brings to a role. To provide such understanding, college students must be exposed to the professional role itself, particularly to how professionals apply basic concepts to practical problems. Such exposure should be differentiated clearly from a serious effort to develop actual professional competence. To be most useful, the exposure should illustrate how, from any of the group of relevant basic disciplines, theoretical ideas can be applied.

The UCLA Freshman/Sophomore Professional School Seminar Program

Students at UCLA have the option through the Freshman/ Sophomore Professional School Seminar Program of learning how faculty across a spectrum of the professions (medicine, public health, engineering, environmental scientists, etc.) put the basic knowledge of academic disciplines to the test. During each academic period, a number of seminars are offered, giving students an opportunity to learn the nature of professional work and the role of professionals in society. Students either desire a future as environmental professionals or have a desire to learn about environmental problems even though their career goals are in unrelated areas.

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Environmental Science and Engineering (ESE) faculty, seem ideally suited to the Seminar program. They address critical issues; they illustrate the interdisciplinary character of many professional activities; they test current concepts and methodologies in the light of actual experience. We have used case studies performed by teams of graduate students and faculty, either currently underway or just completed, as vehicles for revealing the professional's role. A representative case study, "California's North Coast Wild and Scenic Rivers: Analysis of Inter-Agency Planning and Technical Issues," has proven to be a successful Seminar vehicle.

Protection of California's North Coast Wild and Scenic Rivers

The north coastal area of California is both valuable and vulnerable because of its abundance of natural resources, especially rivers and timber. ESE (1980) presents detailed research results and a bibliography of books, technical papers, newspaper articles, and government documents, many of which were used for the seminar.

Within some 13 percent of the land area of the state lies 40 percent of its natural surface water supply. Two-thirds of the north coast runoff flows through basins designated as wild and scenic: the Smith, the Klamath-Trinity, and the Eel-Van Duzen river basins. The need for management to preserve certain resource qualities is not an issue; it is accepted by almost all with an interest in the rivers. Differences emerge in determining what constitutes preservation of the rivers and in defining what is needed to accomplish such a task. The reason for this situation is that the preservation of a river is a complex matter involving many elements: the water itself, its quality and quantity, the fish and other organisms living in the water, the wildlife living near it, the forests and grasslands that surround it, and the minerals deposited in and around the streambed. How these components are managed can affect the economy, lifestyle and quality of life not only of the local residents, but also of a larger, statewide population that has an interest in these resources.

Aside from the technical issues concerning water quality, forestry, fisheries, wildlife habitat and their interrelationships, basic perceptions of resource value differ greatly. For some, wilderness itself is a resource whose preservation requires that only natural processes occur. For others, conservation means efficient use of the resources. This dichotomy in conservation goals traces back to the controversy over the Hetch Hetchy Reservoir, which led to the formation of the Sierra Club early in this century. Decisionmakers must balance the two views in such a way that future generations will also benefit from the resource.

Long-range water resource planning is particularly vulnerable to the dichotomy of economic growth versus maintenance of rivers in their natural state. California economic growth has been intimately linked to water development: to dams, reservoirs, canals, and hydropower. In the north coastal region, the timber and wood products industry has dominated the economy. But watersheds have recently been recognized as having economic value aside from their exploitable resources. Services to society such as cycling of nutrients, binding of soil to prevent erosion, and breakdown of organic pollutants are provided free by ecosystems, while cost is incurred when these natural processes are interrupted.

There is a mixture of outlooks and opinions among people in the region. Hearings held on management plan proposals have been heavily attended by interest groups and local residents, all concerned about the future of the area. One set of views posits that existing regulations--timber harvest plans, water quality planning, and fish and game regulations--adequately protect from environmental deterioration and that any further, future management should be under local control. Other interest groups argue that more stringent regulation is essential.

The nature of water is such as to transcend bureaucratic boundaries. Management of the resource is spread among a variety of agencies, many with competing goals and interests. Portions of watersheds are under jurisdiction of federal, state, and local government. Conflicts arise in determining who should be responsible for river preservation. Because of the involvement of so many groups, each oriented to a specific function, effective water management becomes very difficult. Local planning agencies have been designated as probable management plan implementors, though they are likely not to be in full agreement with the specifics of the plans. The effectiveness of such an approach seems uncertain and likely to open the door to further controversy.

Seminar Presentation

This, then, is the subject matter for our Seminar presentation: a "live," current, environmental problem of major statewide concern, complete with current management plans, public hearings, and many fascinating related problems (such as the future of the Hoopa Indians). Our initial approach with the Seminar is conventional. We show slides, interpret maps and assign a wealth of literature for reading. Reading is technical, socio-political, and legal, developed from our own research and from testimony at public hearings. The groundwork has been laid by the research our faculty and graduate student assistants have done earlier, and also by the lengthy documents prepared by numerous state and federal agencies. Thus, students learn to mine the wealth of knowledge available to them from the full range of sources extending to include current news and personal contacts that might prove useful in the solution of some future problem. Students are led through almost the entire process from assessment of the resource and formulation of the goal, to the legislation framed to meet the goal, to the plans to implement the legislation.

Students also need to express what they have learned before a critical audience and to sharpen their wits under (possibly) hostile cross-examination. Consequently, we require that they regularly participate in oral discussion of the issues raised, with the typical result that they soon learn to parry critical thrusts through use of scholarship. Well written reports are also essential. We have found it particularly useful to let students role play, writing their required report from the viewpoint of one (or a group) of the actors in the drama; for example, the manager of a local sawmill, providing most of the employment for 50 miles in any direction. They have found this to be a challenging assignment, quite different from the usual term paper. We even have asked seminar students to remake legislative and regulatory decisions while playing the roles of a representative cast of interest groups. To do so impresses them very quickly that there is no easy, environmentally sound and economically attractive solution for many of our major problems.

Conclusions

We conclude that by their nature, environmental problems constitute a useful set of examples of how professionals function in our present-day society. The UCLA Freshman/ Sophomore Seminars addressing such problems seem to be among those most closely and ideally approaching the teaching targets originally set for the Program. There are several probable reasons. First, the problems selected for discussion are "live," with current activity and interest. Second, almost every disciplinary interest is actively represented: seminars address history, resources, values, and the natural environment of a region; they address comprehensive planning for futures, the methods for implementation, and likely actual consequences. Third, we have carefully programmed our presentations so that a wealth of source material is at hand, ready for use, and fresh in the minds of participating faculty. In combination, these circumstances provide an effective framework from which to present philosophy, goals, methodology, and technical background for the education of environmental professionals. We believe such experience can be equally beneficial to those with professional aspirations and to "just plain environmentalists."

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LITERATURE AND FILM: CULTURAL DOCUMENTS OF THE ENVIRONMENT

Arthur B. Sacks[1]

First some truisms. Literature and film are products of individual and/or collective imagination and genius converging at a particular time and place. Necessarily, literature, film, all aesthetic objects are artifacts of a particular culture and reflect the temper of the age and the forces that shape thought and action within a given society. Art is wedded to the world, it cannot be otherwise, and even the dreamiest of works, the most surreal of productions is a part of the soil of the planet, the substance of the earth. Books and films are historical documents, and they capture moods and values, attitudes and beliefs, which freeze society. As such, they are the tools of the historian, the windows through which the critic may peer to witness the land scape of the past, the weather of human action. When shown to an audience as shadows dancing on a screen, when produced on a stage or recited before a crowd of silent participants, images that move and utterances that reverberate in the bones of the middle ear recreate the drives, thoughts, passions, anxieties, prejudices, motives, inclinations, madnesses of the past filtered through the consciousness of the present and the individual caught in the present. And hence, like all other phenomena, they are perceived from the vantage point of the perceiver, and tell the viewer, the listener, the reader, through his or her reactions and reflections at least as much about the present as about the past, at least as much about the perceiver as the object perceived and the object's maker.

If we have learned anything from ecology, indeed, if we have learned anything in the past 50 years, it has been the lessons of the connections among phenomena, man-made and otherwise natural. The shinbone is connected to the kneebone, the kneebone to the thighbone. Literature and film help us understand these connections and ourselves--and in so doing they are useful, relevant to an understanding of the ways humankind affects the environment.

More directly, literature and film often deal explicitly with the effects of human action on the environment, the interconnections between the environment and humanity... Chekhov's The Cherry Orchard, Ibsen's The Public Enemy, William Carlos Williams' Paterson, Shakespeare's King Lear, Hamlet, and The Tempest, Cervantes' Don Quixote, Faulkner's

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Go Down Moses and all the novels of Yawktapanawpha County, Wordsworth's Lyrical Ballads and Prelude, Gary Synder's Back Country and Turtle Island, Wendell Berry's Openings and Farming, Chaucer's Canterbury Tales. Fiction, poetry, drama. Sixteenth century, 20th or 14th. And so too for non-fiction, Thoreau's Walden, Leopold's A Sand County Almanac, etc. And as well for film: Jaws, King Kong, The African Queen, The Treasure of Sierra Madre, Dr. Strangelove, Derzu Uzala. Environmental themes caught in different media: attempts to understand the place of humankind in nature, to understand the nature of Nature, and, in the 20th century, attempts to weld the fragments of social and religious order overturned by Darwin and Marx, Malthus and Freud into an integrated whole where harmony is once again realizable.

So literature and film help us to understand our environment and the effects humans have upon it (1) because it is the nature of art to do so and art cannot escape from itself; and (2) because some works explicitly examine these relations overtly, i.e., it is the subject of the works. The study of literature, film, by extension, all of the visual and plastic arts, can help the student of the environment to understand his or her subject, the scholar to interpret the role culture plays in human behavior as it affects the environment, and the environmental activist to better comprehend social forces. By so doing, such study can help effect social and political change for the benefit of the global ecosystem.

In The Comedy of Survival (1974), Joseph W. Meeker notes succinctly:

> "The origins of the environmental crisis lie deep in human cultural traditions at levels of human mentality which have remained virtually unchanged for several thousand years. The premises upon which our culture has been built are powerful and durable, and their weight upon us must be appreciated before we can hope to alter their structure." (p. 6)

> "Industry, technology, the exploitation of the earth and the aggrandizement of mankind are governed by ideas, faith, and mythology. The cultural images describing what we might be have helped us to become what we are: however the human mind images the world, that is how the world tends to become...That is what a cultural tradition is for, and our institutions exist in order to pass such models along. Education acquaints each new generation with the models of life and thought available from previous generations." (p. 7)

For thousands of years literature has been one of the primary vehicles for transmitting the models of our heritage, and perpetuating these. Film and more recently television have joined to become the major transmitters of culture to mass audiences, have, because of their sensory power, become the principal vehicles for educating our young to the images of the world's body and what is right and good.

And what is at the heart of literature and film but an understanding of man's place in the universe. Literature and film are profoundly interested in the relationships of humans to humans, nations to nations, culture to culture, humans and nations and cultures to the world. Meeker has identified a new field of inquiry, literary ecology, ecology as applied to letters which can be extended to the world of film. Meeker defines literary ecology as "the study of biological themes and relationships which appear in literary works" (p. 9). "It is simultaneously," Meeker goes on, "an attempt to discover what roles have been played by literature in the ecology of the human species" (p. 9). This form of inquiry helps us understand the philosophical and cultural underpinnings of human action and belief, help us trace the history and cultural ideologies that have contributed to environmental degradation and crisis. As a field, literary ecology "makes it possible for us to study the function of literary art as it influences the survival of the human species" (p. 10).

Throughout Meeker's work, he is concerned with the role of literature solely. However, film and other artifacts of culture--painting, sculpture, architecture--can and should be analyzed in like manner. Literature, film, painting and, architecture reveal factors and assumptions such as the following which have been at the heart of environmental exploitation:

(a) Man is at the center of the universe and nature exists for man, to be used by man, to be dominated by man. This assumption is as old as Genesis: Adam is given "dominion over the fish of the sea, and over all the earth, and over every creeping thing that creepth upon the earth." Whether dominion translates into stewardship or rape is not essential, in either case it is man who decides values, purpose, worth of the natural world, and determines use.

(b) The universe is directed and there are standards of correct human behavior which involve truth, honor, justice, and these forms exist above the natural realm, are in fact detached from the environment, are pure abstractions devoid of natural phenomena.

(c) Individual development and growth, the romantic involvement with individual personality, separates man from man, man from the natural world.

The study of literature, film, etc. should be incorporated into environmental education and environmental studies curricula in an effort to bring to light assumptions such as these. Doing so would provide valuable insight into the culture which affects the environment, at the same time making students more sensitive to language and image, to history, human thought, and human psychology.

This can be done more easily than is imagined. Literature and film study can be built into an environmental studies degree or an environmental major by fashioning a course or at least designing part of a course around the subject. Invitations to guest lecturers would reduce the need for permanent personnel, but permanent personnel should be sought if dollars allow. The works of literature and film are readily available for use, and our society has a ready supply of qualified individuals able to introduce students to the humanities and explore the unquantifiable aspects of environmental degradation and crisis. It is an aspect of environmental studies and environmental education which has been overlooked for too long and deserves more than the lip service currently paid to it.

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AN ANALYSIS AND EVALUATION OF A FIELD TRIP SERIES

Thea Teich[1] and Robert D. Townsend[2]

Background

Field trips have long been recognized as valuable educational methods. The best field trips are "something more than passively accepted journeys from place to place; (they are) active exploratory experiences" (Dale, 1969).

When most people think of field trips, they think of elementary school and buses lined up at museums, botanical gardens, or science and technology centers. But the non-compulsory field trip has become a popular means for individuals to see and learn under the direction of a knowledgeable guide. Offerings range from the day-long canoe trip through a National Forest offered by the Carnegie Institute to the several-week visit to the Galapagos Islands advertised by commercial tour companies in Audubon or Natural History.

These programs are taking advantage of a recently recognized phenomena in this country: interest in "lifelong learning." This interest is not particularly new; non-formal courses and classes have been offered by civic centers, "Y's" and other organizations for many years. But, because of major societal changes-increasingly older population, divorce rates, changes in family life patterns, mid-career job switches--"our views of education particularly as to whether it should all be packed into the early years, are shifting" (Peterson, 1978). Thus, the educational community is recognizing the potential of this emerging audience and is also realizing that its demands are different from those of the traditional educational audience--children. "Lifelong learning is a conceptual framework for conceiving, planning, coordinating and implementing activities to facilitate learning by all Americans throughout their lifetimes (Peterson, *et al.*, 1978). But this framework involves some qualifications. It does not mean further compulsory education, nor does it limit learning to in-school programs. Indeed, lifelong learning is a basis for integrating formal and non-formal educational institutions as well as other organizations, public and private, concerned with the development of people.

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Thus, an interest in learning has become more widespread than it may have been in the past. Environmental educators can take advantage of this interest by expanding their offerings to non-traditional audiences, such as senior citizens and one-parent families, or by experimenting with different educational methods or programs. One of these is the field trip which enables participants to relate what they have learned in their formal schooling, to what they have learned in the outside world and vice versa (Dale, 1969).

In 1976, the Carnegie Museum of Natural History and the Western Pennsylvania Conservancy, both of Pittsburgh, Pennsylvania, embarked on a cooperative project to increase public knowledge of the natural world, ecological concepts, and human impact on natural systems. At the same time, the two organizations decided it was also necessary to increase the availability of information about their functions. Through the Leonard S. Mudge Environmental Education Program of the Carnegie Museum of Natural History, the "Out of Doors Days" series of workshops and field trips was developed to provide an annual program of activities for adult and family groups concerned with hands-on nature study and environmental education.

Description of Field Trips

The programs were originally designed as a combination Thursday night workshop and Saturday field trip package. This has been modified and in 1979 programs were offered in various formats. These are listed below:

--Life in French Creek: a canoe trip along a tributary of the Allegheny River, stopping at islands and sand bars to search for aquatic life.

--Bird Tracks: an excursion to Carnegie Museum of Natural History's Powdermill Nature Reserve, the largest inland bird banding center in the country to examine the ecology of the area.

--Tales Fossils Tell: a fossil collecting trip to sites close to Pittsburgh plus a special tour of a deep coal mine to examine the geological formation of the area.

--Life on the Peninsula: an overnight trip to Presque Isle State Park, in Erie, Pennsylvania, and nearby Watsburg and Titus Bogs to examine the unique flora and fauna of each area and to view successional changes.

--A Day at Bear Run: a program centering on the Western Pennsylvania Conservancy's property at Bear Run and Fallingwater, and why these are protected as reserves.

--The End of the Glaciers: a trip to several sites near the end moraine of the Wisconsin glacier in Pennsylvania to examine how the glaciers shaped the topography of the region.

--Farms of Pittsburgh: a cooperative program with the Allegheny County Cooperative Extension Service to look at farms and agricultural problems near Pittsburgh.

Out of Doors Days Survey Instrument

At the conclusion of each field trip, participants, including children, were asked to complete a 14-item questionnaire. These included: original source of information, participation in previous trips, reasons for participation, strong and weak points of the program, value of the Thursday night introductory workshop, effect of gasoline shortages and prices on interest in series, membership in sponsoring organizations, participation in other museum programs, number of annual visits to the museum, age, occupation, and distance traveled to the museum. Questionnaires were distributed during the return trip and collected upon arrival at the museum. Data was tabulated and analyzed utilizing the Statistical Package for Social Sciences (SPSS) Subprograms: Frequencies, Pearson Corr, and Crosstabs.

Description of Participants

Our analysis indicates that 64.4 percent of field trip participants were members of Carnegie Institute and 17 percent were members of the Western Pennsylvania Conservancy; 21.7 percent were members of both organizations. However, 59.9 percent had not participated in any other educational program of the Institute. Almost all (99.2 percent) of the participants indicated they enjoyed the field trips although 15.3 percent noted that the programs were different from what they had expected.

Participants' ages ranged from 5 to 75, although some field trips had minimum age requirements. Participants under 20 years formed 16.4 percent of the population, while 54.3 percent were more than 40 years of age. Senior citizens (people over 60 years) constituted 22.9 percent of the group.

Participants' occupations ran the gamut of student through retiree. Students and individuals employed in education accounted for 39.1 percent of the participants. Blue collar workers accounted for 1.8 percent of the population. Participants' occupations are summarized in Table 1.

TABLE 1: PARTICIPANTS' OCCUPATIONS

Occupation	Percent (%)
Student	22.2
Homemaker	11.6
Clerical	4.9
Blue Collar	1.8
Business	8.9
Science/Technology	11.6
Education	16.9
Retired	14.7
Other	7.6

N = 253

Our findings indicate that nearly one-half of the program participants first heard about Out of Doors Days through either the program brochure or Carnegie Magazine, both published by Carnegie Institute. An unexpectedly large percentage (28.1 percent) first obtained information through word of mouth. Participant sources of information are summarized in Table 2.

Because of the current energy situation, two questions were asked concerning the impact of gasoline shortages on participation in the field trip series. Difficulties in obtaining gasoline had affected the summer traveling plans of 38.4 percent of the participants and 33.8 percent indicated that their interest in Out of Doors Days had been affected by these shortages. Despite this concern, one-third of the participants traveled ten or more miles to the field trip starting point. Another third traveled five to ten miles.

TABLE 2

PARTICIPANT SOURCES OF INFORMATION ABOUT OUT OF DOORS DAYS

Source	Percent (%)
Out of Doors Days Brochure	22.0
AM Pittsburgh Television Show	2.0
Newspaper	4.3
Carnegie Magazine	27.3
Pittsburgh Magazine	6.3
Western Pennsylvania Conserve	6.3
Word of Mouth	28.1
Other	3.7

N = 253

Subject matter, expertise of leaders, and provision of transportation ranked highest under reasons for participating in Out of Doors Days. Connection to the Carnegie Museum of Natural History did not contribute significantly to decision-making about participation. Reasons for participation in Out of Doors Days are summarized in Table 3.

TABLE 3

REASONS FOR PARTICIPATION IN OUT OF DOORS DAYS

Reason	Percent (%)
Subject Matter	87.3
Participatory nature of trips	67.1
Connection to Carnegie Museum of Natural History	38.1
Reasonable cost	69.2
Provision of transportation	74.6
Expertise of leaders	76.2

N = 253

Conclusions

From our analysis, we conclude:

--membership magazines and direct mail are more effective than the broadcast media and general print media in publicizing the field trip series. More than half of the participants were informed by the first two.

--once people participate, they tend to participate again and subject matter and leadership expertise are the major reasons given for participation. These "content" reasons are then followed by the logistical ones: provision of transportation and reasonable cost.

--the value of the evening introductory workshop tended to vary as to the background and ability of the presentor. The interest and enjoyment levels indicated by the participants remained fairly consistent over all the field trips. Their opinions of the Thursday night workshop varied greatly.

--the majority of the audience for the field trips were over 40 years old and lived within ten miles of Carnegie Institute.

Implications

The study has several implications for similar programs or educators contemplating such program development.

--an audience can be found in urban, mature populations.

Programs and activities geared primarily for youthful audiences may find increased participation if modified for this older audience.

--people who are members of the educational institution sponsoring a program tend to be more likely to participate in the program. Members participated in more educational offerings of the Carnegie Institute than did non-members. Similar institutions might utilize membership as major sources of program participation, or use specific programs as incentives for increasing membership. Significantly, non-members tended to learn first about the field trip series through word of mouth.

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THE OHIO STATE-YOUTH CONSERVATION CORPS EXPERIENCE

Robert D. Townsend[1]
and
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During the summer of 1979, The Ohio State University's School of Natural Resources joined with The Ohio Department of Natural Resources to conduct an eight-week, residential Youth Conservation Corps (YCC) Program at the 1300-acre Barnebey Center for Environmental Studies, located near Lancaster, Ohio. This event marked the first time a residential camp was established on a university-owned facility for the purpose of making improvements to that facility.

The program consisted of two, four-week sessions. Personnel representing three School of Natural Resources divisions were selected as staff. University faculty members from all the divisions visited the facility during the summer and provided the technical expertise.

Forty-eight teenagers (ages 15-18), randomly selected from throughout the state and representing 28 of Ohio's counties, participated in the two sessions of this work, earn, and learn program. A majority of the campers (72.7 percent) were from cities of more than 100,000 people. Minorities accounted for 13.6 percent of the total and 52.7 percent of the campers were male. The mean age of the campers was 16.1 years.

The majority of the work sites were located on the Barnebey Center facility. Projects involved campers in a variety of conservation-related activities, some of which helped improve and maintain the Center for Environmental Studies. Work projects were selected from a ranked list of tasks, involving input from all the division chairmen within the School of Natural Resources.

The teenagers participating in the program were energetic, enthusiastic, and extremely competent in performing the labor-intensive duties assigned them during the four-day work week. Timber stand improvement, wildlife habitat improvement, and trail reconstruction and maintenance were

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interrelated, ongoing projects throughout the summer. Other improvements to the Barnebey Center facility included: fence construction around the sewage treatment plant, painting, spring development, service road improvement, bridge construction, erosion prevention measures, prairie maintenance, and litter clean-up. The estimated value of these services totaled $46,400. Public service work projects were conducted for the Ohio Division of Natural Areas and Preserves and the City of Lancaster Parks and Recreation Department. Activities included trail maintenance, fence construction, and work on a demonstration model solar home; the campers not only made a contribution to the construction of the solar facility but they learned about the practical use of geo-solar energy.

Locating a YCC program at the Barnebey Center provided a unique educational experience for many campers. The Center is located two miles from the nearest paved road, and it is possible to go for hours without hearing the sound of an automobile. Environmental education experience was continuously occurring and spontaneous. Deer, wild turkey, ruffed grouse, and a variety of other wildlife inhabit the area. "Teachable moments" seemed to occur almost all the time. Formal environmental education was provided on the site of each job, in evening programs, and on weekend field trips. Campers visited operating strip mines, Indian mounds, state parks, and museums. Care was taken to include the state and local history and culture of the area into the environmental education curriculum, drawing upon local residents as resource people. Activities conducted onsite included stream and pond studies, a forest-plot study, orienteering, small mammal trapping (all were released), and geology studies. (Interested individuals may obtain copies of the "environmental awareness scorecard" and environmental education curriculum outline by writing to the authors.)

At the conclusion of each session, campers were asked to complete an End-of-Camp Questionnaire to provide background information on selected demographic variables and to assess camper attitudes toward the work program, the environmental education program, the program staff, and the facility. Participation in this activity was voluntary but all campers completed the evaluation form.

Analysis of the data provided by this questionnaire yield the following findings:

--With respect to their overall feeling about the YCC summer experience, an overwhelming majority of the participants (92.7 percent) awarded the program the highest possible rating.

--Over half of the campers indicated that they desired to seek natural resource-related careers. Forty percent indicated they will attend Ohio State.

--Members of minority groups felt less positive about their YCC experience, and indicated that they learned less about the environment than non-minority group members.

--Older campers exhibited a more positive feeling about the YCC experience.

--Campers from large population centers tended to feel more positive about the usefulness of what they learned in their home environment than did campers from rural areas.

The future of the Barnebey Center YCC Program looks bright. Robert W. Dick, Program Specialist to the Regional Director of Region VI Youth Conservation Corps Programs, in an onsite evaluation stated, "The Barnebey Center Program was the best camp I have visited in the Region--a truly outstanding camp." Dan Atzenhoeffer, YCC Program Manager-Ohio, states, "The Barnebey operation was a great one. I look forward to its continuance and expansion in 1980." The Barnebey YCC Program provided the unique opportunity for the University, The School of Natural Resources, and the Ohio Department of Natural Resources to cooperate in the development of a residential educational experience that can serve as a model for others around the nation. The effort continues. In spite of inflation, budget cutbacks, and program curtailment at the state and federal level, the Barnebey Center YCC Program has been funded for the summer of 1980.

SECTION II:
RESEARCH AND EVALUATION - REFEREED PAPERS

SECTION II: RESEARCH AND EVALUATION - REFEREED PAPERS

The twenty-two papers which comprise this section are organized within six categories. Categories contain as many as seven essays, as few as one. All of the essays attempt to reflect on problems and issues deemed significant to environmental researchers and educators. These essays draw upon existing scholarship and many are based upon the findings of new and original research. The scope and diversity of the material contained within this section is indicative of the broad range of interests contained under the environmental education/ environmental studies umbrella. At the same time, although the depth of analysis varies, these essays underscore the high level of professional attention to inherently interdisciplinary problems which must be faced if they are to be solved, and which must be solved if the human enterprise is to survive.

ENERGY AND TRANSPORTATION

John H. Baldwin, ENERGY AND THE ENVIRONMENT IN THE 1980s.

Toufiq A. Siddiqi, ENERGY POLICY ISSUES AND THE ENVIRONMENTAL AGENDA FOR THE 1980s.

Kevin C. Gottlieb, THE ENERGY-ENVIRONMENT CONUNDRUM: A VIEW FROM THE CONGRESS.

J. Edward Anderson, DESIGNING TRANSIT TO MINIMIZE URBAN COSTS AND ENERGY AND ENERGY USE.

Gene Bammel and Lei Lane Burrus-Bammel, ANALYSIS OF MORGANTOWN'S PERSONAL RAPID TRANSIT SYSTEM.

ENERGY AND ENVIRONMENT IN THE 1980s

John H. Baldwin[1]

Abstract. *The resource requirements, environmental impacts and the most likely contribution of each energy production alternative in the United States in the next decade are analyzed. Critical impacts and resource problems are summarized. Policy issues relevant to the resource and environmental impacts of energy are discussed.*

Introduction

In the last decade, the "energy crisis" disrupted the socioeconomic system of the United States. In its attempts to assure a reliable and affordable domestic supply of energy, the United States government is embarking upon, or supporting several programs that could have serious and irreparable environmental consequences. This paper reviews the major environmental impacts from energy in the next decade, following what appears to be the most likely mode of development. It is hoped that in doing so, the environmental advantages of the alternative, renewable path can be revealed.

II. Energy Forecasts

To assess the environmental consequences of energy in the next decade, reasonable estimates of the most likely level and composition of energy supply are needed. Prior to the 1973 oil embargo, United States energy forecasts routinely projected total energy growth rates between 3 and 4 percent annually. At that growth rate, energy demand in the year 2000 would be over two and one-half times the 1970 demand. Similarly, electrical demand was forecast to increase at approximately 7 percent per year, resulting in an eight-fold increase in demand between 1970 and 2000.

Since then, energy forecasts have dramatically changed. High prices, domestic shortages, health and environmental damage, and threats of catastrophic accidents have dampened demand and lowered forecasts (see Figure 1). Hundreds of forecasts of future energy demand have been published recently. (For a summary of 78 forecasts see Broadman and Hamilton, 1979.) The outcome of these forecasts often vary more by their assumptions than their technique of analysis of analytical

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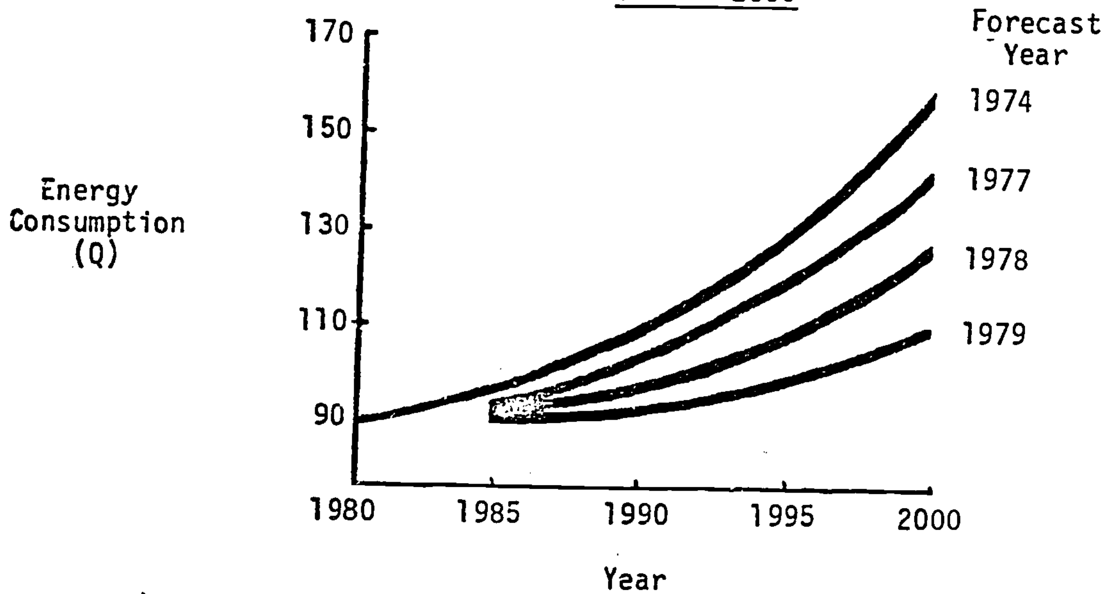
sophistication. In a recent study by the National Academy of Sciences (1979), the basic assumptions concerning growth in GNP, personal demand for energy, and energy price were varied within a reasonable range of estimates, giving forecasts of energy consumption in the year 2010 ranging from 56 to 159 Quadrillion BTUs (Q) (compared with 76 Q in 1976).

Figure 1

Total Primary Energy Consumption: Hudson-Jorgenson Forecasts

1980 - 2000



Source: Hudson and Jorgenson, 1974; Uhler and Zycher, 1979.

Resources for the Future (1979) concluded that between 1980 and 2000, in the United States, it is reasonable to assume that annually: 1) population will grow between 0.6 and 1 percent; 2) GNP will grow between 3 and 3.5 percent; 3) energy prices will grow at approximately 2 percent; and 4) energy elasticity (growth in energy consumption divided by growth in GNP) will be approximately 0.6. Table 1 summarizes several analytically sophisticated, independent forecasts with these "reasonable" assumptions. Note that these figures account for two-thirds energy loss in the production of electricity. Table 1 indicates the distinct clustering of these forecasts around 114 Q for the year 2000 with an average of 10 percent direct use of coal, 14 percent gas, 32 percent petroleum liquids and 42 percent of fuels used to produce electricity.

Table 1

United States Primary Input Energy (1976-2000)[1,2]

Year	Study	Demand (Q)	Coal (Q)	Gas (Q)	Liquids (Q)	Electricity (Q)	Solar Biomass
1976	Actual	76	4.2	17.9	32.4	21.8	-
2000	Resources for the Future (1979)	115	11.5	19.5	38.0	46.0	
	Institute for Energy Analysis (1976)[3]	113	11.3	13.6	31.6	56.5	
	Redeker (1977)[4]	114	6.8	14.8	47.9	43.3	1.2
	Department of Energy (1977)[5]	114	16.0	17.1	30.8	45.6	4.5
	Consensus	114	11.5	16.2	37.0	49.9	1.4

Major Assumptions: Annual Rates of Change[6]

Study	Population	GNP	Energy Elasticity
Resources for the Future (1979)	0.80%	3.2%	
Institute for Energy Analysis (1976)[3]	0.65%	3.2%	-
Redeker (1977)[4]	---	3.2%	
Department of Energy (1977)[5]	0.80%	3.4%	0.58(1975-1985) 0.47(1985-2000)
Actual 1950-1975[1]	1.4%	3.3%	0.90
1978	0.8%	4.4%	0.41

[1] from Resources for the Future (1979)

[2] numbers may not be equal because of averaging

[3] average scenario

[4] baseline scenario

[5] base case scenario

[6] pricing assumptions deleted because of complexities

The fuel mix to produce this energy is further differentiated by accounting for the quantity and mixture of fuels used to generate electricity. Table 2 summarizes the amount and composition of fuels providing the primary energy input (1976-2000). Figure 2 indicates the changes in quantity and composition through time.

Table 2

United States Primary Input Energy:
Supply and Composition (1976-2000)

Energy Supply and Composition (Q)

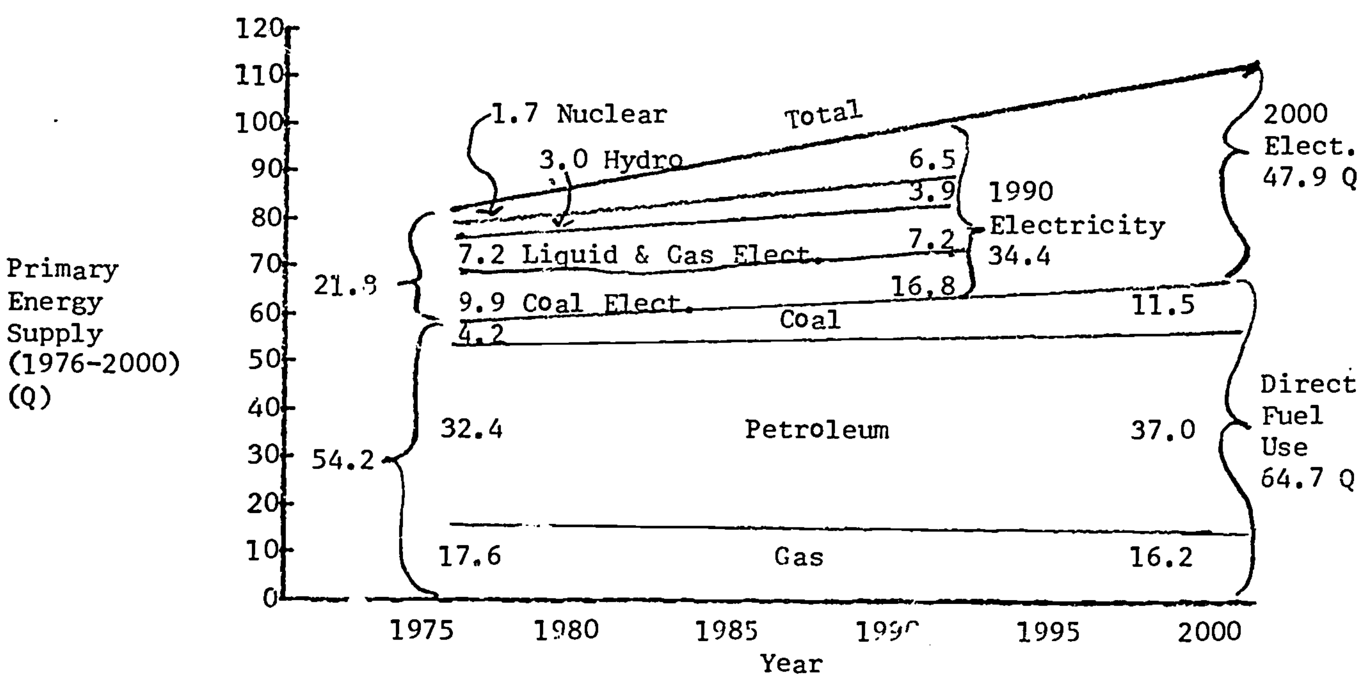
		Energy Composition								
					Electricity[2]					
Year	Total Energy Supply[1]	Direct Coal	Petroleum Liquids	Gas	Coal	Oil, Gas	Nuclear	Hydro	Total
1976	76.0	4.2	32.4	17.6	9.9	7.2	1.7	3.0	21.8
1980	81.3	5.0	33.1	17.4	11.4	7.2	2.7	3.5	24.8
1990	96.1	7.7	35.1	16.7	16.8	7.2	6.5	3.9	34.4
2000	114.0	11.5	37.0	16.2	--	--	--	--	47.9
% Change 1980-90	18%	54%	6%	4%	47%	0%	141%	12%	38%

[1]Rows do not add across because of missing biomass and solar categories.

[2]Probable mix of generating capacity (Electrical World, 1979)(Warren, 1979)

Figure ?

U.S. Energy Supply and Composition (1976-2000)



The changing composition of energy supply is important in assessing the environmental effects from energy in the next decade. The predicted sustained supply of petroleum through the year 2000 reflects optimism about new discoveries, secondary production techniques, and coal liquefication programs. Natural gas supplies will be declining throughout the decade by approximately one-half of 1 percent per year. Conversely, coal use, for power and heat, or for conversion to electricity, will increase 83 percent and 70 percent, respectively, above the 1976 levels of consumption. Two 1978 federal laws, the Power Plant and Industrial Use Act and the Energy Tax Act, were passed to prevent the use of oil and natural gas in industrial boilers and electrical generation, and to stimulate the use of coal for such purposes (CEQ, 1979). The increase of nuclear-produced electricity from 1.7 Q in 1976 to approximately 6.5 Q in 1990 represents the completion and operation of approximately 80 percent of the nuclear capacity currently under construction or on line.

Some may question the continued growth in the supply of electricity. Much of the capacity that will provide that growth in the next decade is currently in the final planning stages or under construction. However, the high costs of electricity will continue to dampen demand. The resultant availability of electricity could provide the electricity necessary to overcome the high front end energy requirements of a developing solar industry (see Whipple, 1980).

III. Environmental Impacts in the 1980s

A. Petroleum and Natural Gas

To maintain domestic production of petroleum and natural gas, offshore and remote exploratory drilling and the use of secondary production techniques must be increased, along with the development of an oil shale industry (Hayes, 1979).

Future offshore exploratory drilling in areas such as the Georges Bank, Baltimore Canyon, Blake Plateau and the Florida Embayment has become a primary focus of environ mental concern. The conflict over drilling in the Georges Banks (which yield 15 percent of the world's fish protein) is indicative of many in the next decades. Although drilling in the Baltimore Canyon and the North Eastern Gulf of Alaska has been disappointing to date, the Department of Energy estimates that between 1977 and 1990, outer continental shelf (OCS) petroleum production will increase from 0.8 to 1.8 million barrels per day, with gas production declining slowly (CEQ, 1979).

Catastrophic oil spills such as the one in the Bay of Campeche in 1979 appear to be the major environmental concern. However, the consequences of chronic, low-level contamination are poorly studied and may have the most serious consequences to marine and estuary ecosystems. Onshore support facilities (storage tanks, pipelines, refineries, etc.) must be properly planned to prevent unnecessary coastal damage.

In August 1977, the U.S. Department of the Interior (USDI) released a revised schedule for OCS oil and gas lease sales. Sales were limited to five frontier leases per year with no additional sales in that geologic region for the following three years. This new policy was implemented to provide adequate time for environmental planning (required by the 1978 NEPA amendments) to prevent boom and bust cycles (CEQ, 1978).

Additional onshore natural gas production may come from tight sandstones, Dovonian shales, and geopressurized zones along the Gulf Coast. The tight sandstones, found in western basins, represent only a modest resource base, are fairly dispersed and under very low pressure, making development difficult. The geopressurized zones off the Gulf Coast represent an unknown resource. Formidable pumping and brine disposal problems may inhibit development (Hayes, 1979) (CEQ, 1979).

B. Oil Shale

The Green River Formation that underlies Colorado, Utah and Wyoming contains an estimated 2 trillion barrels of petroleum equivalent in oil shale deposits. For each barrel of oil produced, 1 ton of shale is mined and heated to 500°C, then discarded as slag. The maximum production envisioned is approximately 1 million barrels per day (compared with current U.S. consumption of 20 million barrels per day) by the year 2000 (Hutchinson, 1979). This goal will be very difficult to achieve, however, because of severe environmental and socioeconomic impacts from the industry and the presence of a large work force in an arid, remote area (a 1-million-barrel per day industry in 2000 would require a direct and indirect labor force of 200,000)(Chappell, 1979).

High air pollution levels already exist periodically in the Piceance Basin of Colorado, the area in which initial development will occur. Additional pollution (particulates, nonmethane hydrocarbons and sulfur dioxide) from even a modest industry would cause frequent violations of air quality standards. In addition, significant emissions of mercury, cadmium, selinium, and arsenic would occur if not properly controlled (Chappell, 1979).

Water quality problems include waste water produced by retorting (1.2 to 3.6 gallons per ton), increased salinity in the White and Colorado Rivers, and leaching of trace elements from the shale and slag into surface and aquifer waters. Between 0.85 and 2.5 barrels of water are required to produce one barrel of oil. This water requirement is often referred to as a limiting factor in the basin. However, a recent Colorado Department of Natural Resources (1979) study concluded that sufficient water is available to the basin to support a one-million-barrel-per-day industry. Conflicts of water quality, water rights, forests and wildlife, may, however, restrict the availability of water to the industry.

The solid waste from an oil shale industry would likely be disposed of on the surface rather than returned to mines. In processing, a ton of shale yields three-fourths of a ton of slag, which is 20 percent greater in volume than the original shale. The favored method of disposal is to pile the slag in 1000-acre piles 200 feet high, provide a soil cover and revegetate. One such pile would be produced each year from a million-barrel-per-day industry. Because of the toxic nature of the slag, the long-term environmental hazards and disruption of land could be significant (Chappell, 1979).

In summary, the environmental effects of a surface oil shale industry are sufficiently damaging to warrant additional research into cleaner in-situ processes and alternative methods of slag disposal. If an industry develops, great care must be taken to control water, air and solid waste pollution.

C. Coal

According to the previous analysis, coal production will likely increase by approximately 74 percent in the next decade. It is anticipated that little, if any, coal will be consumed in the 1980s for large-scale coal gasification or liquefaction programs. However, in the 1990s, with heavy subsidies, coal liquefaction facilities could begin production.

1. Coal Mining

Leasing Federal Lands. On June 4, 1979, the United States Department of the Interior announced its new coal leasing program, lifting the moratorium in the leasing of federal lands for coal mining that had been in existence since 1971. The new leasing program, scheduled to be fully operational in 1985, establishes procedures for screening and prioritizing suitable lands, chooses and evaluates the performances of contractors, and establishes procedures for the issuance, monitoring, and enforcement of leases (CEQ, 1979). If the production of coal is to nearly double in this decade, substantial growth in the industry and its support industries will be necessary. Approximately 250 new large mines must be opened (41 per year average), and greater than 150,000 new miners must be recruited and trained (Miller, 1979).

Underground Mining. Underground mining presents three major problems: acid mine drainage, subsidence, and most importantly, worker health and safety. Since 1900, more than 100,000 miners have been killed and over 1 million have been injured or prematurely disabled (CEQ, 1979). Although the frequency of accidents is decreasing per unit output, the coal mining industry has more than twice the disability days per million employee hours worked than such high-injury industries as metal milling, construction, wood products and primary metals. Although coal mining in general is hazardous, surface mines are safer and the majority of future mining will be surface mines in the West and Midwest. The safety records of individual mines varies widely, indicating that health and safety can be substantially improved. In 1972-73, the underground mining rate of injury averaged 50.2 per million man-hours with a range of 5.3 to 115. The low figure of 5.3 compares very favorably with retail trade (11.3), real estate (11.4) and higher education (7.4) (The Ford Foundation, 1974).

In an attempt to reduce mine hazards, the federal government passed the 1969 Coal Mine Health and Safety Act. This legislation provided benefits for Black Lung victims. There are currently over 100,000 cases of pneumoconiosis in the United States, with approximately three to four thousand deaths a year attributed to it. The Act also set standards for coal dust levels in the mines. The Federal Mine Safety and Health Amendments Act (1977) brought all 20,000 mine safety programs under the jurisdiction of the Department of Labor's Mine Safety and Health Administration. The Act tightened standards, increased the number of annual inspections, required miner training, and established mine rescue procedures.

To date, two million areas in the United States have been affected by subsidence. The Department of Energy estimates another 2.5 million acres will suffer damage in the next two decades. Procedures to monitor, prevent, and control damage from subsidence are now being developed by the Department of Energy.

Surface Mining. The scarring of Appalachia, where more than half of the surface mining has occurred, is a testament to corporate neglect and ineffective regulatory efforts. Over 13 million acres of land have been disrupted by surface mining, with approximately 50 percent reclaimed. By the year 2000, an additional 15 million acres of land will be strip mined. Much of this will occur on federal lands in the arid

West. This amounts to a land area equivalent to the combined areas of Connecticut, Delaware, New Hampshire, Rhode Island, New Jersey, Vermont, and Washington, D.C. (Miller, 1979).

Low sulfur Western coals represent 40 percent of the nation's coal supply (77 percent of the economically strippable coal) and are in great demand. Some areas in the West are so dry they could not be reclaimed (National Academy of Sciences, 1974). Others could be reclaimed, but only after an intensive, coordinated, long-term effort. Reclamation, where feasible, would add only a few cents per ton to the price of coal. The key issue is water. Even without coal or shale mining, water resource inventories in many areas of the West are dropping. Large mining concerns could seriously disrupt the current balance of water resource allocation. Surface drainage and leaching from mines into aquifers could contaminate water systems.

Water Quality. The U.S. Department of Energy estimates that 6,900 miles of Appalachian streams are polluted by acid mine drainage (13,000 miles in the United States). Over 80 percent of the acids (8,000 pounds per day) come from abandoned underground mines. These acids cause an estimated $2 million damage annually to streams and river basins. Abatement costs are very high ($6.6 billion) and cleanup of the old mines difficult. Additional problems can be prevented, but the probability of cleanup of existing ones is relatively low.

Mine Wastes. Approximately one-fourth of the coal extracted is rejected as waste. There currently exist about 3 billion tons of waste in an estimated 3,000 to 5,000 sizable waste piles. About half of the waste piles contribute to water quality problems with 7.5 percent of the mine acid pollution and significant siltation problems resulting from the waste.

Legislation. The 1977 Surface Mining Control and Reclamation Act established a national program to protect the public and the environment from the adverse effects of coal mining. The Act: 1) prohibits mining where reclamation is not feasible, 2) insures that reclamation occurs concurrently with mining, 3) balances coal production with agricultural and other environmental considerations, 4) assists states in establishing regulation and enforcement programs, 5) establishes procedures to reclaim previously damaged land, and 6) provides procedures for public participation in developing regulations, standards, and programs under the Act. This Act will continue to face many challenges in Congress and the Courts. If the coal industry is to develop in the West, the purpose and intent of the new federal land leasing program and the 1977 Land Reclamation Act must be strictly enforced (CEQ, 1979).

2. Coal Combustion

Coal is the most polluting fossil fuel. Combustion of coal produces emissions of trace metals such as cadmium, mercury, nickel, beryllium, arsenic, and selenium which are potentially toxic to living forms. The combustion of coal also emits radioactive substances, nitrous oxides, sulfur oxides, particulates, and carbon dioxides. The sulfur emissions form biologically active sulfate compounds that attack lung and other sensitive tissues. They also combine with atmospheric moisture to form acid rain. The particulate emissions, especially the submicron particles that escape current precipitator emission control devices, pass through the natural filters of the respiratory system and lodge deep in the lungs where they cause a number of respiratory ailments (CEQ, 1979). These submicron particles often travel great distances in the atmosphere before settling out, and often carry toxic trace metals, sulfates, or gases to the lungs. Considerable work is needed on the effects and control of submicron particulates.

The buildup of carbon dioxide in the atmosphere from continued fossil fuel combustion represents a significant long-term hazard to climatic modification (discussed later). The fly ash from combustion must also be carefully handled because of traces of many toxic elements (Miller, 1979).

Today, approximately 74 percent of the largest 623 coal combustion plants comply with sulfur oxide emissions standards, and only 62 percent comply with particulate emissions standards. The environmental acceptability of coal combustion could be improved by greater regulatory compliance and the utilization of state-of-the-art pollution control technologies.

3. Synfuels

On July 15, 1979, President Carter proposed an $88 billion program to develop a synthetic fuels industry. The goal of the program is to produce 2 million barrels of oil per day, by 1990. The program is to be funded from the recently approved Windfall Profits Tax and managed by a Congressionally chartered Energy Security Corporation which could provide loans, make purchase agreements, or guarantee prices or loans (CEQ, 1979).

The potential environmental risks from the synfuels program are great (Nadis, 1979). The major impacts from coal gasification and liquefaction are: 1) carcinogenic organic compounds in products, by-products, and emissions, 2) toxic trace elements in emissions, products and by-products, 3) solid-waste disposal of toxic, mutagenic, or carcinogenic compounds, 4) water pollution from mines and processing, and 5) significant land and water requirements.

When the Institute, West Virginia synfuels facility (in operation between 1952 and 1959) closed, the 359 plant workers displayed an incidence of skin cancer 16 times that from normal occupational exposures. More than 200 industrial chemicals were identified in by-products, several were extremely carcinogenic aromatic hydrocarbons. The most notorious of these, 3,4-benzo-(a)pyrene, was the first human carcinogen discovered (in 1775) (Commoner, 1979).

Many of these problems can be minimized by using state-of-the-art technologies, recycling water, and using waste treatment ponds. All are expensive, creating the temptation to cut corners. The problems of land and water use are also significant. Most of the mining would occur in Montana, North Dakota, and Wyoming where the arid lands are very difficult, if not impossible, to reclaim. To implement the President's synfuels program would require the stripping, and possibly the permanent ecological destruction of 2000 square miles of land, an area the size of the state of Delaware. Two billion tons of rock and residue would have to be moved annually, a volume twice that excavated for the Panama Canal (Nadis, 1979).

The synfuels process requires a large volume of water. A 1.25-million-barrel-per-day industry would require 188,000 acre feet of water per year for mining and processing. As with the oil shale industry, problems of availability, water quality, water rights, etc., may severely restrict the growth of this industry.

Finally, synthetic oil and gas derived from coal add between 1.2 and 2.8 times as much CO to the atmosphere/ unit of thermal energy generated than do conventional fossil fuels. A large synfuels industry could aggrevate the potential problems of climate modification.

The crash synfuels program may pose several serious national risks (<u>Science</u>, July 13, 1979 and September 7, 1979). Among them are: inefficient use of capital, inefficient use of land and water, environmental hazards, economic hazards, and mid-program backlash from environmental and socioeconomic disruptions. It must be questioned whether this is the most acceptable method of providing approximately 5-10 percent of U.S. petroleum consumption. A slower stepped approach would allow for the modification or elimination of the program at any stage of development in a manner that would not seriously disrupt the U.S. economy should insurmountable problems arise.

D. Nuclear Fission

The status of nuclear power is one of the most important, complex, and controversial issues facing the United States in the next decades. In 1973, the Atomic Energy Commission predicted that by the year 2000, 1500 nuclear plants would be supplying over one-half of U.S. electrical demand totaling one-quarter of total U.S. energy demand. As of 1979, 70 plants are on line, producing approximately 13 percent of our electricity (4 percent of all U.S. energy demands). An additional 96 units, representing 101,000 MWe are under construction or authorized. However, since 1978, utilities have canceled plans for 35 plants and are delaying construction on others (CEQ, 1979). Between 1975 and 1979, only seven new nuclear power plants were ordered (Miller, 1979). This trend is consistent with this paper's prediction of 6.5 Q for nuclear electricity by the year 1990. This estimate could bring on line approximately 40 new plants through 1990, or about one-half the plants under construction or authorized. Between 1977 and 1990, uranium mining would result in the production of 300 million tons of radioactive tailings (approximately 130 million tons of radioactive tailings exist today), 24 million cubic feet of low-level radioactive wastes, and approximately 50,000 tons of spent fuel (Warren, 1979).

The nuclear industry is experiencing difficulty for several reasons: 1) uncertainty over uranium fuel supply and cost, 2) concern over power plant meltdown or sabotage, 3) concern over security of nuclear fuel and waste shipments, 4) waste storage problems, 5) nuclear proliferation, 6) spiraling costs, 7) power plant decommissioning, and 8) the controversy over the health effects of radiation.

High exposures to ionizing radiation can cause acute sickness or death. A scientific controversy is currently raging over the effects of chronic, low-level radiation exposures of a human population. Studies of the effects of exposure to low-level radiation are costly and difficult. The latency period between exposure and somatic or genetic effect can be decades, or span generations, making cause and effect studies difficult. Genetic defects and cancer can occur spontaneously or have other environmental causes, such as chemical exposures. Further, the incidence of cancer and genetic defects is low, requiring a large population sample for statistical confidence.

Several controversial reports have recently been published indicating that human beings may be more sensitive to low levels of radiation than previously predicted. If this is true, the risks of exposure to even low levels of radiation may be understated by as much as an order of magnitude (CEQ, 1978). A University of Pittsburgh study (Mancuso, et al., 1977) of the incidence of malignancies in workers at the Hanford Nuclear Facility found a pronounced increase in cancer among workers ages 25-45 at the facility. Other studies have found that even at very low levels of radiation exposure, there is a significant risk of increased incidence of cancer (Najarian and Colton, 1978)(Bross and Natarajan, 1972). These studies have been the focus of scientific and public debates. The debates center around the statistical treatments of the data, epidemiological methodologies, sampled populations, and issues of cause and effect. Further medical research on carefully designed, long-term epidemiological studies will be necessary to resolve the conflict. Until then, however, unnecessary exposures to man-made sources of radiation should be limited.

Natural background radiation ranges from 38-150 millirems per year in the United States. Human activities expose the average citizen to an additional radiation dose of about 80 to 125 millirems per year, the majority of which (an average of 72 millirems per person per year) comes from medical sources. The general population allowable exposure to man-made radiation sources (excluding x-rays) is 170 millirems per year. The current allowable occupational exposure, to 800,000 workers in the United States is 5,000 millirems per year. There is considerable pressure in the scientific community to lower these standards. In contrast, a properly functioning nuclear plant and support facilities will provide an average 0.06 millirems per year (Miller, 1979). Relative to medical exposures this is very little. These figures can be misleading, however, because they are average figures and biologically active isotopes may be involved. People living near nuclear facilities or near uranium mines may individually receive significant doses. For instance, residences near uranium mill tailings near Salt Lake City receive 400 millirems per year (EPA, 1977).

Greater effort should be directed toward problems in containment, protection, and disposal of hazardous materials in the nuclear fuel cycle. Currently, the health and environmental impacts from radioactivity are greatest in the mining and milling phase of the nuclear fuel cycle. Environmental controls are more extensively used toward the back end of the cycle because of greater levels of radioactivity. The deep and open-pit mining of uranium results in significant land use, health problems, and air water impacts. Care must be taken in the mining process to ventilate the mines to ride them of high levels of carcinogenic radon, radon daughters, and radioactive dust in the air.

At present, there are 130 million metric tons of uranium mine tailings in the United States, located at 21 active and 21 abandoned sites. Unmonitored tailing piles result in unnecessary exposures to the public. Gustafson (1979) predicted that mining and milling activities through the year 2000 will result in approximately ten deaths per year in the United States from radiation exposures. Approximately 30,000 acres of land will soon be placed off limits to reduce public exposures.

There are currently no commercial nuclear fuels reprocessing plants in operation in the United States. Government reprocessing facilities, used primarily for weapons development, are operating at capacity and cannot accept materials from the nuclear power industry (Miller, 1979). In 1977, President Carter slowed attempts to develop commercial reprocessing plants in the United States in an effort to reduce the probability of worldwide proliferation of nuclear weapons. The nuclear industry, therefore, cannot reprocess its fuels and must store spent fuel rods on site for eventual waste disposal.

In the absence of fuels reprocessing facilities, increasing amounts of spent fuel are being stored on site. There currently exist about 5,000 metric tons of spent fuel. Over 50,000 metric tons will require storage by the year 2000. Without a permanent waste repository, many reactors will exceed existing storage capacities in the late 1980s. On-site capacity will have to be expanded, and, where permitted by the NRC, fuel compaction procedures will have to be implemented. These procedures cannot, and should not be expanded indefinitely. The buildup of on-site nuclear wastes is hazardous and by 1990 may force the closing of several nuclear facilities if not remedied.

Industry assurances that the problem of long-term nuclear waste storage can be solved are disputed by many scientists (Alfvin, 1974; Angiano, 1977; Ehrlich, 1974). This has stimulated public concern and action to the point of banning construction of new nuclear power plants in four states until acceptable waste disposal programs are demonstrated. In the meantime, the large amounts of nuclear waste from weapons production are awaiting permanent storage. The waste is currently stored in temporary underground tanks in government facilities at Idaho Falls, Savanna River, South Carolina and Hanford, Washington. The on-site storage areas and these central facilities must be closely guarded and monitored to prevent sabotage and accidental release of highly toxic materials (Miller, 1979).

The most recently proposed disposal site is near Carlsbad, New Mexico, where the waste would be placed in a dry salt dome about a half mile below the desert surface. Recent geologic reports, however, question the stability of the salts when exposed to the high temperature nuclear wastes (Angino, 1977); de Marsily, et al., 1977). Public opposition to the New Mexico Waste Isolation Pilot Plant (WIPP) is growing in New Mexico and other states. By 1978, eleven states had declared that they would not accept a waste disposal repository. Fifteen more states are considering such a ban (Fisher, 1978).

In February, 1980, President Carter announced a plan to evaluate 11 sites in 6 states for the permanent disposal site. Geological and environmental reports are to be issued on each site, leading to a decision on one site in 1985 with completion of the facility between the years 1995 and 2000.

Reactor failure and terrorism could cause a serious incident. The potential for such a catastrophic event, along with the routine venting of low-level radioactive gases, mandates that these plants be sited far from population centers.

E. Renewable Sources of Energy

Renewable energy sources collectively provide approximately 6 percent of current U.S. energy needs. The forecast of "most likely" energy supply predicts only a nominal contribution of these sources in the next two decades. However, a Domestic Policy Review released by President Carter in 1979 concluded that 20 percent of U.S. energy needs could be met by renewables in the year 2000 (CEQ, 1979).

On June 20, 1979, President Carter delivered to Congress an outline of a national solar strategy to accelerate the commercialization of renewable energy technologies. A recent study of the barriers to commercialization of solar energy indicates that the major barriers are financial and institutional, not technical (Armstrong and Armstrong, 1979). Thus, federal, state, and local government policy should be directed toward removing financial and institutional barriers.

The impacts of renewable energy vary with the technology. The development of hydroelectric sites has significant impacts on aquatic ecosystems and considerable irreversible land disruption. The prime hydroelectric sites have already been

New hydroelectric facilities conflict with the growing demand for river and canyon recreation. These problems can be circumvented by redeveloping existing, abandoned, or underused hydroelectric sites. In the United States, approximately 50,000 dams could be developed to provide the equivalent electricity of 85 nuclear or coal power plants, with minimal additional negative environmental impacts (Broad, 1978).

If air circulation is not properly engineered, passive solar and energy-efficient buildings may present problems of indoor air pollution (Bossing, 1978). Solar thermal and wind systems have negative indirect impacts from manufacturing and construction and present aesthetic problems during operation. Large-scale solar thermal power systems may have significant land use, water use and working fluid hazard problems.

Geothermal systems could present subsidence problems if withdrawn fluids are not replaced. Mineralized, salty water may require treatment. Air pollutants could include hydrogen sulfide gas, boron particles, mercury, and radioactive radon-222 and radium-226. These problems can be controlled by emission control devices or underground heat exchange systems (Kruger, 1976; Axtman, 1975).

In agricultural areas or areas of high natural productivity, biomass fuels can be an economical source of energy. However, the combustion of biomass can pose air pollution problems. Biomass combustion emissions are lower in sulfur oxide, particulate and nitrogen oxides than emissions from coal or oil combustion (Holzman, 1978). However, the dispersed nature of biomass combustion prevents the use of technologically advanced emissions control devices similar to those used in centralized coal or oil-fired power plants. The net result could be greater air pollution from nonpoint sources.

IV. Comparative Impacts

A. Health

Table 3 provides a summary of the comparative health impacts of selected energy alternatives. Nuclear electricity has less of an impact, in fatalities, than coal or gas electrical generating technologies. However, it is significant that the higher estimate of nuclear overlaps with the other options.

TABLE 3

COMPARATIVE HEALTH EFFECTS OF SELECTED ENERGY OPTIONS (MODIFIED FROM RESOURCES FOR THE FUTURE, 1979)

Energy Source	Health Effect (Fatalities/Effective Plant Year)		
	Occupational and Public	Air Pollution	Total
Electrical Generating Technologies			
-coal	0.8-6.0	0.0-8.0	0.8-14.0
-low BTU gas	0.9-6.0	0.0-0.8	0.9- 7.0
-nuclear fission	0.1-0.4	-	0.2- 3.0
Non Electric Technologies			
-high BTU gas (from coal)	0.7-5.0	0.0-0.6	0.7- 6.0
-coal liquids	0.7-5.0	0.0-1.0	0.7- 6.0
-coal oil (surface retorting)	2.0-6.0	0.0-1.0	2.0- 7.0
-solar home heating	0.2-1.0	-	0.2- 1.0

The air pollution data are included to indicate the sensitivity of the coal option to air quality considerations. If emissions from coal electricity are carefully controlled, this option represents a hazard comparable to all others (except solar). The emissions control devices are expensive, but the health benefits could be significant. Finally, the health advantages of solar technologies are indicated by the lowest range of estimates of fatalities.

B. Large-Scale or Catastrophic Impacts

Apart from the routine health and environmental impacts of energy systems, there are also infrequent, unpredictable, or long-term chronic effects that could pose a real danger. Even though the events described may have a low probability of occurrence, small probabilities become certainties, given time. The possibilities of such an occurrence warrants attention in this analysis, for it is one variable that should be considered in the evaluation of any energy alternative.

1. Acid Rain

Large increases in the acidity of rainfall have been found in several areas of the Eastern United States and Western Europe. It is generally believed that this acidity has its origins in the atmospheric conversion of sulfur dioxide and nitrogen oxide pollutants to sulfuric (70 percent) and nitric (30 percent) acids, respectively. Under normal conditions, the pH of rain and snow should be approximately 5.6. In large areas of the Eastern United States, the annual average pH ranges from 4 to 4.5. Recent studies indicate that acid precipitation is a problem throughout the entire East Coast, that the impacts are spreading to the South and West, that the acidity of the precipitation is increasing, and that widespread damage to the built and natural environments is occurring (Likens, et al., 1979).

Aquatic ecosystems are particularly sensitive to the effects of increased acidity, especially in areas underlain by hard siliceous bedrock such as gneiss, granite, and quartz. These rocks, resistant to weathering, yield waters with very low ion concentrations. These "soft" waters have a low buffering capacity and are unable to neutralize acids from rainfall or snowfall. Thus, both the amount of acid in precipitation and the geological characteristics of an area are important determinants in an ecosystem's sensitivity to acid precipitation. Therefore, areas such as the Adirondacks, the Appalachians and the Sierra Nevada Mountains are particularly susceptible to damage. Known effects of acid precipitation include leaching nutrients from soil, slowing of bacterial decomposition, injury to leaf surfaces, killing of fish and zooplankton, and reducing the viability of whole plant and animal communities (Resources for the Future, 1979; Ballou, et al., 1979).

The spread of the acid precipitation problems to the West could have ominous consequences. Science (January 11, 1980) recently reported a rapid rise of nitric acid rain near the Rocky Mountain continental divide during the past three years. The Rocky Mountains contain some of the most valuable and sensitive wilderness, forest and park areas in the lower 48 states. Greater care is needed to protect them from pollution-induced acid rains.

The EPA requires all new coal-based power plants to remove 70 percent to 90 percent of the gaseous sulfur from emissions through the use of "scrubbers" or flue gas desulfurization units. Even so, EPA predicts an increase in utility sulfur emissions from 18.6 million metric tons in 1975 to between

20.5 (with conservation and best available controls) and 23.8 million by 1995. Greater care should be taken to encourage fuel conservation, install best available controls for nitrous and sulfur oxides, and properly site coal facilities (Likens, 1980).

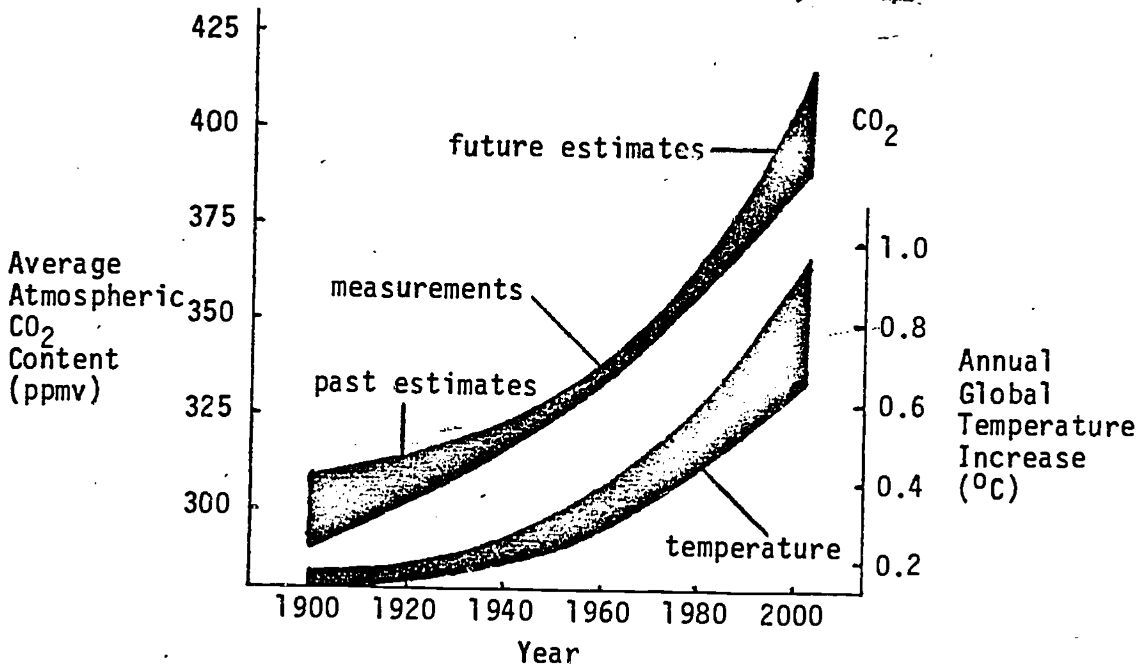
2. Climate Modification: Carbon Dioxide

Atmospheric carbon dioxide will transmit visible light while hindering longer wavelength infrared radiation. Thus, visible light enters the atmosphere from the sun and is degraded to heat which is held in the atmosphere by water vapor and carbon dioxide. This "greenhouse effect" is responsible for maintaining an atmospheric temperature approximately 10°C above what it would be without atmospheric water vapor and carbon dioxide (Miller, 1979).

The dynamics and interactions of the carbon dioxide cycle of the earth are complex and subject to considerable debate. Plants take up CO_2 during photosynthesis and release it when respiring or decomposing. Global deforestation may be upsetting the balance of uptake and release by favoring the latter. The combustion of fossil fuels represents an accelerated form of respiration of materials stored millions of years ago. By weight, the combustion of one ton of coal yields three tons of CO_2. The relatively small average concentration of CO_2 in the atmosphere (about 0.03 percent) can be increased significantly by burning the earth's fossil fuels and destroying the earth's forests. Estimates of the relative contribution of deforestation and fossil fuel combustion vary considerably. Scientists estimate that since 1890, atmospheric CO_2 concentrations have increased from 290 parts per million volume (ppmv) to 330 ppmv, an increase of approximately 14 percent in 90 years (Woodwell, 1978). However, as seen in Figure 3, the accumulation of CO_2 in the atmosphere in recent years is accelerating, due to accelerated rates of deforestation and combustion of fossil fuels. The addition of 40 ppmv has probably resulted in an average global temperature increase of less than 0.4°C to date. As shown, increasing our fossil fuel combustion 3-4 percent/year through the year 2000 will increase CO_2 concentrations to between 365 and 400 ppmv causing a temperature increase of 0.5 to 0.6 in the next two decades (National Academy of Sciences, 1977).

Figure 3

Estimated Changes in Atmospheric Content (Upper) and Resulting Increase in Atmospheric Temperature (Lower) Between 1900 and 2000 (Modified from Miller, 1979).



A word of caution is appropriate. These numbers are based on theory and computer models. A significant difference of opinion exists between the modeling efforts and experimental studies. Two recent, independent, experimental studies have concluded that a doubling of atmospheric concentrations of CO_2 would have an indistinguishable effect on global climate (Science, March 28, 1980; Newell, 1979).

If the theoretical studies are correct, modest changes in atmospheric CO_2 concentrations and subsequent heat buildup could have global significance. A 2°C average global temperature change would cause a 4-10°C temperature rise at the poles, causing an estimated 5 meter rise in the sea level over the next 300 years, from melting of the ice caps (National Academy of Science, 1977). The immediate major threat of global temperature change, however, would be the climatic destabilization of world agriculture at a time when population is growing rapidly (Bryson, 1977). Temperature changes would also cause significant shifts in wind and current patterns.

The conversion of coal and shale to petroleum liquids poses a significant threat to atmospheric CO_2 buildup. The CO_2 released by the combustion of synfuels is 1.4 times greater than that released by coal, and 1.7 to 2.3 times greater than that released by oil and natural gas (Science, July 27, 1979). Fossil fuels may be able to be used for another 30 to 50 years without disastrous effects on climate. That period should be used to shift to other energy sources, such as solar, wind, or a properly managed nuclear industry, that do not produce CO_2 (Miller, 1979; National Academy of Sciences, 1977).

3. Nuclear Reactor Safety

The Rasmussen Report, published in 1975, evaluated the probability and consequences of a nuclear accident in the United States. With 100 plants in operation, the probability of a worst case accident was calculated as 1 in 1 billion per plant per year. This accident would cause between 825 and 13,200 immediate deaths, 12,375 to 198,000 illnesses, 7,500 to 180,000 later cancer deaths, and 4,750 to 171,000 delayed genetic effects (Nuclear Regulatory Commission, 1975). The property damage would range from $2.8 to $28 billion. Insurance companies are unwilling to insure a nuclear plant for an accident for over $500 million. To encourage initial growth in the nuclear industry the Price-Anderson Act was passed in 1957 setting a liability ceiling for a nuclear accident at $560 million, with the government liable for $420 million of that sum.

In January 1979, the Nuclear Regulatory Commission repudiated the Rasmussen Report indicating that: 1) it underestimates the consequences of a nuclear accident, 2) it does not cover all risks in the nuclear cycle, 3) it covers only 100 rather than the 1000 plants projected, and 4) it uses questionable assumptions and procedures (Miller, 1979). In March, 1979, an improbable series of mechanical and human failures caused a partial core meltdown at Three Mile Island Nuclear Plant near Harrisburg, Pennsylvania. No lives were directly lost, but it will be years before any cancer or genetic effects are determined. Thousands of people were temporarily evacuated. The accident caused hundreds of millions of dollars in damage and will require years to clean up. Today, no authoritative evaluation of nuclear power plant safety or safety of the nuclear fuel cycle exists. Nor are there any conclusive scientific studies of the long-term effects of continued exposure to low-level radiation released from the nuclear cycle and power plants.

4. Terrorism

Between 1969 and 1975, hundreds of threats, 15 breaches of security, 15 acts of vandalism or sabotage, and 11 bomb explosions were perpetrated in, or near, nuclear facilities in the United States (Flood, 1976). Absolute protection of a nuclear facility from a trained team of saboteurs cannot be guaranteed (American Nuclear Society, 1976). Such a team could easily precipitate a major nuclear incident.

The hijacking of nuclear fuel shipments represents a more serious problem. Protection of hundreds of thousands of nuclear material shipments is more difficult than protection of a few centralized nuclear power plants. Enriched uranium or plutonium shipments may be hijacked and used to make a nuclear device. Or, the dispersion of a 10-pound mass of toxic plutonium over a 30 square mile area could contaminate it for over 250,000 years (De Nike, 1974). Thus, the effect of one individual in sabotage can easily equal that of a nuclear power plant meltdown.

5. Problems in the West

On October 10, 1979, in Albuquerque, President Carter met with ten Western governors to assure them that the rights and environmental quality of the Western states would not be violated or circumvented by "fast track" energy developments. The ten governors have banded together to form a political block to oppose the proposed Energy Mobilization Board. The President promised the governors that the Energy Mobilization Board would not be given the power to overrule state disapproval of even the largest energy projects. In addition, there is widespread concern among citizens and policicians that the Administration is not fighting hard enough in Congress for that protection.

The eight Rocky Mountain states of Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming contain the major undeveloped energy resources in the United States. The Rocky Mountain region contains: 1) approximately 42 percent of our nation's coal reserve (60 percent of low-sulfur coals), 2) the richest oil shale, geothermal and uranium (95 percent) deposits in the United States, 3) areas of potential new sources of petroleum and natural gas, 4) the area of greatest solar insolation, and 5) salt deposits for potential nuclear waste disposal (United States Senate, 1976). These eight states alone could meet U.S. energy needs for the next 100 years. But, substantial damage to forests, parks, ranches, farms and Indian reservations (with 50 percent of the region's uranium and 20 percent of the coal) would be incurred (see Figure 4). Over 50 percent of the land in the region is owned and managed by the federal government. The area contains many of the nation's most beautiful parks, national forests and wilderness areas. The states want the economic development, but not the impacts. Rapid development could circumvent proper evaluation of conflicts of water quality and water resources, land use, air quality, and the socioeconomic impacts of boom towns (United States Senate, 1976). Thus, the state governments have been attempting to slow the development process to allow for evaluation and citizen participation in the decision-making process. This is directly contrary to the purpose and intent of the Energy Mobilization Board.

The greatest conflict will be for water resources and water quality control in the region. Agricultural interests currently use 90 percent of the water in the region, but rather inefficiently. Additional water could be made available by using trickling irrigation techniques or by drawing more water out of the water tables. The withdrawal of additional water from water tables is hazardous, for in many areas, water tables have already dropped considerably, making the region more arid and forcing farmers to pay very high pumping costs for irrigation (Carr, 1976; United States Senate, 1976).

The tradeoffs involved in reallocating water will be difficult. A 1000 MW coal plant requires as much water for cooling as a city of 12,000 people. A single synfuel or oil shale plant will require the equivalent water of a city of between 7,000 and 11,000 people (Harte and El-Gassier, 1978).

The rise in acid rains in the Rockies gives us warning of the potential for extensive damage to aquatic ecosystems in the area. This could become particularly acute if acid mine drainage problems arise. Other air quality problems include mining dust, particulate pollution from new coal-fired facilities, radiation from improperly managed uranium mining facilities, and an increase in CO_2 production from the combustion of fossil fuels.

The shipment of fuels out of the Western region by slurry, rail or highway as well as the growth and development of urban centers in previously undeveloped areas could cause significant secondary impacts (United States Senate, 1976).

In the next decade, development and conservation interests are going to clash in the West. All levels of government must be prepared to meet the challenge. Governments must work with citizens and establish clear development guidelines and priorities. Land-use plans should be developed and carefully integrated with the various levels and jurisdictions of government. To do so requires motivation, time, and public participation. The proposed Energy Mobilization Board would be contrary to all.

Figure 4

Conflicts Between Land Use, Energy Resources and Water Resources in Eight Rocky Mountain States (Revised from Miller, 1979).

national parks | water shortages | fossil fuel reserve | existing fossil fuel power plants
national forest | uranium reserves | proposed fossil fuel power plants

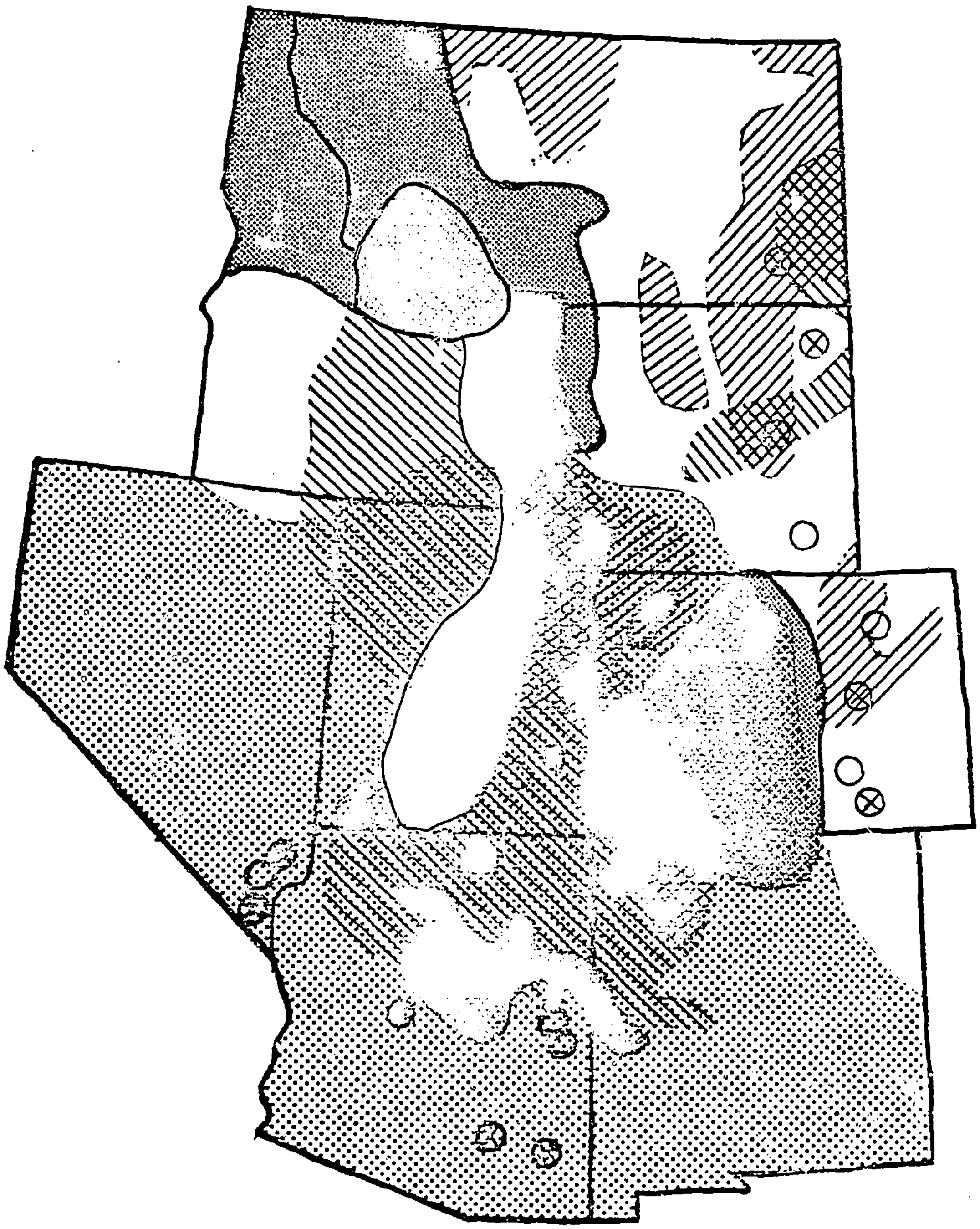


Table 4

Comparative Environmental Impacts of Selected Energy Options. (Dorf, 1978) (Ehrlich et al., 1977) (Miller, 1979) (Resources for the Future, 1979)

Key: significant — negligible — moderate — + beneficial

Energy Option	Health Effects	Air Quality	Water Quality	Land Disruption	Water Resources	Large Scale or Catastrophic Impacts	Energy Contribution in the 1980's
Non-renewable						Oil Spill	
Petroleum						Acid Rain Climate	
Natural Gas						Acid Rain Climate	
Coal						Acid Rain Climate	
Oil Shale						Climate	
Coal Conversion						Climate	
Nuclear Fission						Radiation Releases	
Renewable							
Hydroelectric						Dam Breaks	
Solar						None	
Wind						None	
Geothermal						None	
Biomass						None	
OTEC						None	
Conservation	+	+	+	+	+	None	

C. Environmental Impacts

Table 4 summarizes the health and environmental impacts of various energy systems. Although the various impacts are not commensurable, the patterns of impact are apparent. The coal and oil shale systems have the greatest environmental effects. Although they represent an enormous resource, great care must be taken to reduce the land-use and air pollution impacts. The rush to develop nuclear fission was, in part, due to reported environmental advantages, which are seen in the table. However, great care is needed to assure reactor safety and protection and control of materials in the nuclear fuel cycle. Although several of the renewables have moderate impacts in certain categories, the environmental advantages of the renewables are apparent.

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ENERGY POLICY ISSUES AND THE ENVIRONMENTAL AGENDA FOR THE 1980s

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Abstract. *Reducing the dependence on imported oil as an energy source is an important goal for many countries. The way in which this goal is achieved has substantial implications for environmental quality during the 1980s and beyond. This paper looks at the role of oil in the energy economy of several nations in Asia and the Pacific, as well as the U.S.A., and their plans for increased use of other energy sources. The transnational implications of such policies are discussed.*

Introduction

While attempting to formulate an environmental agenda for the 1980s, we need to take into consideration some of the other factors that will significantly affect national and international policies during the decade. One such factor will almost certainly be the desire of most countries to reduce dependence on imported oil by switching to other energy sources. This could have significant implications for environmental quality in the 1980s and beyond. A look at the recent past may provide a clue to the direction of the impact associated with a change in energy sources.

Major Energy Sources Over the Last Half-Century

In spite of the well-known increase in the rate of technological change that has characterized the twentieth century, it takes many decades for the relative importance of different energy sources in national economies to shift substantially. Table 1 shows the changes that have occurred in three of the more industrialized countries around the Pacific--Canada, Japan, and the U.S.A., over the period 1925-1976.

The trends that emerge from Table 1 as the most conspicuous are:

(i) The substantial decline in the relative importance of solid fuels (mainly coal),

(ii) A corresponding increase in the role of liquid fuels (oil) and natural gas, and

(iii) The emergence of nuclear power as an important source for electricity generations.

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Energy Source	Canada % 1925	1950	1965	1976	Japan % 1925	1950	1965	1976	U.S.A. % 1925	1950	1965	1976
Solid Fuels	81.9	53.0	14.8	11.3	92.4	83.2	35.5	19.0	74.2	42.3	24.3	21.9
Liquid Fuels	12.5	35.0	50.2	50.4	4.4	6.1	58.4	74.0	19.2	37.7	42.8	45.4
Natural Gas	2.1	3.7	25.8	26.6	0.1	0.2	1.4	3.4	6.2	18.9	31.5	30.5
Hydroelectricity	3.5	8.4	9.2	10.9	3.1	10.4	4.7	2.6	0.5	1.1	1.3	1.5
Nuclear	-	-	-	0.9	-	-	0.0*	1.0	-	-	0.2	0.9

*Actual percentage of nuclear power consumption in Japan in 1976 was approximately 0.002.

(Note: Because of rounding, some columns do not add up to exactly 100.0.)

Table 1. Energy consumption by source in Canada, Japan, and the U.S.A. for 1925, 1950, 1965, and 1976. The data for 1925, 1950, and 1965 (except for nuclear energy) are from Darmstadter, Teitelbaum, and Polach, Energy in the World Economy, published by the Johns Hopkins Press (1971). The data for 1976 are from the United Nations' Department of International and Economic Affairs, World Energy Supplies 1972-76, Statistical Papers, Series J., No. 21, 1978. The 1976 data may not be completely comparable with the earlier ones, because of possible differences in conversion factors, etc. The 1965 data for nuclear energy are from the United Nations' World Energy Supplies 1950-1974, Statistical Papers, Series J, No. 19, 1976.

National Strategies for Reducing the Dependence on Oil

The doubling of oil prices in 1979-1980, on top of their quadrupling in 1973-1974, heralds the beginning of the end of an era in which oil has played an ever-increasing role in the energy economy of most nations. The extent of this role and its relative change during the years 1965-1976 in several major countries of Asia and the Pacific are shown in Table 3.

Country	City or Region	1970	1973	1976
Canada	Montreal	100	38	29
	Toronto	100	30	25
Japan	Tokyo	100	64	47
	Osaka	100	42	32
	Nagoya	100(1971)	63	35
United States	Great Lakes	100	76	62
	New England	100	69	65

Table 2. Annual Mean Daily Concentrations of Sulphur Dioxide (SO) in Selected Urban and Industrial Areas, 1970-76. Source: O.E.C.D. The State of the Environment in OECD Member Countries, Paris: O.E.C.D., 1979.

It is not practical at present to switch from oil to other energy sources for all uses. The transportation sector in particular will continue to depend on liquid fuels throughout the 1980s and probably beyond. It is the use of oil for electricity generation, as well as for process heat in industry, that is likely to be phased out and replaced by other energy sources. Also, additions to capacity in these areas are likely to be nonliquid fuels. Table 4 shows the energy sources the different countries expect to emphasize in their energy plans for the 1980s for increments to energy use and oil substitution where possible.

Environmental Quality and the Choice of Energy Sources

Until the mid-1960s, the choice of energy sources in a country was determined primarily by the availability of fuels, their relative costs, and the availability of appropriate energy conversion facilities. Over the last 15 years, rising concern about the quality of the environment also has become a major factor in the choice of energy supply systems, especially in the more industrialized countries. The shift from coal to oil and gas, which is shown in Table 1, was caused not by a shortage of coal, but by the wide availability of oil and gas at competitive prices, the greater ease with which they could be transported, and their relative cleanliness when compared to coal.

The use of coal in many areas of Japan and the U.S.A. was also made considerably more difficult by the passage of major air quality legislation in the U.S.A. in 1963, 1970, and 1977, and in Japan in 1962 and 1968 (O.E.C.D., 1979).

The shift in energy sources, accompanied by the installation of pollution control equipment, led to an improvement in air quality in several urban and industrial areas during the 1970s. As examples, the mean daily concentrations of sulfur dioxide in some urban areas of Canada, Japan, and the U.S.A., which are shown in Table 2, showed the relative decline (compared to 1970 values) in SO_2 levels during the period 1970-1976.

Taking the total energy use in the different countries into consideration, it is evident from Table 4 that there will be substantial increases in the use of coal during the 1980s, and a smaller increase in the role of nuclear power and natural gas. With regard to nuclear power, the longer-term impact of the Three-Mile Island (T-M-I) accident on the energy plans of the nations is difficult to forecast. In the U.S.A. and in Japan the accident has made the siting of nuclear power plants much more difficult; in the U.S.A. T-M-I has accelerated the trend toward postponement or cancellation of several planned units. A likely outcome is that the rate of growth of nuclear power will be slower than predicted during the mid-1970s, but that its share of electricity production will keep on growing in most countries during the 1980s.

Implications for the Environmental Agenda for the 1980s

A paper in this current volume by John Baldwin addresses the environmental implications of major energy production alternatives in the United States. Most of the impacts associated with each energy source are the same in other countries, and it would not be very useful to repeat them here. Consequently, this paper will limit its attention to implications that are transnational in scope, and to the two sources likely to make the largest additions to energy consumption during this decade, i.e., coal and nuclear power.

Coal

Two major transnational issues concerned with the use of coal (and other fossil fuels) are (i) acid rain, and (ii) climatic effects of the buildup of carbon dioxide in the atmosphere. Acid rain has been a controversial issue in northern Europe

Country	1965 Consumption of Liquid Fuels (mtce)	1965 Total Commercial Energy Consumption (mtce)	1965 Ratio of Liquid Fuels to Total Energy Consumption (%)	1976 Consumption of Liquid Fuels (mtce)	1976 Total Commercial Energy Consumption (mtce)	1976 Ratio of Liquid Fuels to Total Energy Consumption (%)
Australia	22.43	53.06	42.9	39.68	90.33	43.7
China, People's Republic	14.67	316.81	4.6	101.08	590.06	17.1
India	14.35	83.81	17.1	28.80	132.93	21.7
Indonesia	7.30	11.87	61.5	25.64	30.43	84.3
Korea, Republic of	2.13	12.32	17.3	19.35	36.58	52.9
Malaysia	3.13	3.30	94.8	7.13	7.62	93.6
New Zealand	3.16	6.41	49.3	6.07	11.35	53.5
Pakistan	4.80	9.40	51.1	5.16	13.11	39.4
Papua New Guinea	0.16	0.16	100.0	0.79	0.82	96.3
Phillipines	6.63	6.94	95.5	13.61	14.38	94.6
Singapore	1.41	1.42	99.3	5.15	5.15	100.0
Thailand	3.89	4.04	96.3	12.49	13.22	94.5

Table 3. The relative importance of oil in the energy economies of several countries in Asia and the Pacific, as measured by the ratio of liquid fuel energy consumption to total commercial energy consumption. Source: Harrison Brown and Kirk Smith. 1980. Energy for the People of Asia and the Pacific. To be published in the Annual Review of Energy, Vol. 5.

mtce = million tons coal equivalent

Country	Energy plans for the 1980s show greater use of	Reference
Australia	coal, natural gas	D.N.D. (1978)
Bangladesh	natural gas	E.S.C.A.P. (1978)
Canada	coal, nuclear, hydroelectric	Helliwell (1979), I.E.A. (1977)
China	coal, some nuclear	Smil and Woodard (1977)
India	coal, some nuclear	Mukherjee (1979)
Indonesia	coal, some geothermal	E.C.A.F.E. (1978)
Japan	coal, LNG, nuclear	I.E.E. (1979)
Korea	coal, nuclear	E.S.C.A.P. (1978)
Malaysia	hydroelectric	Greenwood (1979)
New Zealand	natural gas, hydroelectric	Ministry of Energy (1978)
Pakistan	natural gas, hydroelectric	Riazuddin (1978)
Papua New Guinea	renewable sources	M.M.E. (1979)
Philippines	coal, geothermal, renewable sources	Ministry of Energy (1980)
Thailand	natural gas, coal	N.E.A. (1978)
U.S.A.	coal, nuclear	Just and Lave (1979), Hibbard (1979)

Table 4. Energy supply options likely to play a more important role during the 1980s.

for several years. Various groups in Sweden, for example, claim that the high acidity of several lakes in that country is the result of industrial activity (O.E.C.D. 1979), including emissions from power plants, in the United Kingdom. The economic loss to the recreational and commercial fishing industry is estimated at between $50 and $100 million for Sweden during 1973 (Council on Environmental Quality, 1979).

Japan, Canada, and the U.S.A. are also increasingly concerned about acid rain. In the U.S.A., a study to assess the potential environmental impacts of increased coal use identified acid rain as an important subject requiring closer scrutiny (U.S. H.E.W., 1977). The acidity of rainfall in the eastern U.S.A. seems to have increased by a factor of about 50 during the last 25 years. The pH values measured in some rainfall are as low as 3.0, an acidity equivalent to lemon juice!

Our knowledge about the explicit causes and the total effects of acid rain is very inadequate. It is quite likely that the yields of agricultural crops and of forests are decreased. Works of art, and other steel and stone structures, may be permanently damaged. There may be increases in the concentrations of some trace metals in the drinking water supplies to levels that are harmful.

The climatic implications of the buildup of carbon dioxide in the atmosphere also are receiving increasing worldwide attention. Some of the conclusions reached by participants at a Workshop held at the International Institute for Applied Systems Analysis at Vienna (Williams, 1978) are:

> The evidence is strong that substantial additional atmospheric CO_2 will cause significant climate changes, although quantitative values are difficult to assign with confidence.
>
> We have not yet identified the whole range of adjustments the world would or could make to a substantial climate change. It is not premature to examine possible global and regional responses to the eventuality of such changes and the consequences the responses to the changes can cause on the well-being of the global society.
>
> It is premature to implement at this time policy measures which require the reduction in use of coal and other fossil fuels.
>
> Policies to emphasize the use of coal because of its great abundance in preference to nonfossil (non-CO_2 producing) energy supply systems are equally unjustified....We urge the maintenance of great flexibility in energy supply policies at this time.
>
> Environmental impact assessments of escalating energy use must be performed with greater depth than in the past and on a scale commensurate with the potential importance of the problem.

It would be highly desirable to devise energy supply systems that allow ready environmental amelioration.

The increase in the use of coal in the countries listed in Table 4 alone could exceed 1 billion tons/year by the end of the 1980s. Substantial increases in coal consumption are also likely in Europe, including the U.S.S.R. It has been suggested (Mustacchi, et al., 1978) that if and when CO_2 accumulation in the atmosphere is recognized as a serious problem, it will be feasible to absorb CO_2 emissions from power plants in seawater, at an additional cost per electric kwh not higher than 20 percent. Other scientists feel that the removal of CO_2 is not an economically viable option.

If seawater is the most likely sink for CO_2 emissions, and CO_2 removal becomes a necessity for climatic reasons, it would obviously be advantageous to locate fossil fuel plants close to the seashore in order to minimize additional costs. In many countries, including the United States, major coal deposits are located at considerable distance from the sea, and power plants are frequently located close to mineheads to reduce the costs of shipping coal. Any decision to remove CO_2 emissions could thus have substantial implications for the siting of coal-fired power plants. A large amount of infrastructure, such as the building of roads and railroad tracks, usually accompanies the building of a power plant. Also, industry usually develops in the area to make use of the electricity available. Any decision to shift an electric power plant thus would involve large expenditures in addition to strong social and political opposition. For many developing countries with scarce capital, and great need for additional electricity generation, it is unlikely that plants built far away from seacoasts will be equipped to remove CO_2, even if it becomes desirable on a global level to control such emissions. Thus increased research on CO_2 effects and possible removal options is necessary so that any additional considerations required can be factored into siting decisions.

On a global level, a small change in temperature and precipitation could be beneficial to some countries and harmful to others. A temperature increase of 1°C and a precipitation decrease of 10 percent, for example, could reduce wheat yields in major producing areas such as Kazakhstan in the U.S.S.R. and South Dakota in the U.S.A. up to 20 percent (Bach, 1978). A similar change would lead to an estimated decrease in corn yield in the U.S. of about 13 percent (Benci, et al., 1975), but a possible increase in global rice production of about 2 percent (Stansel and Huke, 1975). With different crops playing differing roles in the food supplies of major countries, it is unlikely that such countries will view small changes in temperature or precipitation as necessarily harmful. A universal "Non-CO_2 Proliferation Treaty" may be as difficult to achieve as its nuclear counterpart. With the experience of the Law of the Sea negotiations in mind, it may be appropriate to initiate discussions during the 1980s on a possible "Law of the Air."

Nuclear Power

The pros and cons of nuclear power have been discussed at great length during the 1970s, but there is every indication that they will continue to be a subject of great importance affecting the environmental agenda for the 1980s. Most of the debate has focused on the probability and consequences of reactor accidents (see, for example, American Physical Society, 1975), the safe disposal of radioactive wastes (National Academy of Sciences, 1979), and strategies for controlling nuclear proliferation (Greenwood, 1977). It would serve no useful purpose to go over all the arguments here; it is sufficient to note that there are large uncertainties in each of the areas just mentioned.

Given the fact that our world is composed of sovereign nations, which can and do change their policies towards other nations, a major concern of all governments is to minimize the internal dislocations that such changes could cause. The 1970s saw an embargo on the shipment of oil from Arab countries to the U.S.A., Canadian decisions to phase out the export of oil to the U.S.A., the U.S.A. decision to ban imports of oil from Iran and curtail shipments of nuclear fuels to India (although shipments to India are presently continuing on an ad hoc basis). These events have greatly increased awareness in all countries of the crucial role of energy in their economies, and have stimulated a desire to achieve either energy self-sufficiency or to ensure external supplies for a time span adequate to make any shifts which may be required.

Many of the countries in the region, including Australia, Canada, India, and the United States have a resource base adequate to provide energy self-sufficiency by the 1990s. China, Indonesia, and Malaysia are essentially self-sufficient at present, and this is unlikely to change in this century. On the basis of known reserves, energy independence does not appear to be a viable option for Bangladesh, Korea, Japan, Pakistan, and many of the island nations of the Pacific.

For the nations faced with the necessity of importing their energy requirements, the choice of the form in which energy is imported depends on several factors. Some of the more important considerations are:

The nature of the demand: If the energy needed is primarily for vehicular transportation, oil is clearly the form in which energy will be imported.

The relative cost of the fuels: If fuels are needed to provide a source of heat for electric power plants, the fuel that is cheapest at the plant site on a cents-per-kilowatt-hour basis is likely to be imported.

Environmental considerations: In areas with problems related to air quality, for example in Japan, less polluting fuels such as liquefied natural gas are being imported for use, even though it may be cheaper to use coal.

Reliability of supplies: In North America, it is considered almost axiomatic that many mid-Eastern and north African countries of OPEC cannot be considered reliable suppliers of oil for the longer term. It may be something of a surprise to learn that, in many parts of Asia, both Canada and the U.S.A. are considered less reliable suppliers than the same OPEC countries. Developing countries wishing to reduce dependence on oil by emphasizing coal or uranium find that they would, in all likelihood, have to import these in either case from Australia, Canada, China, South Africa, the U.S.A., or the U.S.S.R. The links to the country's foreign policy thus become a very major concern in such a decision.

Ease of storage: Administrations in the U.S.A. have been trying for several years to store enough oil to keep operations at near normal levels for about six months, in case imports were suddenly cut off. They have had very limited success in achieving this goal. For developing countries, with less available capital and technology, the possibilities for storing huge amounts of oil hardly exist. Storage of coal in quantities sufficient to last for a year or more would be even more difficult. In view of the much smaller quantities involved, the fuel to keep nuclear reactors running for the same time can be stored with relative ease.

The weighting assigned to each of the above factors in different countries will vary. If a country feels that its energy suppliers are reliable, it is likely to choose energy imports in a form that is least costly or easiest for its existing infrastructure to cope with. If it feels very vulnerable to cutoffs, it may base its decision on the ease of storage and attempt to build up fuel reserves. These concerns must have contributed to the decisions of Japan and Korea to boost their nuclear generating capacity significantly during the 1980s.

The nuclear debate in the United States has focused on what role nuclear power is likely to play in the country's energy future. There seems to be a feeling amongst the general public that the nation must first decide whether or not to continue building nuclear power plants, and if it chooses to forego the option, it does not have to worry too much about the long-term disposal of radioactive wastes. This, of course, is hardly the case. Large amounts of such wastes already exist in the U.S.A. from the military program as well as the 70 or so commercial power plants in operation. Additional quantities will continue to be produced by these, as well as from similar programs around the world. Solutions to the problem of disposal of radioactive wastes will have to be found, not only for the U.S.A., but for Japan, Korea, India, China, Canada, and the European countries. If any country disposes of long-lived wastes in an unsatisfactory fashion, so that they escape into the atmosphere or oceans, it would become a problem for all countries.

Research into the safe disposal of radioactive wastes should be an important component of the environmental agenda for the 1980s, and should be pursued with a much greater sense of urgency, whatever one's views on the desirability of nuclear fission reactors. Even if we decide to phase out nuclear power during the next decade, the existing reactors would have to be decommissioned, and the wastes presently being stored "temporarily" disposed of in a fashion that will isolate them for millenia from the common global environment.

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THE ENERGY-ENVIRONMENT CONUNDRUM: A VIEW FROM THE CONGRESS

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Abstract. *The Carter Administration's legislation to reduce oil imports through coal conversion is facing obstacles in the Congress. The environmental obstacles, in the form of acid rain and carbon dioxide concentration, can be handled technically but may not be surmountable politically. Failure of this legislation could lead to future environmental damage.*

In July of 1979, President Carter introduced an Import Reduction Program to save an additional 4.5 million barrels of oil a day (mbd) by the end of the 1980s (July 16, 1979). The importance of the President's effort is clear. In 1980 alone, the United States will spend $90 billion for foreign oil. That amount is equal to the net assets of General Motors, Ford, IBM, and General Electric combined. Projecting this rate of expenditure for the next 12 years will mean that in little more than a decade the United States will have paid out casn equivalent to the trading value of all the stocks listed on the New York Stock Exchange (Sawhill, April 14, 1980).

The horrible potential of spending over a trillion dollars in the next decade for foreign oil lends a sense of added urgency to the President's import reduction program. That program would:

--create an Energy Security Corporation to direct the development of 2.5 mbd of oil substitutes from coal liquids and gases, oil shale, biomass, and unconventional gas by 1990.

--establish a three-member Energy Mobilization Board empowered to expedite permitting and construction of critical energy facilities.

--provide new incentives for development of heavy oil resources, unconventional gas, and oil shale.

--require utilities to cut current oil consumption by 50 percent, saving 750,000 mbd.

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--establish a major new residential and commercial conservation program designed to save 500,000 bd by 1990.

--provide $2.4 billion annually in energy assistance to low-income families in the United States.

--provide a total of $16.5 billion over the coming decade for improvements in the nation's mass transportation system and in automobile fuel efficiency.

If this program were to work, oil imports could be cut in half by 1990, that is to 4-5 mbd. To achieve this objective, the President proposed spending $142.2 billion over the next decade. Of this total, the largest amount, $88 billion, would be obligated to the Energy Security Corporation for the development of synthetic fuels. Oil and gas produced from coal is likely to dominate that synthetic fuel effort.

The legislation to make the President's proposals law began its laborious journey through the Congress in the summer of 1979. Not until May of 1980 did a conference committee between the House and Senate finally agree on the components of the controversial Energy Mobilization Board (EMB) legislation. The conference, discussing the equally contentious legislation forming the Energy Security Corporation (ESC), which will award the development money to synthetic fuels producers, may remain in session throughout the summer of 1980.

It is easily understood why these two components of the President's program have attracted so much attention. The ESC will have not only the power to provide badly needed capital for energy development, but it will have the prerogative of setting up its own federal plants if the private sector does not move with enough speed. The EMB legislation has also become provocative because it is viewed as a mechanism for waiving or bypassing existing jurisdiction for governmental regulations (for example, if the Environmental Protection Agency or the Department of Interior fails to decide in a timely fashion on an Environmental Impact Statement: Senate Bill 1030, U.S. Senate).

That these two provisions passed the Senate and the House with comfortable margins is a commentary on the times. Gas lines, consumer revolts over energy prices, and political instability in the OPEC nations have led to a renewed call for energy independence by the public and their political leaders. While total independence (i.e., reliance solely on domestic energy sources) can only be a distant dream now, a drastic reduction in foreign imports is possible. President Carter's import reduction program is basically a sound one but its most significant component, the one most likely to contribute to import reduction in a sizable and rapid way, has received little attention.

The greatest potential for relatively immediate relief from reliance on foreign oil is the conversion of oil and gas-fired utility boilers to burning coal. Contained in the Powerplant Fuel Conversion Act of 1980, this provision would order 107 existing plants to convert to coal. These plants, already approved for conversion environmentally by the EPA, could reduce imports by 1 million barrels of oil a day by 1990. The technology is known, the need for saving oil is ever-present but, nevertheless, this legislation is in trouble. Why? The answer to this question most eloquently yields insight into America's energy-environment predicament, or what may be termed the energy-environment conundrum.

America will have to burn even larger amounts of coal over the next 30 years. As a recent study indicates, this trend will be true also for most other industrialized nations in the world (Wilson, 1980). The World Coal Study (WOCOL) of coal use trends suggests the following:

--that coal can provide up to two-thirds of the new energy required between 1980-2000.

--that coal is easily available and minable in increasing amounts.

--that steam coal production, used in boilers, will have to increase by 1000 percent over the next 20 years.

--that enormous amounts of capital will have to be forthcoming from the coal producers themselves if this development is to occur in a timely fashion (this money will have to be generated predominantly by the U.S., Canada, Australia, and South Africa because these nations control the largest coal deposits).

--that OPEC's price increases in 1979 erased the cost advantage (on a Btu basis) which oil previously held over coal.

Notwithstanding the findings of this study, the history and the future of coal burning in America is full of obstacles which have forced our continued reliance on foreign oil. The current coal program of the Carter administration is designed to alter this trend, increase demand for domestic coal, and reduce oil and gas use for electric generation. The program consists of five parts:

--a $10 billion, ten-year program to reduce utility oil and gas consumption by the equivalent of one million barrels of oil daily, replacing them with coal and other fuels;

--an acceleration of coal leasing on federal land;

--a program to increase coal exports to the 80 million ton per year level by the end of the decade;

--$20 billion for the first phase of a program designed to create a synthetic fuels industry, which could be producing the equivalent of as much as two million barrels of liquid and gaseous fuels per day by 1990;

--rapidly growing investment in coal research and development, which will top $1 billion in 1981.

The Powerplant Fuel Conversion Act of 1980 is the crucial mechanism of the Carter coal program. In phase I it provides for grants of $3.6 billion for partially defraying the utilities' costs of conversion. In as little as one year after the passage of this bill, some of the conversions would be complete and we would see a reduction in oil consumption. By 1985, all 107 conversions should be completed, reflecting an increased coal demand of 40 million tons per year, an increase of approximately 7 percent over current annual coal production. In phase II under this act, 600,000 barrels of oil a day could be saved through a $6 billion incentive to utilities with coal-capable facilities and others which would have to undertake new construction (Sawhill, May 5, 1980).

Unfortunately, this legislation has encountered at least four obstacles in the current Congress. In his comments introducing the hearings on this bill, Representative John Dingell, Chairman of the Subcommittee on Energy and Power of the House Committee on Interstate and Foreign Commerce, summarized these obstacles as follows:

--questions about the accuracy of the plants specified for conversion

--propriety of using federal funds to finance conversions which the electric power industry should initiate on its own

--potential for state revision of utility regulation laws serving as an incentive to the private sector, and, therefore, substituting local capital for federal support

--and the consistency of coal conversion with environmental standards (Dingell, April 16, 1980).

Space requirements in this paper necessitate limiting discussion to the fourth obstacle, the consistency of energy development, and use with environmental standards. But, one more generic comment about coal conversion legislation is appropriate here.

In 1978, this writer presented a paper on the Powerplant and Industrial Fuel Use Act of 1978, the first coal conversion bill (Gottlieb, 1978), which had just passed the U.S. Senate. It was the thesis of that paper, that the 1978 bill would fail in its mission to convert plants to coal because there were too many exemptions allowed for in the legislation. At the Dingell hearings on the Conversion Act of 1980, Congressman Nick J. Rahall, Chairman of the Congressional Coal Caucus, testified that in the two years since the original bill was passed only one plant in the entire United States actually converted to coal as a result of the 1978 Act (Rahall, April 16, 1980). The 1980 Act is designed to correct the flaws in the earlier bill and to supplement the move to coal on a grander scale, if the obstacles indicated above can be overcome.

Environmental obstacles to energy development and use are not new. Protecting the environment against rapacious energy development or capricious energy use is of the utmost importance. There would be little sense to a society which had easy access to energy and a strong energy-based economy if the environmental compromises which made the energy available had rendered the living environment unsafe or undesirable. Unfortunately, America's recent efforts at developing a national energy policy, instead of protecting the environment by fostering carefully planned energy development, has endangered the environment unintentionally. The contentious debates surrounding Congressional energy policy development reflect regional and economic differences, energy consumer and producer differences, and differences between the White House and the Congress. All of these differing points of view eventually coexist along an energy-environment continuum which ranges from the extreme view of "more energy at any cost," to the equally extreme view favoring an "undisturbed environment at any cost." Any group or faction, even a small one in the Congress, for example, can retard legislative development by engaging in the procedural tactics of delay. As a consequence, urgently needed legislation which ought to require only months for passage, can consume more than a year, or in some cases, more than one entire session of Congress.

When energy legislation is involved in this process of delay, the result is that lengthy energy development programs are postponed. While the development is postponed, the demand for energy continues to grow and the existing supplies of energy continue to reach their point of exhaustion. If energy development is orderly and well-timed, it can be scheduled to meet demand in a way which enables other crucial considerations such as the environment to be fully considered.

However, the public cry for energy will be met by compromising other variables, and environmental quality is one of the first to be compromised.

The two major environmental issues involved in increased coal development are increased concentrations of carbon dioxide (CO_2) contributing to a "greenhouse" effect, and increased sulfur content leading to "acid rain." Much has been said and written about each of these problems but there is little which is conclusive. Both are bonafide problems which require more research and demand the best available technology to control their harmful effects. But there is a danger in excessive optimism or, for that matter, pessimism over the environmental danger from these problems.

The official position of the Department of Energy (DOE) on the CO_2 question is that increased coal use will mean increased carbon dioxide, but that the extent of the effects are not known now. Additional study is being funded by DOE to determine the effects. In a letter to Representative Al Ullman, Assistant Secretary of Energy George Fumich commented on the uncertainty of the conclusions which can be drawn from the data (Fumich, July 31, 1979). Fumich's point is corroborated by a study done by an Ad Hoc Study Group of the National Research Council (NRC). This study contends that the role of the deeper waters of the oceans as a sink for excess CO_2 might well mitigate the problem of perceptible temperature changes. The NRC panel called for additional study, and concluded that more reliable estimates would have to await more sophisticated computers which would enable scientists to predict locations and intensities of regional climate changes more accurately (NRC, 1979).

Problems with the reliability of CO_2 estimates encourage distrust of all but the most general policy recommendations based on CO_2 data. In July of 1979, the Senate Governmental Affairs Committee conducted a symposium on carbon dioxide accumulation in the atmosphere. Drawing on the world's top scientists in this field, the Committee's findings suggest that the effects of CO_2 buildup on "agricultural zones, growing seasons, and marine productivity are still in the realm of speculation" (U.S. Senate, 1979). While the participants could draw general conclusions and identify trends, they could not achieve precision on any dimension of the problem. Consequently, they too concluded that additional research, testing, and computer modeling would be needed.

This symposium focused on the potential CO_2 buildup from a massive increase in synthetic oil and gas fuels from coal. Since the CO_2 emissions from synthetics are twice that of natural gas, 1.7 times more than oil and 1.5 times more than coal itself, the symposium members recommended having available non-fossil fuel energy alternatives which could supplant synthetics if evidence of CO_2 buildup were to become more conclusive. However, they made no recommendation on the substitution of coal-fired utility generators for oil-fired generation (U.S. Senate, 1979). Considering that CO_2 emission levels from coal and oil are similar, the 1980 Powerplant Fuel Conversion Act should not be attacked for increasing CO_2 emissions per se since the electricity generated from coal would be merely substituting for existing electric generation from oil.

Acid rain is another of the environmental obstacles which must be dealt with in the move to coal called for in the 1980 Conversion Act. Burning of untreated high sulfur coal in power plants will increase the acid content of the air and, therefore, eventually the lakes below that air. Such acidity could poison fish, contaminate drinking water, damage forest and farm crops, and increase corrosion. Evidence emanating from Sweden, Norway, New England, and the Midwest confirms the potential of these dangers.

Clearly, by conserving energy generally we can, by careful planning, reduce the use of fossil fuels specifically. Such conservation by definition reduces the CO_2 buildup and the acid rain threat at one time. Still, one gains little comfort from the preceding relationship when one realizes that as the availability of oil declines and its price increases, America will turn to coal for reasons of national security as well as economics. Being successful with conservation is one method for reducing the use of imported oil. But it cannot succeed by itself. Since adequate alternative energy sources will not be in operation on a scale large enough for some time to come, the likelihood is that the primary "oil-backout" method will be through coal conversion. Therefore, the sulfur question must still be answered.

While there is much to be learned about the causes and effects of acid rain, the oxides of sulfur and nitrogen which are released when fossil fuels are burned can be controlled by current technology both before and after the burning process. Congressman Rahall at the House hearing on the 1980 Fuel Conversion Act, called for expansion of the Act's $10 million funding for coal preparation facilities. This kind of preparation can remove 90 percent of the sulfur in raw coal and can take the place of more expensive pollution control equipment. Depending on the ambient air quality of the particular region on which the conversion to coal will occur, stock emission controls can also be used as a substitute or supplement.

The Act also provides $400 million to utilities for equipment to reduce acid rain by reducing sulfur dioxide and nitrogen oxide emissions. Grants for scrubbers and coal cleaning are provided. While this amount is not adequate to cover the entire problem, it is a credible beginning which can be increased in subsequent legislation.

Any form of control technology inevitably involves cost and environmental controls are particularly expensive. In new power plants, scrubbers will represent 11 to 12 percent of the capital cost of a system. In a 500-megawatt plant, $67 million will be spent on cleansing the emissions of sulfur oxides. The costs for retrofitting an old plant are 25 percent higher. But in rational terms, these costs are minimal when compared with the potentially permanent costs of lost natural resources. For years Americans have purchased energy cheaply. Seldom was the consumer's expense for energy equal to the replacement cost of that energy. But, in the current politically charged election atmosphere with a faltering economy, asking businesses to convert to coal, pay substantially for pollution control equipment, and pass only part of that cost along to consumers already angered by rising energy costs, is more than most politicians are willing to do. Unfortunately, in the final analysis, even technical questions about acid rain policies evolve into political questions which eclipse the environmental considerations.

The technicians and policymakers at EPA genuinely believe that utilities should be required to clean their coal before they burn it, as a way of reducing acid rain (Wall Street Journal, March 28, 1980). But these officials of the Carter Administration must battle other Carter people in the White House, the DOE, and the Office of Management and Budget (OMB), people with a different set of priorities. The DOE officials want to keep conversion costs low to encourage more companies to convert. The OMB people want to keep costs low so that DOE will award fewer grants and subsidies (i.e., less federal spending) to encourage conversions. And the officials in the White House want lower costs and fewer regulations so they can balance the budget, appeal to the business sector, reduce oil imports, use more domestic energy sources, and--get reelected (Jaroslovsky, March 28, 1980).

According to EPA, existing state air quality laws are not adequate to handle a major national coal conversion program. But EPA realizes that the Congress will not tighten the federal law in the present economic and political climate. Therefore, EPA will try instead to make tight pollution controls a condition which must be met before a utility can get aid under the 1980 Powerplant Fuel Conversion Act. DOE opposes that policy option because it will jeopardize passage of the legislation and discourage utilities from full participation in the program. Clearly, these are not technical problems; they are political problems. If these political problems persist, other critics of coal conversion and/or government subsidies may try to kill the bill for this session of Congress. Some environmentalists may cheer that result but they would be misguided if they did so.

If the 1980 Powerplant Fuel Conversion Act fails to pass, our dependence on foreign oil will continue and neither the CO_2 nor the acid rain levels will be reduced significantly. But the failure to move to coal conversion in an orderly way will surely hasten the day when the unrestrained use of coal will become a reality. With all the potential for environmental problems posed by coal burning without adequate controls, environmentalists might be better off supporting this bill now and lobbying for whatever controls they can secure. Politics is the art of the possible. The 1980s will be a difficult decade for environmentalists. If they want to maximize their gains in the legislative arena, they will have to set their sights on that which is "possible" right now.

The Powerplant Fuel Conversion Act of 1980 passed the Senate by a vote of 86-7 on June 24, 1980. But the bill no longer contains the $6 billion worth of coal conversion incentives proposed by the Carter Administration. The Senate cut these incentives from the bill discouraging increased coal usage. An additional obstacle to coal use in the bill was the delay permitted for conversions of natural gas utilities to coal. Natural gas states lobbied for and received a concession permitting natural gas utilities to remain in operation until their useful life had been exhausted. This provision, as with so many others in Congress during the last two years, diminishes the likelihood of domestic coal playing the dominant role in weaning America from excessive reliance on foreign oil.

On a related matter, the Senate defeated the Congressional Conference Committee's report on the Energy Mobilization Board legislation. The creation of the Board, to accelerate energy development had been opposed by a coalition of environmentalists and pro-business forces. The environmentalists feared the Board's potential for overriding existing environmental regulations while the business supporters opposed the imposition of a new government agency into what they prefer would be a matter entirely for the private sector. The defeat of this conference report may defeat this legislation for the foreseeable future.

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DESIGNING TRANSIT TO MINIMIZE URBAN COSTS AND ENERGY USE

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Abstract. *Analysis of characteristics of transit systems leads to the conclusion that guideway-transit costs and energy use per person carried are minimized if the system uses small, automatically controlled and electrically powered vehicles operating on-demand and nonstop between off-line stations in a network of narrow guideways. Since the system takes very little land, is quiet and nonpolluting, it can catalyze remarkable improvements in the urban environment.*

Scheduled and Demand-Responsive Systems

Conventional city buses, streetcars, and rapid rail systems operate on fixed schedules. To give the potential patron confidence in the service provided, these schedules must be published, maintained, and not often changed. Vehicles must move whether or not people are in them. As demand declines after the peak periods are over, the average vehicle occupancy also declines, usually markedly. To keep operating costs reasonable, the schedule time between vehicles, or headway, must increase. But with less frequent service, fewer people ride than would have ridden if the rush period headway had been maintained. Because of high operating costs, the Washington, D.C. Metro Authority decided to stop subway service after 6 p.m. and on weekends. While the energy use per seat-mile of large vehicle, scheduled systems is generally very good, the system energy use in energy per person carried per mile averaged over a 24-hour period is disappointing. Space and time variations in travel demand fundamentally work against the efficiency of these scheduled systems.

The automobile, on the other hand, provides purely demand-responsive service. When it is not in use, it does not cruise empty but remains stationary and wastes no energy. But when it is moving, it uses more energy than is theoretically necessary for two reasons. First is its large weight per person carried. New small cars may weigh as little as 500 to 600 pounds per seat, but the rush period occupancy is only about 1.2 persons and the daily average is about 1.6 persons. If the car could be made smaller and lighter, less dead weight per person would be carried. However, the vehicle would not

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not be as useful for all of the kinds of trips people want to take and would provide less protection during collisions. Second, during an urban trip, the automobile typically makes many stops. Each time it stops, its kinetic energy is converted to heat in the brake linings. To accelerate the automobile back to cruising speed, the kinetic energy must be restored.

The taxi is a demand-responsive system, but often cruises without paying passengers just to attract fares. For this reason the taxi inherently uses more energy per person wishing to travel for serious purposes than the private automobile. Of course, because the private automobile lends itself to joy riding, it leads to much waste of fuel. The group taxi service called "dial-a-ride" is also not very efficient because of the circuity of the trip required to pick up and drop off individuals having different origins and destinations. Commuter vans are quite efficient because of the common origins and destinations of a group of persons living in one community and working at the same location; however, the feature of common origins and destinations makes this service concept unsuited to general transit requirements.

An Ideal System

An ideal transit system from the viewpoint of energy minimization would be demand-responsive like the private auto, of minimum weight-per-seat (or per place if standees are permitted), able to provide the maximum ratio of occupied seats per place (called the load factor) over a 24-hour period, able to travel nonstop at a modest speed from origin to destination, and still able to provide general transit service.

To understand what kind of system this might be, it is necessary to understand that the weight-per-place of transit vehicles is quite independent of vehicle size. Figure 1 shows data from the Lea Transit Compendium (Lea, 1975), which reports on almost all transit vehicles in the world. Vehicles of size from those with only three seats to rail cars carrying upwards of 200 passengers,many of whom must stand, can be built in the range of 300 to 400 pounds per place. From similar data, one also finds that the cost of transit vehicles per place also varies very little with capacity (Anderson, 1978; Cooke, 1980).

This means that transit vehicles can be purchased for roughly the same amount per pound regardless of size. The cost of the required vehicle fleet is therefore proportional to fleet capacity. But the required fleet capacity is proportional to average trip time, and for a given cruising speed the trip time is decreased if the number of intermediate stops is decreased. Thus, the nonstop trip of the ideal system minimizes not only energy use, it minimizes the fleet cost.

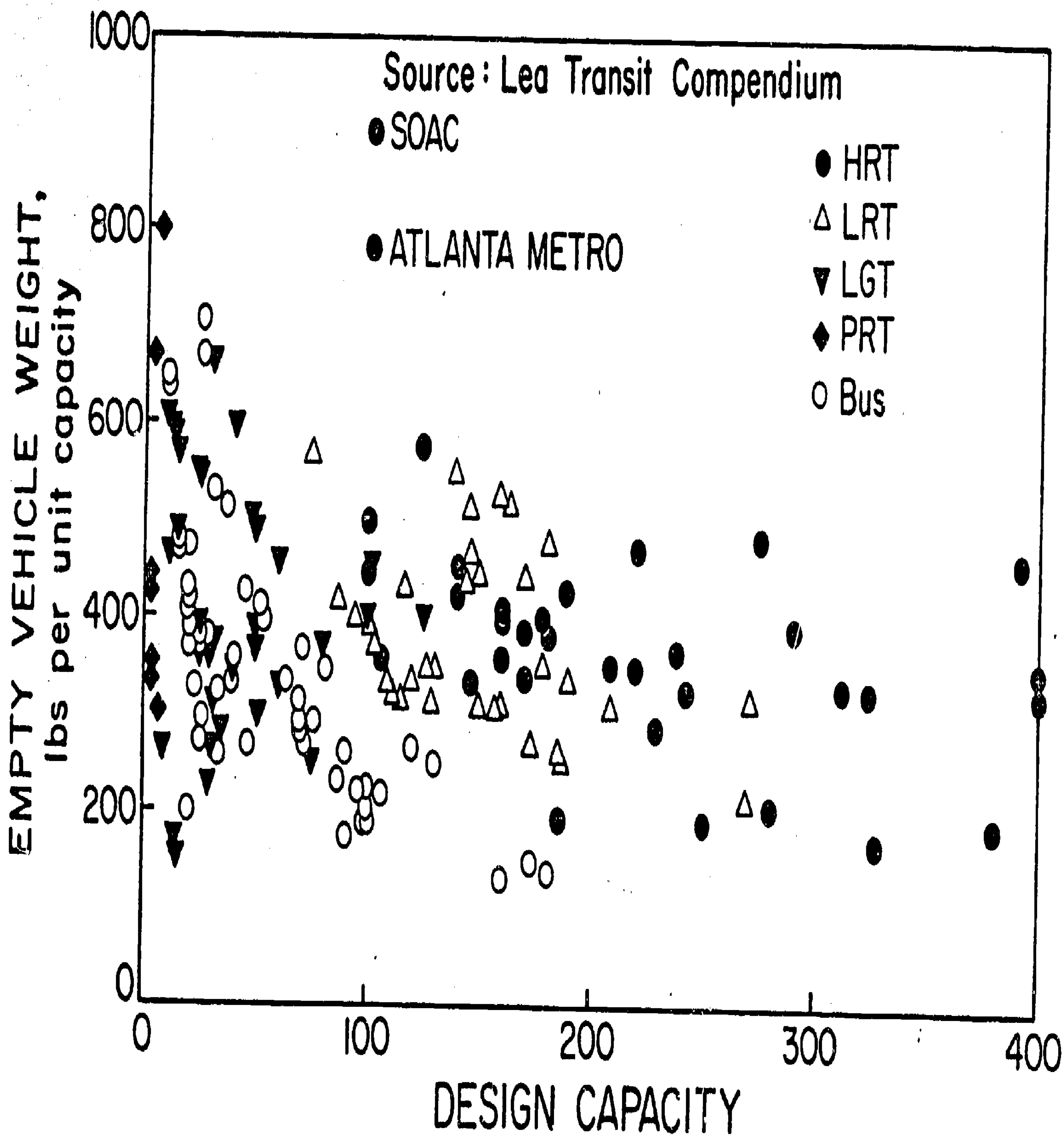

Figure 1. The Empty Vehicle Weight per Place (Unit Capacity) of Transit Vehicles

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Automation

If the vehicles have paid drivers, most of the operating cost is in driver wages. In this case it is advantageous to increase vehicle size to amortize driver wages over as many passengers as possible. But, for general transit service, large vehicles must run on fixed schedules because that is the only practical way groups of people arriving at different times and headed to different destinations can be accommodated.

If the vehicle does not have a paid driver, the driver may be one of the passengers or the vehicles may operate under automatic control. In the former case, the vehicle is either a commuter van or a private automobile. The commuter van is very efficient for the trip it takes from a community to one work place and back, but as mentioned above, it is not suited to general transit service. If the vehicles are automatically controlled, there is no economic advantage to large size because the initial cost per place is nearly independent of capacity, even including the automatic controls. This is true because control and failure-management functions can be performed by microprocessors.

An examination of the data on various operating automated transit systems also shows that operating and maintenance costs per place-mile are only weakly correlated with capacity (Cooke, 1980). Energy use and operating costs of the whole system are therefore proportional to the number of place-miles per day. It has been shown from simple analysis (Anderson, 1980) that, in moving a given number of persons per day, a purely demand-responsive system requires only one-half to one-third as many place-miles per day as a scheduled system, and that the energy use of well-designed systems for demand-responsive versus scheduled service is in about the same ratio.

Automated vehicles can run at very slow speeds in mixed traffic, but to move at speeds significant enough to use the system for general transit service, and to keep the feature of nonstop trips, the system must run on an exclusive guideway. Thus, the concept of an "automated guideway transit" or AGT system emerges. In spite of automation difficulties with BART and Morgantown, over a dozen AGT systems are now in successful operation in the United States, Japan, and Germany. An exclusive-guideway system clearly cannot be ubiquitous as is the automobile, but this feature can be turned into an advantage. By being able to go everywhere, the automobile has made possible very low density urban areas in which the average trip lengths are very long and fewer trips can be taken by walking than would be the case with higher density.

The only economical way an AGT system can provide purely demand-responsive service 24-hours a day, and hence the minimum number of place-miles per day per person carried, is to make the vehicles small enough so that each vehicle can be used economically for a party of one, two or three people traveling together. A vehicle with one seat for three persons is large enough and is a good configuration for safe operation (Anderson, 1978). If the vehicle is larger, the requirement to maximize the load factor means that it must wait for more than one party. But, it has been shown (Anderson, 1978) that the wait time for the second party in general is excessive, even in the rush period, and vehicles will often have to leave the stations with only one party aboard.

Capacity

Demand-responsive service cannot be provided if the stations are on line, and certainly the capacity will not be adequate in such a system if each vehicle has room for only three persons. Therefore, the stations must be placed on bypass tracks off the main lines. With off-line stations, the vehicles can be caused to wait at stations for service 24 hours per day without interfering with through traffic. Empty-vehicle movement is required to account for varying demand from station to station, but the movement is strictly in proportion to demand. Studies of station capacity (Irving, 1979) and potential station demands (Anderson, 1978) show that the typical station would have three berths or boarding locations, and rarely would a station be required to have more than six to ten berths. Crowds would rarely accumulate because the vehicles leave the stations once every few seconds. This does not mean, however, that the passengers would need to deboard and board quickly. By moving the vehicles through the stations in platoons of size equal to the number of berths, the unloading and loading time is kept adequate and well above the average time for each vehicle to pass through a station (Irving, 1979).

With off-line stations, the line capacity is not restricted by the delay of vehicles in stations. Maximization of line capacity requires careful study of the kinematics and dynamics of emergencies in which a vehicle fails in such a way that it slows down quickly. With an exclusive, grade-separated guideway, very sudden stops would occur rarely. If the vehicles are propelled and braked through wheels, the maximum safe flow is about two seconds per vehicle if the passengers are seated (Anderson, 1978; Irving, 1979). If adult standees are permitted, the maximum flow is decreased by 30 percent.

Two seconds per vehicle is equivalent to 1800 vehicles per hour, a capacity of about one freeway lane at the optimum speed of about 35 mph. Since this capacity is too limiting in many cases, it is necessary to examine alternative means of propulsion and braking. Much analysis and testing has shown that the linear electric motor is the best choice for this application. It permits positive traction regardless of water or ice on the guideway, can be controlled readily and very rapidly (in tens of milliseconds), provides adequate force levels, is very quiet, and has no moving parts to maintain. At the present time, there are about a dozen linear electric motor AGT systems under development or in operation in the United States, Canada, Germany, and Japan. With the linear electric motor, kinematic analysis shows that it is practical to consider operation eventually at a capacity of about four vehicles per second maximum, thus providing a flow equivalent of not one but eight freeway lanes, a capacity rarely needed. The conclusion is that a small-vehicle AGT system of proper design will not be capacity limited.

Dependability and Safety

To make such a system (or any AGT system) adequate in terms of service dependability, critical on-board systems such as controllers, motors, and brakes must be redundant and failure monitored. If they are, analysis and testing show that the system will be much more reliable than existing systems even if the smallest vehicles are used (Anderson, 1978; Irving, 1979; Hobbs, 1977). With the fault-tolerant features of redundancy and failure monitoring, collisions between vehicles will be rare, but because one can never be sure they will not occur, the vehicle must be designed to withstand collisions. If the vehicle is designed with a three-passenger seat and a padded dashboard in front of the passengers, the use of constant-force, constant-displacement hydraulic shock absorbers provide adequate protection at speeds up to 25 to 30 mph. At higher speeds, seat belts or airbags are recommended.

One more factor needs to be taken into account to provide adequate capacity and safety--the switch. The vehicles must be able to switch quickly and separately from the main line to an off-line station, and from one line to another. To do this with adequate reliability, the moving parts of the switch must be in the vehicle and not in the track. This has required clever design of both the track and the in-vehicle switch, and during the 1970s several ways have been found to solve this problem.

The Guideway

The guideway itself requires attention right from the beginning of the design because it is usually the most expensive component in the system. The guideway may be elevated, at grade or underground. Underground systems are generally the most expensive, and at-grade systems have the greatest safety problems and land requirements. Therefore, elevated guideways are usually, but not always, preferable.

Two major considerations come from analysis of minimum-cost elevated guideways (Anderson, 1978): 1) There is an optimum shape for minimum weight per unit length--a narrow deep beam. The vehicle therefore must be designed together with the optimum guideway rather than the guideway designed after the vehicle configuration has been chosen. The difference has been shown to be as much as a factor of five in cost per unit length. Moreover, the narrow guideway has much smaller visual impact and is much less of a problem in ice and snow; 2) With the optimum guideway shape, the weight per unit length of the guideway is minimum if the vehicle weight per unit length is minimum, and the vehicle weight per unit length is minimized if its width and height are minimized. A vehicle designed for three adult passengers seated side by side provides as small a cross-section as is practical. If the vehicles were to be designed so that the passengers could enter standing up, they would weigh significantly more per unit length and would be subject to much higher lateral wind loads. Thus, the requirement of cost minimization of the guideway leads to the requirement that every adult be able to sit.

Characteristics of an Optimum System

The criterion of minimum vehicle movement to minimize energy use and the requirements of cost minimization lead to an automated guideway transit system using three-seated passenger vehicles moving in direct response to demand between off-line stations along a system of narrow guideways. The vehicles should be propelled by linear electric motors. They should have redundancy in critical subsystems monitored by a microprocessor, and the moving switch elements should be on board the vehicles. The memory of the destination station should be stored aboard each vehicle, which moves its switch to guide itself along the proper path through a network of guideways in response to commands from wayside diverge-point controllers, and should contain intelligence needed to respond properly to emergency situations. Station computers command the flow of empty vehicles in response to present demands, or with experience, with anticipated demands, and a central computer provides only the functions of optimum monitoring of empty vehicles and flow adjustment to minimize possible bottlenecks (Anderson, 1978; Irving, 1979). Such a system is designed to be fault tolerant--no failure can affect but a small portion of the system. Vehicles should carry a battery with enough energy to reach the nearest station in the case of a power failure. Such a system is usually referred to as a true personal rapid transit (PRT) system.

Use of the System

To use a PRT system, the patron (a single individual or a group of two or three people traveling together) selects the destination station from a map and orders the trip by pushing buttons. Lights on a display panel confirm the destination and show the fare, which can be paid in cash or by credit card. After the fare is inserted, a magnetically encoded ticket is dispensed. The patron takes the ticket to a stand in front of the first empty vehicle in line and inserts it into a slot. The ticket is read into the vehicle memory and its door unlatches. The patrons, traveling together by choice to a common destination, then get in, close the door and are off nonstop to their destination. If they need to get off sooner, they press an emergency button which stops the vehicle at the nearest station. To encourage higher vehicle occupancy and hence minimum vehicle weight per person carried, it is recommended that a fare be charged per vehicle rather than per person.

Energy Use

The title of this paper promises discussion of how the transit system, the basic characteristics of which are derived above, can minimize urban costs and energy use. Assume that the vehicles weigh 500 pounds per place, a modest amount of streamlining is used to reduce air drag, a reasonable amount of attention is paid to reduction of road resistance, the average load is one person per vehicle counting empty vehicles, and the motor efficiency is 50 percent (reasonable for a linear induction motor). The energy use of such a system on a daily basis, assuming an electrical generating plant efficiency of one-third, is equivalent to an automobile system (1.6 persons per auto) averaging about 85 miles per gallon of gasoline if the cruising speed is 25 mph, or 64 mpg if the cruising speed is 30 mph. If the vehicles weigh 400 pounds per place, the latter figure increases to 80 mpg. In the above calculation, it is assumed that two-thirds of energy input to the electrical generating plant is lost to the atmosphere as waste heat. If most of this waste heat is used in a district heating system to heat buildings, the transit system efficiency in auto-equivalent miles per gallon would be substantially higher than indicated. In this direct sense, an optimally designed AGT system can conserve a substantial amount of energy. By comparison, if the same kind of calculation is made for a trolley-car system (a scheduled large vehicle system now often called light rail transit) with a motor efficiency of 70 percent, the 24-hour system efficiency calculated on the same basis is in the range of 20 to 25 miles per gallon.

Impacts on the Central City

The greatest advantage of this optimum AGT system in terms of its ability to attract patrons and to save energy is obtained if the system is deployed in a gradually expanding network of lines serving not a corridor but an area of the central city. If the lines are placed half a mile apart, the maximum distance to a station will be about a quarter mile, considered to be maximum walking distance in most transit analyses. A narrow-guideway optimum AGT system requires land only for support posts and stations and most of the stations can be located in buildings with an elevator in each of them to accommodate the handicapped. By contrast, the present auto system consumes about two-thirds of the land in the central business districts of most American cities. While streets would still be needed for emergency vehicles and some trucks (the automated system could accommodate most of the freight traffic in the central city), streets could be narrowed and partly converted into linear parks and gardens. Coupled with the very low noise level of linear-electric-motor propulsion and the lack of auto-exhaust pollution, the inner-city environment would become far more attractive than at present as a place to both live and work. A much more livable higher density environment than ever would be possible with the auto system could be created, and by deliberately not placing the stations too close together, many more trips could be taken by walking than is common today.

If, instead of areawide networks covering the inner region of the city, the system were deployed as a family of line-haul systems to the suburbs (as indicated above the capacity is adequate to do that), it would encourage continuation of long trips from home to work and foster present urban sprawl. It is clear that suburban folk would lobby hard for the line-haul approach, but it would be better in terms of energy savings to begin area networks in major activity centers in several locations and to develop policies to encourage people to live near their place of employment. In any case, a line-haul system will not be attractive as a means of traveling to the downtown unless one can get around conveniently once there. To begin these small area networks, the jurisdiction for development cannot be region wide, but must encompass only the area involved, and that area must stand the cost of the system. If a metropolitan-wide commission is assigned the task of building the system, past experience, such as obtained in Denver in the period 1972-1975, shows that jurisdictional fights between representatives of inner-city and suburbs will probably make effective action impossible.

Status

In the early 1970s many development programs were underway to develop systems having many of the features of the system described above. It is well that most of these programs stopped because they contained features that made them noncompetitive. Others should have continued but did not. Catherine Burke (Burke, 1979) has studied the political reasons for difficulty in maintaining development on such a radically new transit concept. The one program that has continued for over a decade the development of the true personal rapid transit concept as described here is Cabintaxi (Hobbs, 1979). This program has been sponsored by the German Ministry of Research and Technology with the work being done by the joint venture Mannesmann DEMAG Fordertechnik and Messerschmitt-Bolkow-Blohm GmbH. This program has had systems under full-scale testing since the summer of 1973 in Hagen, West Germany. The Cabintaxi system has been the subject of extensive application studies for German cities and is being considered for several American cities. The first Cabintaxi system is to be built in a suburb of Hamburg connecting a high-density region to two U-Bahn stations.

Summary

There is no longer any question that true personal rapid transit systems can be built with very adequate capacity, safety, service dependability, and for a reasonable cost. It also seems clear that such a system would provide an unparalleled level of transport service for the denser portions of cities, and, if planned carefully, would seem to be able to do more than alternative transport systems to lower urban costs and energy use. The remaining question only the public can answer: Should it be built?

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ANALYSIS OF MORGANTOWN'S PERSONAL RAPID TRANSIT SYSTEM

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Abstract. *Morgantown was selected in 1971 as the site for a demonstration project in urban rapid transit systems. Although the system cost $120 million more than the original $20 million estimate, and operating expenses have quadrupled, the system has proved to be a safe, quiet, reliable, efficient, nonpolluting means of urban transit. While rider response indicates improving acceptance of the system, economic realities make its continued funding unsure.*

Background Information

In 1948, the population of Morgantown, West Virginia comprised 18,000 residents and 7,500 students. In 1980, there were 36,000 residents and over 20,000 students. In spite of the doubling in population, public transportation in the city was virtually unchanged from 1948 through 1971. Morgantown occupies a series of steep hills separated by shallow valleys. A roadway wider than two lanes requires an unusual amount of earth moving. It is a difficult city in which to build modern, four-lane roadways.

Climatically, Morgantown is located at the northernmost reaches of the balmy, moist, southern wind patterns, at the southernmost reach of the cold Canadian air masses, and just far enough inland to receive the tail-end of storms off the Atlantic. The city averages 42 inches of rainfall annually, 3 feet of snow, minimum winter temperatures of -15°F., and maximum summer temperatures of 95°F.

Because of the climatic and geographic features, Morgantown was deemed an ideal site to test a computer-controlled urban rapid transit system. It is the home of West Virginia University, the downtown campus of which is 2.5 miles from the newer Evansdale campus, and an additional 1.7 miles from the Medical Center.

In July 1969, West Virginia University was awarded a grant by the U.S. Department of Transportation to study the feasibility of constructing a rapid transit system in Morgantown. In April 1971, contracts to build the "Personal Rapid Transit System" (PRT) were awarded by the Department of Transportation, with the Boeing Aerospace Company of Seattle as the principal contractor. The first phase of the system,

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which linked downtown, the downtown campus, and one stop on the Evansdale campus, was completed in October 1975. After two years of operation the system was shut down for one full year while a second phase was completed, linking the Medical Center campus with the other units. During Phase II, certain problems which had been discovered with the initial system were re-engineered.

The system completed its testing phase as of May 1980, and was turned over to the University which now has complete responsibility for its upkeep and performance.

Description of the PRT System

The system consists of five passenger stations, two maintenance facilities, three boiler stations (which pump heated ethylene glycol to keep the track from freezing in the winter), a control center, 8.7 miles of single-lane guideway, and 73 vehicles.

The vehicles are 15'8" long, 6'8" wide, and 8'9" high. The small size of the vehicle was dictated by the fact that passenger demand at nonpeak hours is low. The system can transport 1,100 people in 20 minutes. Each car can carry 20 people, and there is a 15-second interval between cars. Maximum speed of the vehicles is 30 mph. The 8,650 pound fiberglass vehicles operate on a 70 hp. direct current motor using 575 volts; they have four-wheel steering, an air-bag suspension system and pneumatic tires.

Two features of the Morgantown PRT system deserve special attention. First, each car travels nonstop from pickup point to destination. Since there are no in-between stops, the longest trip--4.2 miles from downtown to the Medical Center--takes 11.5 minutes (Alumni News, 1979). The second innovative feature is that the system operates, or can operate, on demand. As a passenger enters a station, a button on the turnstile informs the computer of the desired destination. When 15 others have chosen the same destination, or within three minut s, a car will be programmed for the desired stop.

Three major questions relate to the development and use of a similar PRT system elsewhere: finances, environmental impact, reliability.

(a) Finances

Reader's Digest (Armbrister, 1977) published an article on Morgantown's PRT entitled, "Anatomy of a Boondoggle." The author pointed out that the initial cost estimate of the PRT was $18 million. Since the actual cost exceeded $140 million, the overrun exceeded the estimate by a factor of 7.5. Equally disconcerting is the estimated annual operating expense. The budget estimate for 1980-1981 is $2,730,000 (Board of Regents, 1980). It is expected that one-third of this amount will come from student fees, one-third from state government, and one-third from the federal government (which, perhaps as symbolic compensation for unexpected expenses, has named Morgantown the first "National Transportation Center").

In the years from 1972 to 1980, the cost of operating a comparable bus system has more than quadrupled. Operating a fleet of inter-campus buses cost $200,000 in 1972, and cost over $750,000 in 1978-1979. Robert Bates, in charge of non-PRT campus transit, estimated the cost of running a very efficient bus system in 1980-1981 at less than $1 million.

(b) Environmental Impact

Initial plans for the PRT included a stop at the University coliseum to take advantage of the large parking area as well as to facilitate access to that facility. This would have necessitated running the guideway (railway plus electric system) through the University arboretum, a major biological demonstration area bordering the Monongahela River. This stop was eliminated at the insistence of those who felt the bird-life and other scientific and scenic values of the area would be compromised. The guideways have been constructed so that they either parallel the highway, are above a railway, or are on University or county property. For the construction of the guideway, one single-family residence and one scrap metal yard were removed. The actual construction period did play havoc temporarily with traffic patterns in several places. Since the vehicles are powered by electric motors, they are quiet, produce no immediate pollution, and actually provide the riders with some pleasant views of the river and the surrounding hillsides (Environmental Impact Statement, 1969).

(c) Reliability

From the data provided by the operations manager of the PRT (Barker, 1980), it is clear that reliability has improved steadily. In 1976, the PRT was operating 92.7 percent of the time of its planned schedule, in spite of a very severe winter with unusually heavy snow storms and several days of sub-zero temperatures (Sherwin, 1980). In the fall of 1979, with Phase II operating and the system improved, the PRT provided service 96.2 percent of the time. Unfortunately, the downtime usually occurs at peak periods, and is due to one form or another of system overload.

On March 20, 1980, a vehicle pulling into a station stopped abruptly. It had broken a steering axle, and the on-board computer, which monitors a number of potential malfunctions, caused a shutdown of the entire system (Appezzato, 1980). Twenty-five of the 71 vehicles then operating were found to have cracks in their steering axles. By March 25th, rewelding had taken place and the system was back in full operation. This interruption of service was the longest in the history of the PRT.

The spring of 1980 proved to be a time of very high reliability with a minimum of problems. Minor difficulties with propulsion systems or with steering mechanisms cause occasional downtimes of 10 to 15 minutes. During 1979-1980, the largest single problem has involved the entrance turnstiles: passengers occasionally try to insert a quarter rather than the fare card. This appears to be a human error for which turnstile systems, whatever their design, have little tolerance. The only accident involving bodily harm in the five-year history of the PRT system occurred when a young lady twisted her ankle on one of the access ramps in 1978.

Rider Response

The first investigation of rider reaction to the PRT was conducted by the Office of Economic Research in 1976. Findings from that initial effort indicated that people used the PRT more than they had the buses, people who lived within a quarter mile of a station decreased their use of automobiles by 16 percent, and that safety "ranked highest in the features people liked about the system" (Sherwin, 1980:1).

(a) Subject Selection and Administration of Questionnaire

Students enrolled in both sections of Forestry 140, Resources of West Virginia, were administered a short, 25-item questionnaire (Appendix A) on March 19, 1980. The purpose of the questionnaire was to determine (1) the current student attitude towards the PRT, (2) whether or not any gender differences existed in that attitude, (3) if the amount of student driving in town had been reduced, and (4) student assessment of expense to the state and federal government.

Students enrolled in Forestry 140 were selected for two reasons. First, Forestry 140 is classified as partially satisfying one of three University "core" requirements and consequently draws a representative group from the various schools such as Arts and Sciences, and Engineering. Secondly, Forestry 140 is not taught on the main campus, but rather on the Evansdale Campus. The provided means of transportation between campuses is the PRT.

Questionnaires (N = 320) were distributed the last 10 minutes of Wednesday's class (March 19, 1980) by the investigators. The students had the option of returning the completed forms in the provided addressed envelopes either through the campus mail system or by bringing it to Friday's class. The Spring of 1980 had been selected since the PRT had been closed in 1979 for completion of Phase II. Therefore, all sophomores, juniors or seniors, except for transfer students, had been exposed to both the buses and the completed PRT as provided forms of University transportation. Transfer students had been exposed to the bus system for a week in March when the PRT was shut down due to cracked guide axles. Freshmen do not take Forestry 140.

(b) Data Analysis

The response rate was 40 percent (N = 128). Overall reaction to the PRT might be classified as neutral in that very few extreme responses (strongly agree or strongly disagree) were scored, the average item response was 3.9 (response range, 1-7). The three strongest responses were 2.3 for Item 4 (the PRT is safe), 2.9 for Item 6a (people usually get the desired car in less than 10 minutes of waiting) and 3.0 for Item 13 (the PRT has not detracted from Morgantown's visual appearance) (Table 1). No comparable negative (5.0-5.8) scores existed. The strongest response over 4.0 was 4.7 for Item 9 (students would like to return to the buses) which actually indicated support for the PRT.

Significant differences (.01) between male and female responses were identified for Items 6a, 7, and 15 (Appendix A, Table 1). Males, more often than females, perceived that the wait was less than 10 minutes. Females agreed more strongly than males that women were "worried about using the PRT after dark" (Item 7, Table 1). The same trend existed for Item 15 which referred to females being "worried about using the bus after dark" (Table 1). There was no significant (.05) difference in response pattern between Items 7 and 15 when genders were separated or combined (Table 2). The indicated fear is not associated with the PRT but with travel after dark on school transportation. This might also explain why some females perceive the wait (Item 6) to be longer than men perceive it to be (Table 1).

Table 1

AVERAGE RESPONSES TO TRANSPORTATION QUESTIONNAIRE

Question #	X^2	df	$N_1{}^a$	$N_2{}^b$	$N_1\bar{X}$	$N_2\bar{X}$	Total $\bar{X}$
1.	2.878	6	83	42	3.446	3.857	3.584
2.	12.882	6	82	41	3.634	4.341	3.870
3.	6.830	6	81	41	3.086	3.439	3.205
4.	5.768	5	82	40	2.159	2.475	2.262
5.	4.167	6	79	40	3.494	3.750	3.580
6a.	20.885***	6	74	45	2.459	3.869	2.924
6b.	7.767	6	72	39	3.861	4.103	3.946
7.	17.108**	6	71	42	4.549	3.833	4.283
8.	3.953	6	81	40	4.556	4.600	4.570
9.	5.170	6	80	36	4.563	4.889	4.664
10.	6.732	6	82	39	4.073	3.641	3.934
11.	2.338	6	77	41	3.545	3.195	3.424
12.	3.327	6	79	40	3.975	3.500	3.815
13.	1.934	6	81	40	2.963	3.075	3.000
14.	4.180	6	77	40	3.818	4.275	3.974
15.	21.445**	6	68	41	4.647	3.732	4.303
16.	3.726	6	74	40	4.284	4.125	4.228
17.	10.670	6	81	40	4.111	3.650	3.959
18.	10.713	6	76	39	3.211	3.308	3.243
19.	5.565	6	79	35	3.241	3.538	3.339
23.	4.296	2	78	40	1.603	1.500	1.568
24.	1.858	6	45	11	35.30%	33. 05%	34.86%

** = significant at .01 level

*** = significant at .005 level

a = males

b = females

Table 2

Chi-Square Comparison of Items 7 and 15

Group	x^2 *	df	N_1(#7)	N_2(#15)	$N_1\bar{X}$	$N_2\bar{X}$
Males	3.984	6	71	68	4.549	4.647
Females	3.299	6	42	41	3.833	3.732
Both	2.089	6	113	109	4.283	4.303

* no significant (.05) differences

Question 24 was directed "For car owners only." Forty-three point seven-five percent (43.75%) of the sample responded to the item, 45 males (54 percent of the male sample) and 11 females (24 percent of the female sample). The PRT reduced driving in Morgantown an average of 34.86 percent, 35.3 percent for males and 33.05 percent for females. The most frequent reduction rate was 1-9 percent (Table 3). There was no significant (.05) difference between male and female reduction (x^2 = 1.858, df 6).

Table 3

PERCENTAGE OF DRIVING REDUCED BY THE PRT

% Reduced	#Males	#Females	Total	%
1- 9	15	3	18	32.14
10-19	6	1	7	12.50
20-29	6	2	8	14.20
30-39	2	2	4	7.14
40-49	2	0	2	3.57
50-59	2	1	3	5.36
60-69	0	0	0	0.00
70-79	3	1	4	7.14
80-89	5	0	5	8.93
90-99	4	1	5	8.93
Totals	45	11	56	99.91

Generally, the students did not express knowledge of expense for the PRT system. One indicator was the high percent of no response, 26 percent did not answer or wrote "no idea" for state expenditure and 24 percent did the same for federal government expenditure. Only 3.9 (N = 5) of the sample correctly responded with $40 million for the state while 4.6 percent (N = 6) responded with $100 million for the government. The trend was to underestimate the cost, only 5.5 percent (N = 7) went over the $40 million mark for the state while 13.3 percent (N = 17) exceeded the $100 million for the government.

Forty-one percent (41%, N = 76) of the sample responded to the open-ended Item 25, "Other comments." The most frequent expression (N = 13) was for more stations. Others commented on such matters as inconvenience during breakdown (N = 8), the desire for extended hours of operation (N = 8), and the need for improvement during bad weather (N = 4).

Conclusions

Regardless of titles, transit systems can seldom be as rapid as one's own vehicle, nor can they be as personal as a private car. There are times when the PRT is the fastest and most convenient means of transportation between two or more points in Morgantown. Like most cities, Morgantown not only has a problem with traffic congestion, but also with space to park all the vehicles driven into the campus or downtown areas. Riding the PRT eliminates this problem for the riders and increases the number of parking places for those who drive. Some parking space is provided near the Medical Center entrance and at the coliseum, a short walk from the engineering building station.

With respect to alleviating some of Morgantown's severe traffic problems and people-mobility difficulties, the PRT is a great success. As a demonstration center for the kinds of problems a transit authority may encounter, it is an instructive laboratory. As an indicator of how expensive a PRT is likely to be, it is perhaps somewhat misleading. Since this was the first of its kind, a number of research and development costs should not be encountered in future attempts. But conversely, most other cities are likely to meet much higher expenses in property condemnations or in the securing of rights-of-way. The University or the county owned most of the property on which or over which the PRT was constructed. Perhaps most important to any city looking for more efficient systems of transit, the costs of construction have escalated significantly since the years of the building of the PRT in Morgantown.

Over the last 50 years people have been conditioned to use their cars and go wherever they wish, or go nowhere in particular. Having to walk to a station, wait for a car, and travel to a predetermined destination may be viewed as a sign of a falling standard of living. Perhaps only when the inconveniences are minimal and the economic advantages immense will a majority of riders enthusiastically endorse a PRT. Meanwhile, the Morgantown Personal Rapid Transit (actually a Group Rapid Transit) serves as a practical example that a rapid transit system can be developed, be made efficient, and provide safe and dependable transportation to 15,000 or more people per day. An annual fight in the state legislature and in the Congress in order to obtain funding for the PRT indicates that such an expensive solution to urban transit problems should be analyzed exhaustively before acceptance. Rider response in Morgantown indicates increasing approval of the PRT; its high initial cost and expense of operating the system might make potential imitators study other alternatives to this particular model of a Personal Rapid Transit system.

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APPENDIX A

TRANSPORTATION QUESTIONNAIRE

DIRECTIONS: How well do the following statements express your personal feelings, attitudes, beliefs about the University's transportation system. Rate on a scale of 1-7 (a "1" means that you strongly agree with the statement while a "7" would indicate that you strongly disagree with the statement) by checking the appropriate space.

	strongly agree 1	2	3	4	5	6	strongly disagree 7
1. Currently there are enough PRT (Public Rapit Transit) stations on campus.	_	_	_	_	_	_	_
2. Morgantown now has less road traffic because of PRT.	_	_	_	_	_	_	_
3. The PRT is an improvement over the buses.	_	_	_	_	_	_	_
4. The PRT is safe.	_	_	_	_	_	_	_
5. The PRT is an efficient transportation system.	_	_	_	_	_	_	_
6. People usually get the desired car in less than							
10 minutes of waiting	_	_	_	_	_	_	_
5 minutes of waiting	_	_	_	_	_	_	_
7. Females are worried about using the PRT after dark.	_	_	_	_	_	_	_
8. The PRT's service day is long enough (starts early enough and ends late enough).	_	_	_	_	_	_	_
9. Students would like to return to the buses.	_	_	_	_	_	_	_
10. People didn't have to wait as long for the buses.	_	_	_	_	_	_	_

	strongly agree 1	2	3	4	5	6	strongly disagree 7
11. West Virginia has put too much money into the PRT.	___	___	___	___	___	___	___
12. The buses were (are) more convenient on bad weather days.	___	___	___	___	___	___	___
13. The PRT has not detracted from Morgantown's visual appearance.	___	___	___	___	___	___	___
14. Students are generally satisfied with the PRT.	___	___	___	___	___	___	___
15. Females were (are) worried about using the bus after dark.	___	___	___	___	___	___	___
16. Students are charged too much money to use the PRT.	___	___	___	___	___	___	___
17. The PRT is OK during the nice weather but it's not convenient during rainy or cold days.	___	___	___	___	___	___	___
18. The buses are more dependable.	___	___	___	___	___	___	___
19. Overall, the PRT is more desirable than the buses.	___	___	___	___	___	___	___

20. How much money do you think that the State and the Federal Government has spent on the PRT? Fill in the amounts in the blanks.

State of West Virginia ______________ Government ________________

21. What is your gender? Check the appropriate answer. Male ____ Female ____

22. What is your occupation? Check the appropriate answer. Student _____;

Faculty _____; Staff _____; Non-University (town person) _____; Other _____.

23. How far do you live from a PRT station? Check the appropriate distance.

less than 1/2 mile ____; 1/2 to 1 mile ____; more than a mile ____.

24. <u>For car owners only</u>. Have you reduced your driving due to the PRT? If so, what percent of your Morgantown-Campus driving has been reduced? Check the appropriate percent.
1-9% ____, 10-14 ____, 15-19 ____, 20-24 ____, 25-29 ____, 30-39 ____, 40-49 ____,
50-59 ____, 60-69 ____, 70-79 ____, 80-89 ____, 90-99 ____, 100% ____.

25. Other comments?

ENVIRONMENTAL EDUCATION AND CITIZEN ACTION

INTRODUCTION: ENVIRONMENTAL EDUCATION FOR CITIZEN ACTION

Thomas Tanner[1]

Abstract. *An introduction to this section of the yearbook, including a rationale for, and history of, environmental education for citizen action.*

I am pleased to introduce this section of papers dealing with environmental education for citizen action, for two reasons. First, because this topic is so important, and represents some of the most exciting, cutting-edge work in our field. Second, because it has been my professional preoccupation for a decade. Hence, the reader will forgive some unavoidable use of the first person singular.

My comments on the papers to follow are necessarily preceded by a rationale for, and history of, the work in this area.

Rationale

As we entered the decade of the 1970s, I was very concerned that the role of citizen action was being seriously slighted in the K-12 curriculum. Conservation education and traditional school texts had taught, if I may be permitted what is only a slight hyperbole, that we were safe in the hands of Big Brother; government resource agencies had largely solved our environmental problems and were now steadfastly protecting our resources for generations to come. Having been a member of several citizen conservation organizations since as early as 1957, I knew this doctrine to be sorely inadequate. It ignored the fact that the agencies were created because of, and then kept somewhat on track by, the sometimes angry clamor of concerned citizens. Nongovernmental, voluntarily-supported groups such as The Nature Conservancy, The Wilderness Society, and the National Audubon Society had long influenced public policy by responsible and informed action. They educated, they testified, they lobbied, and sometimes, in the courts of last resort, they litigated. At times they were in league with, but sometimes they opposed, those agencies which their earlier concern had helped create. In recent years they forced a closer scrutiny of such gifts of dubious value as the SST, they spearheaded creation of the wilderness preservation system, and are now trying desperately to educate both the public and its elected representatives about the feasibility and impacts of various energy sources.

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The obstacles which they face are not inconsiderable. They must rely upon voluntary contributions, while their adversaries are able to draw upon public or corporate funds that are extracted from all of us, as taxpayers and consumers, whether we agree with their position or not. Two essays which are personal favorites treat this inequity as a threat to the democratic system of decision making. John Quarles, President Nixon's Deputy Administrator of the EPA, describes the considerable power of the corporate lobby, which defeats its citizen adversaries "not by superior logic, but by superior resources" (1974). James Moorman, an attorney now serving in President Carter's administration, documents the many methods by which federal agencies subvert, distort, and break the law. When citizens protest, they are met with a phalanx of stalling tactics designed "to exhaust plaintiffs, not remedies" (1974).

However formidable the obstacles, these citizen groups were and are a necessary force in American political life, relatively free of those pressures which sometimes confuse or compromise the goals of the government agencies. They represent <u>participatory</u> democracy, which requires far more effort than do mere periodic visits to the voting booth. They exemplify Jefferson's populist ideals, and understand his dictum that "The price of freedom is eternal vigilance."

But few teachers know about them, and few teach about them, as research reported here shall indicate.

<u>History</u>

In the first issue of the <u>Journal of Environmental Education</u>, Stapp and his students wrote that environmental education must "inform citizens as to how they can play an effective role" (Stapp, <u>et al</u>., 1969). But in the decade since, only a handful of instructional materials has been developed to illustrate the necessity and methods of citizen action. One multi-media package featured a battle over pollution control at a General Motors plant in Tarrytown, New York (Hatch, <u>et al</u>., 1971). Under my direction, case studies were written about the controversies over the Miami jetport and a proposed dam in Oregon (Avery and Koerner, 1972). In 1974, the Office of Environmental Education funded two independently conceived proposals to develop true case studies of citizen action. Lynton Caldwell and his colleagues prepared no fewer than 68 cases (Caldwell, Hayes and MacWhirter, 1976). In a masterful introduction, Caldwell argues the need for citizen-action education. The content is suggested by his title, "The People Versus the Duly Constituted Authorities," and such subtitles as "Why the Adversary Process?", "Toward Better Modes of Public Decision Making," and "Functional Citizenship." Caldwell's introduction alone is worth the price of the book.

The second project produced only six case studies, but unlike Caldwell's, these were designed as complete teaching units, with instructional strategies and availability information for free and inexpensive audiovisual materials. These were developed by myself, partly because of my dissatisfaction with many of the early environmental education instructional materials. Not only did they not deal with citizen action, but they rarely gave the teacher sufficient background information or adequate instructions. The case studies (Tanner, 1976) were an attempt to avoid these traits.

In mid-decade, another approach to citizen-action education was evolving at Southern Illinois University, where Harold Hungerford, his associates, and students developed a hierarchy of goals and concepts for environmental education which culminated, at the highest level, in the goal of informed citizen action. Prerequisite levels included ecological concepts, awareness of issues and conflicting values, and action skills. Instructional materials for grades 6-10 were written, field-tested, and revised over a period of some years (Hungerford, et al., 1978).

A final development consisted of national and international environmental education conferences which legitimized citizen-action education by placing it at or near the top of their findings and recommendations. These included Snowmass (Schafer and Disinger, 1975), Belgrade (Unesco, 1976, 1977), the North American Regional Seminar (Aldrich, Blackburn and Abel, 1977), and Tbilisi (Unesco, 1978).

The Current Papers

In 1979-80, I was privileged to organize a symposium on Environmental Education for Citizen Action, for the 1980 NAEE Conference. The invited scholars agreed to participate, and the symposium was remarkably well attended, surpassing my most optimistic hopes. This introduction, and the four papers which follow, formed the symposium program.

First, Hungerford presents a paradigm for environmental action which summarizes the modes of action and the levels of organization which employ them. Next, Ben Peyton describes the research he did as a doctoral student of Hungerford. His results underline the desperate need for teacher education regarding citizen action. The third paper reports Peyton's more recent research, with Barbara Miller, on the concept of locus of control--the perception which people have of their own power as citizens. Finally, Caldwell examines the next necessary stage of citizen action, in which environmental battles will move from the courtroom to the mediation table, for reasons both of expedition and equity.

The 1980 conference attracted two other closely-related reports by Hungerford's associates, students, and former students. I am pleased to introduce those papers as well. Hungerford, et al. present the hierarchy of goals and concepts described earlier, and Champeau, et al. assess teacher comprehension of this curriculum framework.

I hope that this section of the yearbook will influence the teaching and research of many of its readers.

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A PARADIGM FOR CITIZEN RESPONSIBILITY: ENVIRONMENTAL ACTION

Harold R. Hungerford
and
R. Ben Peyton

Abstract. *The UNESCO-UNEP Tbilisi Declaration calls for individual participation in environmental issue remediation. Further, UNESCO-UNEP research reports a paucity of programs involving receivers in issue remediation. A much needed paradigm of citizenship action is presented which has been and can be applied in environmental education programs. Available instructional materials are described.*

Historically, environmental education has been characterized by instructional and curricular diversity. This situation, in and of itself, is not a negative one. The problem lies in the reason for this phenomenon--a basic lack of agreement as to what constitutes a substantive structure of environmental education. A myriad of environmental education models exist as well as a propensity to call a wide variety of educational activities "environmental education." Tanner (1974) puts it quite well when he states, "...teachers and other educators scurry off in all directions under the environmental education banner..."

Even with a plethora of instructional practices characterizing environmental education, one recent trend emerges from the literature. This trend is the responsibility for environmental education to produce human beings with what is called an "environmental ethic." The assumption is probably made here that this ethic should result in a citizenry which is capable of taking ecologically-sound environmental action focusing on the remediation of environmental issues.

The literature abounds with definitions of environmental education and strategies for building toward environmental awareness and an appropriate "environmental ethic." However, only a few of these references deal directly with environmental action and/or processes inherent in action strategies. One notable example is the following:

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> Above all, environmental education is oriented toward the development of values that are translated, ultimately, into action...each student must acquire an environmental ethic, a concern for a moral commitment to his responsibility to the environment. (Hawkins and Vinton, 1973)

Another example rests with the model of substantive structure for environmental education developed by Harvey (1976) which identifies environmental action as a major goal of what is referred to as man-environment relationship education (MERE).

Perhaps the most important example of a document which deals directly with the topic of environmental action as a goal of environmental education is the Tbilisi Declaration. The Tbilisi Declaration was formulated in 1977 during a UNESCO-UNEP intergovernmental conference in the USSR. The Declaration offers five categories of objectives for environmental education and one of these is described under the heading of "Participation." The participation objective reads: "...to provide social groups and individuals with an opportunity to be actively involved at all levels in working toward resolution of environmental problems."

In addition, there are other generic models which incorporate environmental action as an integral part of an overall strategy for environmental education. Some of these reflect a direct reference to implementing environmental action as a part of an overall environmental education program without presenting an action paradigm per se (Stapp and Cox, 1975). Still others tend to imply a need for environmental action training (Allman, et al., 1976; Lovet, 1974). In such cases, action components do not reflect all of the dimensions of environmental action known to society. Also, these action training components are dealt with episodically, without syntactical organization.

The writers, in a 1976 publication which attempted to operationalize "environmental literacy," proposed that literacy is, in part, reflected by human beings who have knowledge of and the ability to communicate the need for environmental action strategies, who have the ability to use those skills inherent in environmental action strategies, and who are willing to use action strategies to remediate environmental issues.

Even though references exist in the literature relating to the need to develop citizenship responsibility skills, the literature remains heavily weighted toward awareness. The inference may be made that most writers perceive that awareness can, in fact, lead to effective citizenship responsibilities. However, there also exist in the literature both intuitive and empirical evidence that this is not the case. Hawkins and Vinton (1973) are emphatic when they state, "Awareness, appreciation, and understanding of the environment are only the first steps and do not necessarily lead to effective action." Winston (1974) also puts this situation into critical focus when she writes:

> There is no indication that awareness will result in students' environmental concern...expressed concern for improved environmental quality does not offer conclusive evidence that students have had an attitude change significantly committing them to behaviors that will lead to improved environmental conditions.

Still other empirical evidence for this position stems from research conducted by Peyton (1977) and Ramsey (1979).

Given the veracity of this situation, it would be possible to hypothesize that many human beings who are developing sound environmental ethics are frustrated in their ability to take effective action simply because they are unaware of the action possibilities that exist, i.e., they have had no preparation specifically geared toward environmental action.

The need for providing training specifically directed at environmental action strategies is succinctly reflected by Stapp (1971) when he notes, "...few programs emphasize the role of the citizen in working, both individually and collectively, toward the solution of problems..." Additional evidence supporting the need for such training grew out of a 1975 UNESCO-UNEP questionnaire entitled, "Assessment of Resources for Environmental Education: Needs and Priorities for Member States." This questionnaire was mailed to 136 UNESCO Member States. It was completed and returned by 111 of them. A synthesis of findings yielded numerous trends and problems in environmental education worldwide. Among the problems described in this synthesis was:

> Educational programmes based on real problems and a functional logic aimed at their solution, have not yet been developed, in a general manner, in any of the countries studied. (ENVED 6; 1977)

The potential consequence of providing action training in education is discussed by VandeVisse and Stapp (1975) who write, "Citizens are more likely to become involved in environmental issues if they are aware of how they can have some effect upon decision-making."

Due to the need inferred by both the literature and the writers' personal experience in environmental education, a paradigm is proposed which would permit curriculum developers and others to specifically plan for training in environmental action as an integral and substantial component in this field. Such a paradigm results from an analysis of environmental action strategies themselves, the levels at which these strategies are utilized by individuals and organizations, and the logical constraints placed on action, i.e., those questions which should be answered by citizens before an action is taken.

Therefore, a three-part paradigm follows which identifies and defines specific categories of action. It then identifies and illustrates the levels at which these actions can be taken. And, finally the constraints that must be placed on action are posed as questions which should be answered before an action is taken.

Part I: Categories and Definitions of Environmental Action

Subsequent to an analysis of citizen participation, the writers pose six (6) categories of environmental action. These are: (1) persuasion; (2) consumerism; (3) political action; (4) legal action; (5) ecomanagement; and (6) interactions of these. Operationally, the writers define each of these as follows:

(1) Persuasion: An effort to verbally motivate human beings to take positive environmental action as a function of modified values, e.g., argumentation, debate, speech making, letter writing.

(2) Consumerism: An economic threat by an individual or a group aimed at some form of behavioral modification in business or industry (e.g., boycotting) or some conservative mode of behavior with respect to goods and/or services (e.g., discriminating and conservative use of goods and services).

(3) Political Action: An effort aimed at persuading an electorate, a legislator (or legislature), or executive governmental agency to conform to the values held by the person or persons taking that action, e.g., lobbying, voting, supporting candidates.

(4) Legal Action: Any legal/judiciary action taken by an individual and/or organization which is aimed at some aspect of environmental law enforcement--or, a legal restraint preceding some environmental behavior perceived as undesirable, e.g., lawsuits, injunctions.

(5) Ecomanagement: Any physical action taken by an individual or a group aimed directly at maintaining or improving the existing ecosystems, e.g., reforestation, landscaping, installing bird boxes.

(6) Interaction: Any combination of two or more of the above action modes, e.g., letter writing for consumerism or political action, combining boycotting and lobbying for solutions to international issues.

Part II: Levels of Decision-Making for Environmental Action

Fundamentally, environmental action results from the activities of either an individual or a group of individuals working cooperatively. Although there are glaring exceptions to the rule, in principle one finds that the individual acting alone is of restricted effectiveness in promoting major activities. This limitation is largely a function of the power base from which the individual operates. This is not to be interpreted that the writers consider individual actions to be wasted. Indeed not! However, it would be wise to acknowledge and appreciate the increased effectiveness of cooperative action.

Further, one should consider the ability to maximize the effectiveness of the action as a correlate to the scope of the organization. Certainly, national organizations exist on a power base much more powerful than the neighborhood coalition. Figure 1 is an effort to diagram this principle.

The argument may be raised that there are unnumerable times when individual action is more appropriate than group action. Further, it may be argued that groups are merely aggregates of individuals working together and that the power of the group depends primarily on the actions of individuals within the groups. However, the organization per se permits those individuals to maximize the influence of their values. The influence, for example, of the 150,000 members of Ducks Unlimited is potentially far greater than the effectiveness of those individuals acting separately, without organization. It appears eminently important for educators and citizens alike to conceptualize the realities of group vs individual action as they relate to environmental problem solving.

Part III: Action Analysis Criteria

Given that the individual--or the group--understands the options available for action and the levels at which the action can be initiated, it follows that a particular action decision needs to be analyzed and evaluated before it is taken.

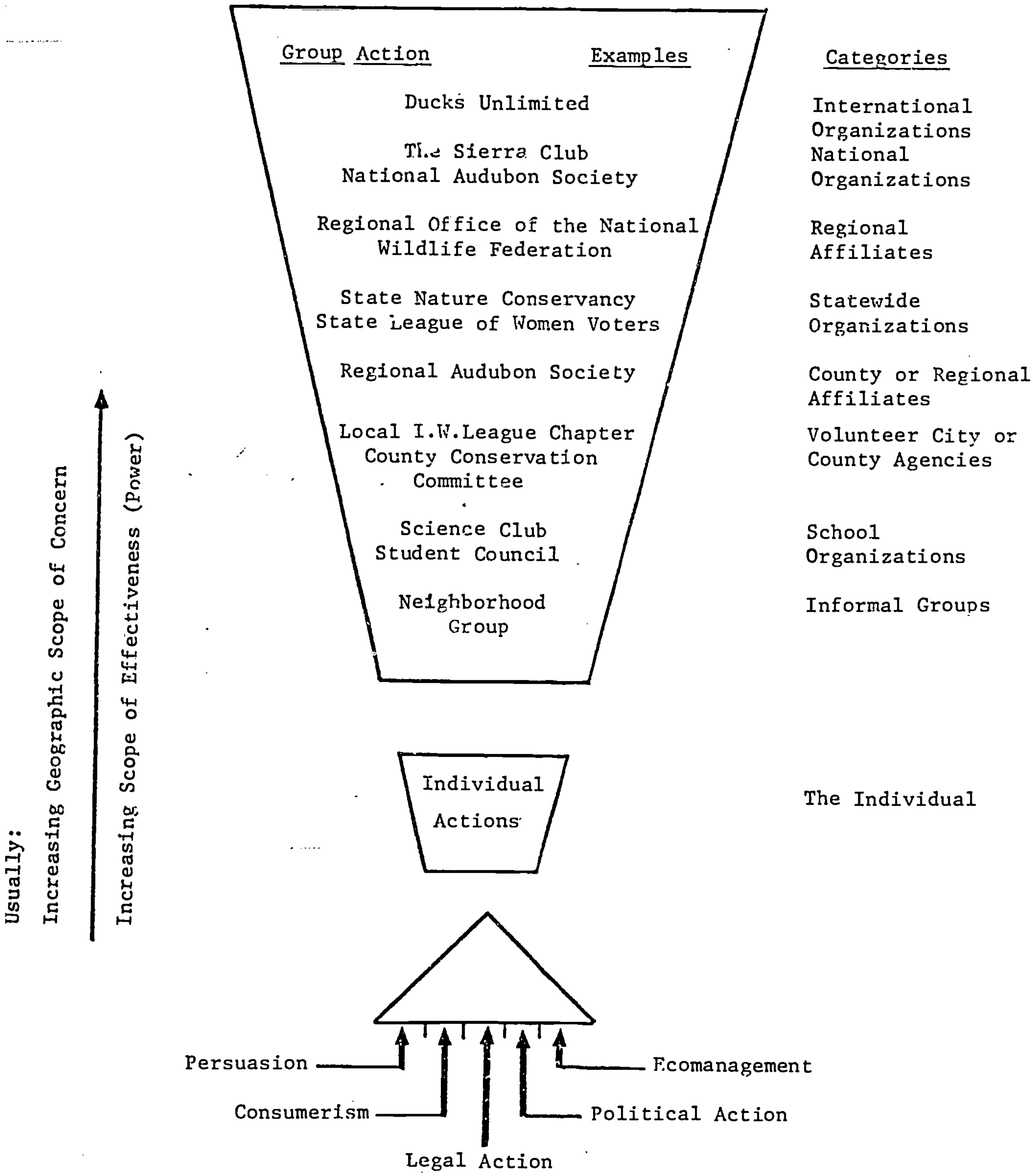

Figure 1. Levels of environmental action and decision-making: individual and organizational.

It is probably true that an individual--or a group-selects a particular action in terms of whether it will get a particular job done and whether it is commensurate with the values held. Sooner or later, however, the decision must be inspected on other grounds as well. To ignore one or more of these criteria could be disastrous.

The writers, therefore, propose a set of 14 questions which should be answered before a particular action is undertaken. Further, it is felt that these 14 questions need to be made available to environmental education instructors and students in order to increase the sophistication with which actions are taken. The questions follow:

1. Is there sufficient evidence to warrant action on this issue?

2. Are there alternative actions available for use? What are they?

3. Is the action chosen the most effective one available?

4. Are there legal consequences of this action? If so, what are they?

5. Will there be political consequences of this action? If so, what are they?

6. Will there be social consequences of this action? If so, what are they?

7. Will there be economic consequences of this action? If so, what are they?

8. Are my (our) personal values consistent with this action?

9. Do I (we) understand the procedures necessary to take this action?

10. Do I (we) have the skills needed to take this action?

11. Do I (we) have the courage to take this action?

12. Do I (we) have the time needed to complete this action?

13. Do I (we) have all of the other resources needed (other than the above) available to make this action effective?

14. What are the ecological implications of this action?

Evaluating the Paradigm

As with any theoretically-based model, this paradigm's substantive structure exists on a framework of logic which is, at least in part, based on empirical observations. This particular paradigm is a vehicle for curricular decision making--a model that must be tested and retested before being accepted, rejected, or revised. This phenomenon is not uncommon in education. It is reflected by the widely accepted and generic environmental education model published by Stapp and Cox (1975). In science education it is exemplified by the substantive structure of Science: A Process Approach (Gagne, 1970) and others.

Initial evaluation of such a paradigm could be reflected by numerous activities. Among these is a philosophical examination and evaluation by peers. It is basically the same kind of examination originally made when the paradigm was being constructed--an inspection and comparison against what is, i.e., information currently available concerning citizenship action and its role in environmental education and problem solving. A second mode of evaluation would be the very pragmatic assessment of whether the paradigm could be utilized in environmental education curriculum development. Further, said paradigm must be evaluated in the context of whether students can acquire the knowledge and skills necessary to implement action strategies once curricula have been developed and implemented.

A summative evaluation of the paradigm would occur when an assessment is made concerning the willingness of students (who have been given training in the paradigm's elements) to actually engage in ecologically sound environmental action at a citizenship level of performance. This behavior is, in essence, a criterion level of performance and an ultimate goal of environmental education.

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AN ASSESSMENT OF TEACHERS' ABILITIES TO IDENTIFY, TEACH, AND IMPLEMENT ENVIRONMENTAL ACTION SKILLS

R. Ben Peyton[1] and Harold R. Hungerford[2]

Abstract. *A questionnaire was used to survey 225 pre- and inservice teachers from three midwestern states. The teachers perceived they had limited abilities to use the persuasive, legal, political, consumer, and ecomanagement skills necessary to remediate environmental issues. They felt confident to teach but not prepare curricular materials dealing with environmental action skills. Very few reported participation in environmental action as individuals or as members of organizations.*

Introduction

The importance of providing students with opportunities for learning and applying environmental action skills has received growing recognition in environmental education literature (Hungerford, Wilke, Peyton, 1979; UNESCO, 1978). The rationale for extending environmental education efforts beyond an awareness of environmental issues lies in the ultimate goal of environmental education to produce citizens exhibiting environmentally ethical behavior. While research findings in environmental education and related fields are not conclusive, it is becoming increasingly clear that skill in environmental problem solving is one of several components which must be attended by environmental education to produce the desired life style changes (Dispoto, 1977; Ramsey, 1979).

If environmental education is to effectively achieve its goals, classroom teachers must be provided with the appropriate knowledge and skills as well as with effective curricular materials. The need for increased teacher training in environmental education has been recognized by Gallagher (1975), Childress and Wert (1976) and Zeitler (1975). Two research studies have been reported which suggest that the majority of sampled Colleges of Education are not offering adequate numbers of courses on environmental science and environmental teaching methods (Havlick, 1971; Trent, 1976). Several studies indicate that educators themselves perceive a need for more training in environmental education (Botinelli, 1976; Fryman, 1976; Schwaab, 1975).

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Efforts to remedy the deficiencies in teacher preparation must include all dimensions of environmental education goals including ecological foundations, awareness of environmental issues, investigative and evaluation skills, and environmental actions skills. The Intergovernmental Conference on Environmental Education held in Tbilisi, USSR, has identified the need for teachers to be involved in environmental decision making.

> ...in order to assure an adequate training of educators, it would seem important to encourage their participation, along with other socio-professional groups, in concrete actions aimed at the preservation and improvement of the environment. Educators are, in effect, called upon to play a decisive role in the prevention and solution of environmental problems, not only through their educational activities, but also through their participation, as citizens and professionals, in the elaboration and carrying out of environmental policies. (UNESCO, 1977:16)

The purpose of this research study was to make an assessment of the competency level of teachers in environmental action skills. More specifically, the intent was to sample teacher populations to determine (1) their knowledge and their sources of knowledge relating to the identification and application of environmental action skills, (2) their perceptions of their own abilities to implement and/or develop environmental action curricular materials in the classroom, and (3) the extent to which they have been or intend to be personally involved in environmental problem solving.

METHODS

Instrument Design

The design of the survey instrument was based on a model for environmental action developed by Hungerford and Peyton (1976, 1977). The term "environmental action" refers to the evaluation, selection and implementation of effective, rational plans of action to remediate some environmental problem. The action may involve communication skills, participation in the political and legal processes, and/or many other types of skills. The model identifies and defines six major categories of action into which these skills may be classified (persuasion, political, consumer, legal, ecomanagement and interactions of these five) and lists 13 criteria to be considered when selecting an action for a given environmental issue. The action categories are operationally defined in the Appendix.

The research instrument was submitted to a jury (N = 6) and revised according to their comments. Jury members included recognized professionals in science education (1), environmental education (4) and statistics (1). Face validity of the instrument in its final form (Appendix) was accepted subsequent to the approval by the jurors.

The first section of the survey instrument collected demographic data. The other three assessed participants' knowledge of environmental action modes, their roles as environmental activitists, and their abilities to identify criteria for selecting environmental actions. These latter three are briefly described below.

Knowledge of Environmental Action Modes: This section (Part A, Task 2 in Appendix) presented and operationally defined each of the five categories of environmental actions and asked the subject to list up to five specific examples for each category (e.g., lobbying through letter writing as an example of political action). This provided a measure of the extent of the subject's familiarity with examples of the categories of environmental action. The subjects were next asked to assume they had professional curriculum development skills and to record their own perception of their ability to produce instructional units in each of the five categories of action. Similarly, subjects were asked to record their perceived ability to teach available instructional units in each of the five action categories.

Participant's Role as an Environmental Activist: Participants were asked to indicate those categories of action (e.g., consumerism, political) in which they felt competent to take environmental action and for the source of their abilities to take such action (Part B, Appendix).

They were also asked to record individual and/or group environmental actions (e.g., letter-writing campaigns, boycotting tuna products) in which they had participated.

This section also inquired about participants' plans to take future action. Respondents who indicated no plans to take future actions were asked how important a role the lack of environmental action skills played in their refusal to take action. Those who indicated that they did intend to take environmental action in the future were asked to identify the issue and type of action.

Ability of Participant to Identify Criteria: The final task of the instrument requested subjects to list as many discrete action analysis criteria as possible which would be applied to the selection of the most appropriate environmental action.

Thirteen such criteria had been proposed by Hungerford and Peyton (1976, 1977). These were grouped into five categories (Table 1) and used as a basis for evaluating responses by participants. For example, any response which indicated that social, economic, ecological or other consequences should be considered was placed in Category IV (What are the consequences of this action?).

Administration of the Instrument

The instrument was administered by either the researcher or by two other professional educators trained in the procedure. Participants were informed of the purpose of the survey and encouraged to answer items candidly. Comments emphasizing the importance of environmental education were followed by a final appeal to their educational professionalism for complete cooperation. Participants were encouraged to ask for clarification of any items and were assured of sufficient time to complete the form. A monitor was available at all times to answer questions concerning the forms. Most participants were completed in 40 minutes and the forms were not collected until all respondents had finished.

Monitors were informed to observe participants during this phase, and to note individuals who were obviously not interested in cooperating in the project. Forms completed in such a short time that the subject could not possibly have thought out the items (less than 15 minutes) were to be marked or otherwise kept separated from the others when collected. Since no assurances can be given concerning their environmental action competencies, these instruments (N = 14) were withdrawn from the data to ensure that uncooperative individuals did not overly bias the survey results.

Sample Population

The survey instrument was administered to samples of teachers enrolled in graduate or undergraduate methods courses in science education. A total of 225 participants were assessed between January and March, 1976 (Northern Kentucky State College N = 80; University of Missouri at St. Louis, N = 79; Southern Illinois University at Carbondale, N = 66).

Participants were selected on the basis of availability. No attempts were made to randomize the selection. All members of the selected classes volunteered to participate.

Table 1

Summary of Participants' Responses to Part C: Criteria for Selecting Appropriate Environmental Actions

		Number and Percent of Participants Listing the Category (N = 225)
I.	Is there sufficient evidence to warrant this action?	24 (6%)
II.	Are there alternative actions available?	23 (10%)
III.	Is this the most effective action?	39 (17%)
IV.	What are the consequences of this action?	84 (37%)
V.	Do I have the ability to implement this action?	98 (44%)
VI.	Ambiguous/Inappropriate Responses	29 (13%)
VII.	No Response/"I Don't Know"	58 (26%)
	All Categories I - V	1 (.4%)
	Any 4 of the 5 Categories	7 (3%)

The sample was predominately female (84 percent), and at a preservice level of experience (59 percent). Over half of the participants indicated their level of emphasis as "generalist" (54 percent) and major as elementary education (67 percent).

Since data were collected from sample populations at three different institutions, it was necessary to attempt to equate the population on some variable so that the data could be collapsed for analysis. The researchers felt the criterion variable most critical for equating groups could be expressed as the <u>environmental action competency score</u> (EAC score) since it reflected all of the dependent variables in question. The EAC score for each participant was calculated by totaling the number of examples provided in each of the environmental action categories with the number of criteria listed for selecting an appropriate environmental action. An analysis of variance indicated no significant difference existed between samples from the three institutions (R^2 = .0245; F = 1.839; P = .14) and data were collapsed for subsequent analysis.

Instrument Scoring Reliability

Due to the phenomenological nature of Task 2 (subjects provided examples of operationally defined action categories), and Part C (subjects identified criteria for selecting appropriate environmental actions) it was considered necessary to establish inter-scorer reliability for the scoring procedure. Three professional educators were trained to score responses in each of the two sections of the instrument. Scoring procedure for Task 2 involved evaluating the response to determine whether it represented an acceptable example of an action category. In Part C, scorers analyzed responses and classified them in the five categories of environmental action criteria (Table 1). A random sample of 20 completed instruments was selected for the reliability test. The scoring results of the trained scorers were then compared statistically for inter-scorer reliability.

The scorers' results were discussed and instructions for scoring revised. Another group of instruments was selected and scored, followed by further comparison, discussion, and revision of instructions. This system was repeated until inter-scorer reliability was deemed acceptable using a randomly selected group of instruments. The final revision of scoring instructions yielded the following Pearson product moment correlations across three scorers:

Persuasion: $r_{1,2} = .66$, $r_{1,3} = .79$, $r_{2,3} = .66$;

Consumerism: $r_{1,2} = .78$, $r_{1,3} = .81$, $r_{2,3} = .70$;

Political Action: $r_{1,2} = .70$, $r_{1,3} = 1.00$, $r_{2,3} = .70$;

Legal Action: $r_{1,2} = .90$, $r_{1,2} = 1.00$, $r_{2,3} = .90$;

Ecomanagement: $r_{1,2} = .90$, $r_{1,3} = 1.00$, $r_{2,3} = .90$.

In Task 2, scoring results in each of the five action categories were subjected to Pearson Product Moment Correlation analysis. In each case, correlations were above the value of .549 required for statistical significance at the .01 level (df = 19).

In Part C (environmental action criteria) multiple regression analysis was used to establish interscorer reliability. Results of the other three scorers were used as predictors of the researcher's scores for each of the seven categories. R^2 values in all categories ranged from .47 to perfect correlation ($P < .01$).

Limitations of the Study

Limitations are imposed on this study by the sample population, the instrument design, and scoring procedures. The sample used represents primarily elementary educators (pre- and inservice) from three midwestern universities. The action model used in the design of the instrument may not have fit the frame of reference of the participants and therefore responses may not accurately represent their competencies. The opportunity also existed for subjects to purposefully misrepresent their own competencies. Further, the extensive time and energy required for completion certainly could have decreased participants' motivation to think carefully before responding to the items. Finally, while scoring methods were validated statistically, some variation in results must also be attributed to scoring procedure.

The researchers attempted to minimize the impact of these limitations as described in the methods. However, inferences and recommendations must be considered within the constraints imposed by sample characteristics, instrumentation, and scoring procedures.

RESULTS AND DISCUSSION

1. To what extent can teachers provide examples of persuasive, consumer, political, legal and ecomanagement modes of action?

2. To what extent are teachers able to identify the major criteria for selecting appropriate environmental actions?

The data indicate participants are limited in the extent to which they are able to provide examples of various modes of environmental action and identify criteria for selecting actions. Fewer than 20 percent of the participants provided examples of all five action modes. The category for which the largest number of participants (64 percent) provided examples was "persuasion". The remaining four categories in descending order of frequency of appropriate responses were "political" (57 percent), "ecomanagement" (51 percent), "consumerism" (48 percent), and "legal" (42 percent).

Findings for Research Question 2 (Table 1) indicate a similar lack of ability to identify criteria applied in the selection of environmental actions. These findings suggest to the researchers that participants tend not to have transferred their formal training and experiences to a functional frame of reference for environmental action. This is the case even though formal general education (e.g., civics courses, communications courses) and nonformal life experiences have exposed them to most of the necessary action components. These results are also consistent with findings in Research Questions 3, 5, and 6, in suggesting that participants would have difficulty teaching action skills or taking part in environmental action themselves.

3. How do teachers perceive their own ability to prepare and teach environmental education units or modules in each of the five identified action modes?

Fewer than 7 percent of the participants reported feeling competent to prepare units in all five environmental action categories. When viewed separately, "ecomanagement" was the most frequently indicated area of competence (34 percent of the participants), followed by "persuasion" (31 percent), "consumerism" (31 percent), "political" (20 percent), and "legal" (12 percent).

A larger proportion of participants felt competent to teach already constructed units in each category ("ecomanagement" and "persuasion," 77 percent of the participants; "consumerism", 76 percent; "legal," 65 percent; and "political," 64 percent). The more positive response to teaching prepared units leads the researchers to infer that participants were reflecting a confidence in their ability to learn to implement new environmental action curricular materials in the classroom. However, even though participants were asked to assume they had curriculum development skills, it is difficult to assess whether the low percentages dealing with preparing units or modules is a function of insecurity in curriculum development or lack of understanding of the substantive structure of environmental action. One can only speculate from other data in this research (environmental action competency scores) that the lack of cognitive content associated with environmental action would contribute significantly to feelings of insecurity with respect to curriculum development in this area.

4. What sources of information have contributed significantly to teachers' knowledge of environmental action skills?

The most frequently mentioned sources of information about environmental action were college (26 percent) and high school (11 percent) courses. However, multiple regression analysis revealed that the number of courses taken does not predict the environmental action competency score ($R^2 = .0088$; $F = 2.4661$; $p = .1177$). This further indicates that such courses may have enhanced awareness of issues and confidence in that awareness, but have done little to prepare students in the environmental action dimension.

Participants' environmental action competency scores were positively related to the number of actions reported taken ($R^2 = .16$; $F = 45.27$; $p = .000$). When asked to indicate the sources of information concerning environmental action skills, 15 percent of the participants responded that environmental action experiences had contributed to their knowledge. This does not, however, eliminate the additional possibility that attainment of environmental action skills via other means may lead to more involvement in environmental action taking.

Membership in environmental organizations and/or the reading of periodicals of environmental organizations were mentioned by only 8 percent of the participants as having contributed to their knowledge of environmental action. Most participants (80 percent) reported not belonging to any environmental organization. Membership in only one organization was reported by 14 percent, and 5 percent reported belonging to two such organizations. Few participants mentioned activist groups such as the Sierra Club or National Audubon Society. These results would seem to indicate that active environmental organizations play a very limited role in educating teachers about environmental action.

5. What is the extent of involvement of teachers as environmental activists?

The participants report a limited involvement in environmental actions. A history of three individual actions each was reported by only 4 percent of the participants. Three group actions were reported taken by only 3 percent. However, 17 percent reported taking some form of group action. Over half of the participants (56.4 percent) indicated they had not taken any form of positive environmental action.

Even the few actions reported were of less demanding forms such as "helping to clean up a river bank," "recycling trash," "buying returnable bottles," or "talking to friends about an issue." There was little involvement reported in political or legal categories (campaigning, organizing lobbyist activities, initiating litigation). These findings are consistent with the lack of involvement in active environmental organizations reported in Research Question 5.

Participants' own perceptions of their ability to take effective environmental action are consistent with the population's reported history of action taking. Only 3 percent felt competent to take action in all five categories. Participants felt most competent with "persuasion" (35 percent felt competent in this category), "consumerism" (36 percent), and "ecomanagement" (36 percent) categories of action. Few participants felt competent to take "political"

(17 percent) or "legal" (8 percent) actions. Thirty-eight percent did not feel they could effectively take action in any of the areas.

Of the 137 participants (61 percent) who felt they would probably take environmental action in the future, only 23 percent identified a specific issue on which they intended to take action, and 16 percent have identified the action itself. Issues varied, but most were general issues such as "air and water pollution," "energy conservation," or "conserving our natural resources." Similarly, the actions listed in these cases were ambiguous: "probably some letter writing," "boycott products," or "some form of persuasive or political action." Few responses to this task were specific such as "halt the Meramec Dam from being built by educating the bill's sponsor about the problems the dam would cause," and "stop the effect on the ozone layer caused by aerosol sprays by boycotting those products and writing letters to the manufacturing companies."

6. To what extent do teachers attribute a lack of knowledge concerning action skills to their own reluctance to take environmental action?

Participants who expressed no intention to take future action were asked whether they perceived a lack of environmental action skills and whether they felt they would take action if appropriate skills were acquired. Eighty-seven (87) participants fell into this category. Most (83) indicated a lack of environmental action skills and 77 stated that they would take action if they had the appropriate skills. These results support the researchers' position that environmental action skill components must be provided if environmental literacy is accepted as a goal of environmental education.

SUMMARY

The results indicate that the population of pre- and inservice teachers surveyed is poorly prepared in the environmental action skills identified and measured by the instrument. Most of the population has had limited experience in environmental action taking, perceive they possess little competency in the necessary skills, and have incomplete plans or none at all for future involvement as environmental activists. Categories of action in which participants consistently were most comfortable and competent represent the least sophisticated forms of environmental action and involve skills within the capabilities of educated members of society (e.g., speaking, letter writing, picking up litter, planting trees).

A statistical relationship between the number of actions taken and environmental action competency scores, plus the role of past action experiences attributed to knowledge of action skills by 15 percent of the participants, indicates that environmental action involvement could be a source of competency. Although 53 percent of the participants have had at least one course in which environmental issues were a significant topic, statistical analysis indicates that these courses do not account for a significant proportion of the variance in environmental action competency scores. This finding supports the contention that environmental education has stressed awareness of issues, but neglected the environmental action components of environmental literacy.

Only 8 percent of the participants indicated environmental organizations had contributed to their knowledge of environmental action skills. The National Audubon Society is representative of the environmental organizations which allocate time, money and materials for the purpose of improving environmental education in the schools. This research indicates such efforts have had little impact on the environmental action skill development of the pre- and inservice teachers sampled.

Participants with no future plans for action tend to perceive that a lack of appropriate skills contributes to their reluctance to become involved. This supports the researchers' position that environmental action skill competencies must be developed if environmental education is to achieve the ultimate goal of environmental literacy (e.g., remediation of environmental problems).

The findings of this study indicate that without some form of future intervention (teacher training, availability of appropriate curricular materials, or nonformal educational experience such as involvement in environmental organizational and/or actions) there is little reason to expect the assessed sample (or similar samples) to effectively prepare environmentally literate students in their classrooms.

RECOMMENDATIONS

In summary, it is recommended that...

1. ...similar research be conducted to assess the environmental action competencies of secondary school teachers.

2. ...research which extends beyond the minimal competencies investigated by the present study be conducted to establish the specific environmental action skill competencies and deficiencies of teachers.

3. ...longitudinal research studies be implemented to identify and determine specific roles of all the cognitive and affective factors necessary to produce environmentally active citizens.

4. ...teacher training programs be evaluated and modified where necessary to include environmental education experiences extending beyond the "awareness of issues" level to an involvement in environmental action skills.

5. ...environmental action curricula prepared for use at any level should provide students with generic as well as episodic environmental action models.

6. ...environmental organizations increase the emphasis on action skill components in materials prepared for use in public schools.

7. ...environmental organizations increase their efforts to involve educators as environmental activists.

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APPENDIX: ENVIRONMENTAL ACTION INVENTORY

(The items and instructions included in the instrument are presented here in abbreviated form. The format has been modified slightly and area for responses omitted to conserve space.)

ENVIRONMENTAL ACTION INVENTORY

PART A

To the respondent: Remember, there are NO hidden agendas in this inventory. This inventory simply assesses the status of environmental action as it relates to both pre and inservice teachers. Your honest participation should lead to improved instruc ional practices in environmental education.

1. Your Identification Number:

2. Your Sex: Male Female

3. Your Year in School:

4. Years of teaching experience, if any (please do not include student teaching).

5. Level of Concentration: (Early Childhood, Elementary Education; Senior High School; Other).

6. Area of Emphasis: (Generalist; Science Education; Environmental Education; Social Studies; Other, please explain).

7. The number of courses you have taken in...(Ecology; Resource Management; Conservation; Environmental Education; The number of OTHER courses you have taken in which environmental issues was a significant topic).

8. ...the income level that BEST reflects the gross income for your family while you were in high school...

9. The size of the community in which you grew up, i.e., spent most of your youth...

10. Please write the names of any environmental or conservation organizations with which you affiliate (include those from which you receive journals or periodicals).

TASK 1: Please list below, what you perceive to be the three (3) most important environmental issues facing man today.

TASK 2: There are many strategies or modes of environmental action to which a citizen may turn in dealing with an environmental issue. These actions can be classified into categories of actions. Within these categories, action can be taken on an individual or a group basis.

Generally, we perceive there to be five (5) separate categories of environmental action. These are listed below. For each category, list up to five (5) examples (modes) of environmental action available within that category. If you can identify no examples in a category, please so state.

1. PERSUASION: Used when someone or a group tries to convince others that a certain environmental action is correct.

   Examples of persuasion action

2. CONSUMERISM: Consumerism is an economic pressure exerted by an individual or a group aimed at some form of behavior modification in business or industry.

   Examples of consumerism action

3. POLITICAL ACTION: Political action is an effort aimed at persuading an electorate, a legislator (or legislature), or executive governmental agency to conform to the values held by the person or persons taking that action.

   Examples of political action

4. LEGAL ACTION: Any legal/judiciary action taken by an individual and/or organization which is aimed at some aspect of environmental law enforcement--or, a legal restraint preceding some environmental behavior perceived as undesirable.

   Examples of legal action

5. ECOMANAGEMENT: Any physical action taken by an individual or a group aimed directly at maintaining or improving the existing environment.

   Examples of ecomanagement

TASK 3: In this task it is assumed that, as an educator, you have the general skills necessary to produce (prepare) instructional units or modules.

Do you personally feel you have the knowledge necessary to develop a unit or module for environmental action purposes for use with students on:

A. Persuasion skills?

B. Consumerism skills?

C. Political action skills?

D. Legal action?

E. Ecomanagement?

TASK 4: Would you personally feel comfortable teaching an already prepared unit or module which focused on the environmental action skills associated with:

A. Persuasion?

B. Consumerism?

C. Political action skills?

D. Legal action?

E. Ecomanagement?

PART B

YOU AS A CITIZEN

TASK 5: Some human beings (citizens) feel totally frustrated in terms of solving environmental issues either as an individual or on a group basis.

If these frustrations exist from your own personal frame of reference, please list one, two, or three environmental issues which you feel to be of importance but, at the same time, you feel totally frustrated with in regards to resolving either as an individual or on a group basis.

TASK 6: Please check those categories in which you feel you could competently take environmental action, either as an individual or as a member of a group, should the occasion arise within the next week or so. (A. Persuasion; B. Consumerism; C. Legal Action; D. Political Action; E. Ecomanagement; F. I do not feel competent in any of these categories.)

If you feel competent in any of the above categories, please respond to the following: Where do you feel you gained the ability to use action skills? Check one or more of the following: (A. A high school course; B. A college course; C. Membership in an environmental organization; D. Participating in an environmental action; E. Other, please explain.)

TASK 7: Have you ever taken an environmental action as an individual or as a member of a group?

If you answered "yes," please list those specific actions below and check whether they were taken as an individual or as a group member.

TASK 8:

A. Do you think that you will take an environmental action at some point in the future?

If you answered "no," please go to B below.
If your answer was "yes," please go to D.

B. Do you feel that a lack of environmental action skills is a major reason why you don't think you will be taking some action in the future?

C. Do you think you would be willing to take action in environmental issues if you gained the skills for so doing?

If you wish to comment on C, please do so here.

D. If you DO intend to take some action, have you identified the issue on which the action will be taken?

E. If "yes," specifically what is that issue?

F. If you responded above, do you know what kind of action you will take?

G. If "yes," please identify specifically what kind of action you anticipate taking.

PART C

THE TASK:

To review, the five (5) action categories are generally identified as persuasion, consumerism, political action, legal action, and ecomanagement.

Whenever a citizen or a group of citizens decides that an environmental action should be taken in any one or more of the above categories, there are undoubtedly some considerations (e.g., consequences, constraints, rules, or questions) to be made when selecting the appropriate action for use. These considerations may deal with the feasibility, possible outcomes, or appropriateness of the proposed action.

How many considerations (constraints, rules, questions, consequences) that would apply to the selection of most environmental action strategies can you think of? If you can think of some of these considerations, please list them below. Number each discrete item. Thank you.

DEVELOPING AN INTERNAL LOCUS OF CONTROL AS A PREREQUISITE TO ENVIRONMENTAL ACTION TAKING

R. Ben Peyton[1] and Barbara Ann Miller[1]

Abstract. *Principles of the locus of control theory (L of C) and supportive research findings are reviewed. A citizen's L of C may have important implications for environmental education in promoting the ultimate goal of responsible environmental action. A paradigm of environmental behavior is proposed.*

Introduction

It is generally accepted by educators that the major goal of environmental education should be to produce "an environmentally literate citizenry that is both competent to take action on critical environmental issues and willing to take that action" (Hungerford and Peyton, 1976, p. 11). Many writers have stressed the importance of extending environmental education beyond the awareness level to the citizen participation level (Balzar, 1971; Childress and Wert, 1976; Ginzbarg, 1971; Harvey, 1977; Hawkins and Vinton, 1973; Hungerford, et al., 1979; UNESCO, 1978).

Educational efforts to produce environmentally literate citizens have been largely based on the postulate that a linear relationship exists among cognitive (knowledge), affective (attitude), and conative (behavioral) domains. Accordingly, environmental education programs often present awareness and knowledge of ecology and/or environmental issues, and assume that this awareness and knowledge will lead to the desired attitude development and, ultimately, to the necessary environmentally ethical behaviors.

Findings of current research into the relationships that exist among the cognitive, affective, and conative domains indicate that these relationships are far more complex than previously assumed (Borden and Schettino, 1979; Burrus-Bammel, 1978; Heberlein, 1973; Ramsey and Rickson, 1977). Increased awareness and/or knowledge do not necessarily lead to positive attitude formation or to environmentally ethical behavior. Nor is there evidence to indicate the extent to which experiences such as values

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clarification, increased environmental sensitivity, or acclimatization, generate increased participation in environmental action taking. Indeed, little empirical research exists in environmental education which identifies the variables responsible for a specific environmental action, nor the relationships among these variables.

Certainly, a number of variables may interact in promoting environmental action taken by an individual, including the individual's knowledge (beliefs) about the issue, attitudes toward the components of the issue, and environmental action skills. An additional variable which has not been considered by environmental educators in this context is an individual's perception of whether or not he/she has the ability to bring about change through his/her own behavior. This variable--locus of control--suggests that an individual with the necessary environmental knowledge, values, and skills, may not engage in environmental action taking if he/she perceives an individual inability to bring about change in such a situation. Evidence indicates that this perception may reflect more than a lack of confidence in the action itself. Some individuals do not attempt to bring about desired change because they attribute change to chance or powerful others (e.g., God, parents, government, "they," etc.) rather than to their own behaviors.

The theoretical construct of locus of control (L of C) has been frequently researched in the behavioral sciences. However, research exploring the role of L of C in environmental education is almost nonexistent (Smith, 1979). The purpose of this paper will be to:

1. review the principles of the L of C theoretical construct;

2. describe the potential implications of the theory of L of C for environmental education; and,

3. propose a paradigm to guide further research into the variables impinging on environmental action taking.

Locus of Control Construct

Julian B. Rotter was one of the first to propose and define the theoretical construct known as locus of control (1966). His theory developed as a result of analysis of patients in psychotherapy.

> ...clinical analysis of patients suggested that while some patients appear to gain from new experiences or to change their behavior as a result of new experiences, others seem to discount new experiences by attributing them to chance or to others and not to their own behavior or characteristics (Rotter, 1966:2).

Rotter proposes that an individual's actions can be predicted on the basis of one's values, expectations, and the nature of the situation. Rotter's basic formula for predicting an individual's behavior in a specific situation is presented as:

the potential for behavior (X) to occur in relation to reinforcement (A)

is a function of

the expectancy of the occurrence of reinforcement (A) following behavior (X)

and

the value placed on reinforcement (A)

This approach to predicting behavioral outcomes places equal emphasis on expectancy, reinforcement value, and the psychological situation. It is the expectancy of reinforcement which reflects an individual's L of C. Rotter, et al., define expectancy as the "probability held by the individual that a particular reinforcement will occur as a function of a specific behavior on his part in a specific situation...(1972:12)." Reinforcement value reflects the perceived importance of the expected outcome if the behavior is successful. Thus, a specific behavior will more likely occur if the individual places a sufficiently high value on the expected outcome of the behavior and also anticipates that the behavior will be effective in producing the desired results (reinforcement).

Rotter has identified two attitude positions which an individual may have with respect to expectancy for reinforcement (L of C).

> When a reinforcement is perceived by the subject as following some action of his own but not being entirely contingent upon his action, then, in our culture, it is typically perceived as the result of luck, chance, fate, as under the control of powerful others, or as unpredictable because of the great complexity of the forces surrounding him...[We] have labeled this a belief in <u>external control</u>. If the person perceives that the event is contingent upon his own behavior or his own relatively permanent characteristics, we have termed this a belief in <u>internal control</u> (Rotter, 1966:1). (Emphasis added.)

Rotter's formula may be used to predict whether an individual will take a specific environmental action. If the desired action is writing a letter to a Senator with regard to an Alaskan land bill, the probability of the individual writing the letter may depend on: (a) his/her expectancy that the letter writing will indeed contribute to the preservation of Alaskan lands, and (b) the value which the individual places on preserving Alaskan lands. Given that the individual values Alaskan land preservation, an individual who perceives an <u>internal</u> L of C is more likely to write a letter expecting to gain the desired reinforcement. Alternatively, an <u>external</u> individual attributes change in the Alaskan land situation to chance or powerful others and fails to take action.

Rotter (1966) describes the L of C construct as a distribution of individuals on a continuum according to the degree to which they accept personal responsibility for what happens to them. Other writers have emphasized the importance of viewing L of C not as a trait or personality type, but as an individual's more common tendencies to expect events to be contingent or noncontingent upon his/ her actions (Lefcourt, 1976; Phares, 1976).

Locus of control has been shown to operate as both a generalized expectancy covering many diverse situations, and as a specific expectancy directed toward a class of situations. When an individual is confronted with a novel or ambiguous situation, the individual's behavior is more likely to reflect a generalized expectancy for control. If a familiar situation is encountered, behavior will predictably follow the individual's specific expectancy for control in that situation (Lefcourt, 1976; Phares, 1976).

Many paper and pencil instruments have been developed to measure an individual's L of C. Both generalized and specific expectancies have been assessed in a variety of age groups, populations, and topic areas (Crandall, <u>et al</u>., 1965; Dean, 1969; James, 1957; Mischel, <u>et al</u>., 1974; Nowicki and

Strickland, 1973; Reid and Ware, 1974; Tomera, 1979). The L of C instrument which has received the most recognition was developed by Rotter (1966). His Internal- External Control Scale includes 29 forced-choice items which measure generalized expectancy across a range of situations. Several researchers have developed instruments intended to distinguish between different types of external control (Crandall, et al., 1965; Kleiber, et al., 1973; Levenson, 1972). In their view, important differences exist between the individual who believes outcomes are in the control of other people, and the individual who believes outcomes are a result of fate or chance. Levenson (1972) devised a L of C instrument which further distinguishes among externals as attributing control to either "powerful others" or "chance." Her Internal, Powerful Others, Chance Scale has been used with some success in supporting these factors as independent orientations.

Factors Influencing Locus of Control

There has been considerable research to identify the factors which influence the development of an individual's L of C. Locus of control appears to be influenced by familial origins, ethnicity, social class, and mental age.

Research pertaining to familial origins of L of C seem to indicate that family environment, consistency of parental reinforcement, and ordinal position in the family affect L of C. In general, a warm, supportive, nurturing environment encourages internality (Davis and Phares, 1969; Katkovsky, et al., 1967; Shore, 1967). Earlier born children tend to be slightly more internal than later born children in large families (Chance, 1965; Crandall, et al., 1965; Eisenman and Platt, 1968; MacDonald, 1971).

Studies on the social antecedents of L of C indicate expectancy of reinforcement is related to ethnicity and social class. Lefcourt (1976) reviewed the literature and reported a trend for blacks to be more external than whites, and showed lower socioeconomic status to be associated with externality. Gurin, et al. (1969) questioned the benefits attributed to internality. They proposed that internality may have negative implications especially among minority groups and the economically deprived. They further suggested that individuals in such groups are better adjusted when able to attribute failures to chance or powerful others. An internal individual who experiences repeated failure could eventually suffer from self-derogation and self-blame.

Although an individual's L of C has been shown to be relatively consistent when measured over short durations, several researchers have been able to demonstrate shifts in L of C over longer periods. Bailer (1961) and Penk (1969) suggest a positive relationship between age and internality. However, Bailer's study indicates mental age rather than chronological age is the salient aspect with regard to increases in internality.

Abundant literature exists pertaining to L of C. Although not exhaustive, this review of the literature has outlinedfactors found to influence the development of an individual's L of C. In summary, L of C is the degree to which an individual perceives reinforcement to be contingent (internal) or noncontingent (external) upon his/her actions. Locus of control seems to operate as both a broad, generalized expectancy and as a situation specific expectancy. Further, an individual's perceived L of C appears to be stable over short durations, and may be influenced by familial origins, ethnicity, social class, and mental age.

Implications for Environmental Education

Several generalizations which may be inferred from research on L of C may have important implications for EE. These generalizations and their potential implications are presented in this section along with a brief review of the supporting research.

A word of caution is appropriate concerning the nature of the supporting research. Many of the reported findings are based on correlational studies. Certainly these are legitimate methods of research; however, care must be taken not to infer causation between variables which show a significant correlation. For example, a significant relationship has been reported between having an internal L of C and resistance to subtle manipulation. It follows that internals may tend to be more discriminating in accepting information for use in problem solving--a desirable trait in an environmentally literate citizen. However, it does not necessarily follow that making externals more internal would also make them more resistant to manipulation. This infers a causal relationship between the two variables which has not yet been substantiated by research.

In addition, the literature cited is limited by the problems of research design and population constraints which are commonly inherent in behavioral research. However, even with the recognized limitations of available research findings, it is proposed that sufficient evidence exists to warrant consideration and further investigation of these potential implications by environmental educators.

1. <u>Internals more frequently participate in productive action taking than externals</u>.

Several researchers have reported evidence that internals are more often the initiators of social action and change, or participate more actively than externals in attempting to control their environment (Brown and Strickland, 1972; Rosen and Salling, 1971; Ryckman, Martens, Rodda, and Sherman, 1972). Gore and Rotter (1963) measured black college students' willingness to participate in various kinds of social actions at the height of a social protest movement. Internal blacks stated a greater willingness to become personally involved in a more active form of civil rights behavior. Strickland (1965) measured the degree of actual participation by blacks in the civil rights movement and reported a positive correlation between internality and participation.

Some discrepancies with regard to activism and L of C have been reported. Lao (1970) found that externals who blamed discrimination on the social system tended to participate and become more personally involved in civil rights activities than internals. Gurin, <u>et al</u>. (1969) presented a thorough review of L of C in blacks and proposed that a more complex relationship exists between L of C and behavior. They reported that when internal-external control refers to blacks' conceptions of their condition as blacks, it is the external rather than the internal orientation that is associated with more effective behaviors. Internal blacks who tended to see the cause of blacks' problems in personal inadequacies of blacks, rather than in the social system, supported the view that individual self-betterment is the best approach to dealing with the problems. Thus, these internals did take action, but the actions were individual rather than group actions. Both studies by Lao and Gurin, <u>et al</u>., reported a preference for collective action rather than individual action by externals who tended to blame the system.

The relationship between internality and individual action taking has strong implications for environmental education. Achieving the goals of environmental education depends on developing individuals willing to initiate positive, rational environmental action taking. In view of the generalizations reported here, this would seem to make internality desirable.

2. <u>Internals differ from externals in their ability to recall relevant material, and in how actively they seek additional information</u>.

In a study by Wolk and DuCette (1974), internals were found to demonstrate performance superior to externals on assigned tasks which involved recall of relevant information. Seeman (1963) presented prison inmates with three categories of information varying in relevancy to the parole process. Six weeks later he found that internals recalled significantly more of the relevant information than externals.

The relationships among L of C, knowledge, and information seeking behavior were investigated by Seeman and Evans (1962). Results of their study involving 43 internal-external pairs of white male tuberculosis patients indicated that internals were more knowledgeable about their illness, were more inquisitive with the hospital personnel about the disease and their own condition, and expressed less satisfaction with the amount of information they were receiving. Other researchers have supported these findings (Davis and Phares, 1967; Williams and Stack, 1972).

Having greater recall of relevant material and more actively seeking additional information are certainly important abilities for effective environmental problem solving. If becoming more internal leads to increases in recall and inquisitiveness (causal relationship), then developing an internal L of C among citizens may be an important goal of environmental education.

3. Internal individuals are superior to externals in their utilization of information.

Phares (1968) compared the utilization of information in decision making by internals and externals. Subjects were provided with information about four men and were asked to match each of the men with a suitable occupation and mate. After the task was completed, internals provided over 50 percent more reasons to justify their matches than externals. When only correct reasons were counted, internals provided three times as many correct responses as externals.

Rational, objective problem solving might be enhanced by an increased ability to accurately apply information. If the relationship between this characteristic and internality is a causal one (i.e., becoming more internal would cause a greater utilization of information), citizens' perception of L of C should be an important consideration of environmental educators.

4. Internal individuals are more resistant to subtle manipulation and are less influenced by high-prestige individuals than externals.

Studies concerning an individual's tendencies to conform indicate that internals are more trusting of their own judgment, and are less apt to conform to the influence of others (Biondo and MacDonald, 1971; Crowne and Liverant, 1963; Doctor, 1971; Getter, 1966; Gore, 1962; Hjelle and Clouser, 1970; Lefcourt, 1967; Odell, 1959; Strickland, 1970).

Further studies have revealed that internals are not simply resistant to influence, but are more discriminating in what influences they will accept. Ritchie and Phares (1969) reported that both internals and externals shifted their views as a result of a persuasive message. However, externals were found to shift their opinions more when the message was attributed to a high-prestige, rather than a low-prestige source. Prestige of the source was not as influential in shifting the attitudes of internals as the content of the message. Other studies with similar findings have been reported by Ryckman, Rodda, and Sherman (1972).

These findings also seem to have important implications for producing rational, objective environmental problem solvers. It is essential that the value positions and credibility of informational sources be carefully assessed when investigating the dimensions of an environmental issue. It seems reasonable to expect internals to be more capable and/or willing to reject information which comes from biased or prestigious, but uninformed sources.

5. Internal individuals exhibit a superior capacity to delay gratification in order to attain greater, long-term gains.

Using normal and mentally retarded youth, Bailer (1961) found a significant positive correlation between internality and capacity to delay gratification. Strickland (1972) tested both black and white sixth graders and found that internals exhibited more delay behaviors than externals, but only among the white subjects. A later study (Strickland, 1973) reported internality was significantly and positively correlated with delayed, larger rewards in white, middle class youth. Mischel, et al. (1974) reported that internality was positively correlated with an individual's ability to persist in a task to obtain greater rewards. These studies seem to substantiate the greater capacity of internals to delay gratification in order to attain more significant, long-term gains.

Solving environmental (and other social) problems often requires behaviors that sacrifice short-term rewards for the attainment of greater, long-term gains. If environmental education is to produce citizens capable and willing to adopt behaviors to improve and/or maintain environmental quality, increased internality may be an important part of the process.

6. <u>Internals respond differently to those tasks which they perceive to be skill-related, than to tasks they perceive to be chance-determined.</u>

Phares (1957) and James and Rotter (1958) demonstrated in studies which ignored L of C, that if a task was perceived to be solvable through skill, individuals would seriously use experience and feedback as a basis for making decisions.

However, individuals will ignore feedback and tend to gamble on outcomes if the task is perceived to be chance-determined. Other researchers who measured L of C have reported that internals devote more attention to decision making concerning skill-related matters, and less attention in chance-related situations than do externals (Julian and Katz, 1968; Lefcourt, et al., 1968; Rotter and Mulry, 1965). Davis and Phares (1967) presented each of three groups with a diffirent reason for success or failure in an upcoming task (skill, chance, or no such instructions). Internals showed a decrease in participation in the chance-instructed group, whereas externals participated more. Internals participated significantly more than externals in the skill and no instruction situations.

In view of the above findings, it appears important for environmental education to present citizens with the perception that the outcomes of environmental actions are skill-related and not due entirely to chance events.

7. <u>An individual's perceived L of C is susceptible to change.</u>

Gorman (1968) and McArthur (1970) measured changes in L of C following contemporary political events relevant to control expectancies. In each study the experimental group had a vested interest in the outcome of the event. The failure of the desired outcome to materialize did not reinforce an internal L of C. In both studies, the experimental group showed a greater shift toward the external end of the continuum; however, no indication exists as to the permanence of this shift.

deCharms (1972) established a teacher training program specifically aimed at encouraging personal causation (internality) in the students involved. Evidence showed that the teachers' training did indeed increase the students' sense of personal causation. Further, deCharms was able to demonstrate that these shifts have persistence when measured over a period of up to two years, and that additional exposure to trained teachers has a cumulative effect in increasing the students' internality. Other researchers reported similar shifts toward internality following training and substantiated the cumulative effects of training reported by deCharms (Martin and Shepel, 1974; Nowicki and Barnes, 1973).

Rowe has investigated the impact science education methods may have on students' L of C. She suggested that:

> ...science appropriately taught may contribute to improving the sense of fate control and that this improvement, in turn, will increase the amount of voluntary learning and investigating that people will engage in (Rowe, 1973:300).

Rowe reported evidence that teaching techniques such as divergent questioning, sufficient wait time, and inquiry models shift students' perception of fate control (L of C) toward internality.

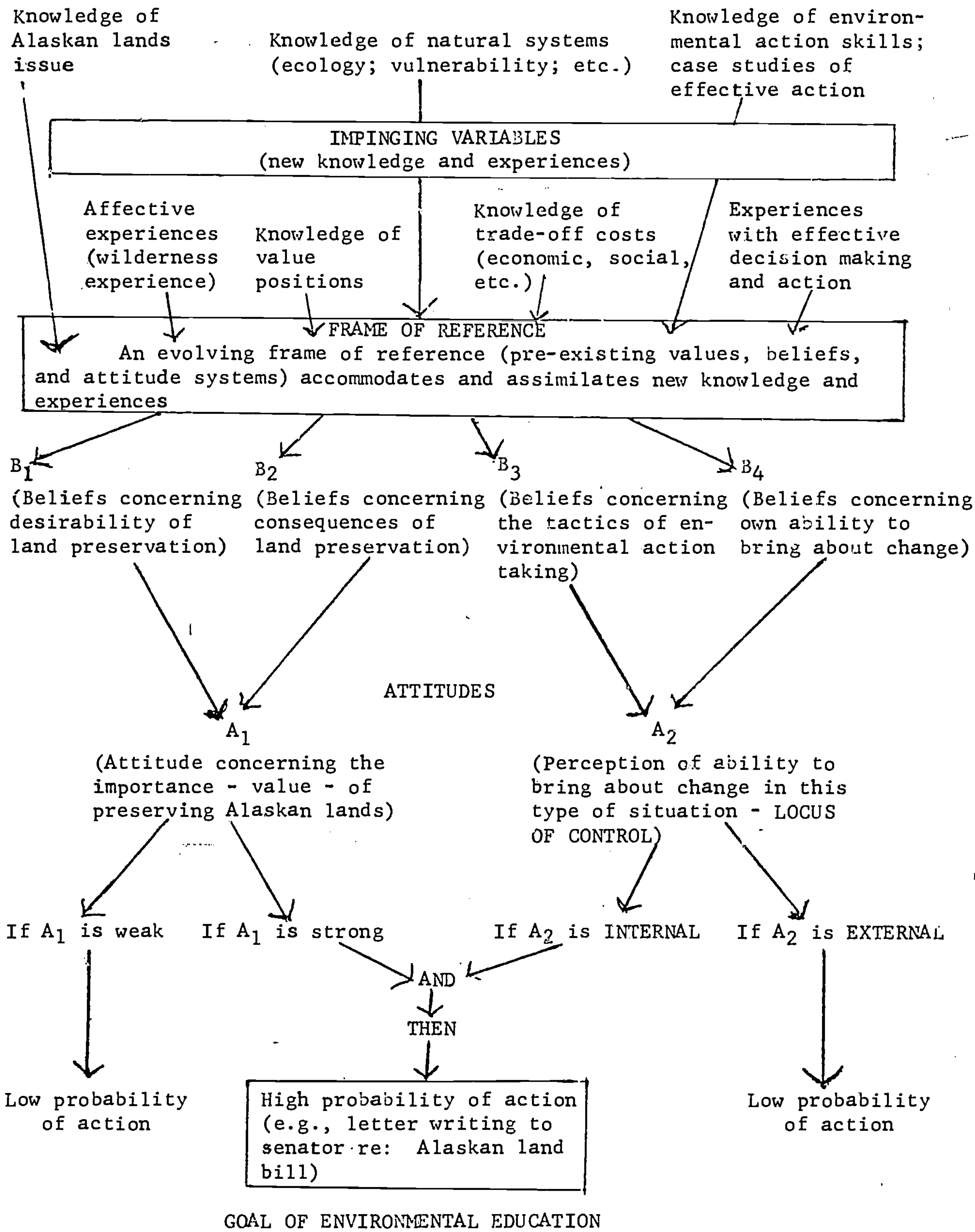
Given that an internal L of C in citizens is accepted as a desired perspective in an environmentally literate individual, it is significant that L of C is responsive to training and experience. The nature and extent of such training to be offered by EE are by no means defined clearly as yet. However, the implication seems evident that environmental educators should begin to examine environmental education curricula and teaching methods to determine how an internal L of C may be best developed in citizens.

A Paradigm of Environmental Behavior

The research reviewed here indicates that internals may be expected to be more autonomous and better informed problem solvers than externals, and to participate more frequently in environmental action taking. Given that Rotter's formula for predicting an individual's potential for behavior is viable, and that environmentally responsible behavior is the ultimate goal of environmental education, it follows that the L of C theory has important implications for environmental education.

The proposed model (Figure 1) attempts to graphically relate the L of C construct to the many other variables and processes which impinge on environmental action taking by citizens (e.g., writing a letter about the Alaskan lands issue). The left side of the model includes those impinging variables (knowledge and experiences), beliefs (B_1 and B_2), and attitudes (A_1) with which environmental education has traditionally dealt with. More recently, environmental education literature has encouraged including a knowledge of, and experiences with, environmental problem solving as reflected by the impinging variables on the upper right side of the model. The review of the L of C theoretical construct presented in this paper supports the inclusion of such recent trends in environmental education, and further

Figure 1: ANATOMY OF AN ENVIRONMENTAL BEHAVIOR



suggests that citizens be given diverse, positive experiences with effective decision making and action. In addition, L of C implies that other beliefs (B_3 and B_4) and attitudes (A_2) are important considerations in bringing about a specific environmental action.

The processes involved as precursors to an environmental action are implied by the frame of reference component. The paradigm assumes that a citizen has a frame of reference which reflects all past learning experiences, values, beliefs, and attitudes, and which serves to process any new knowledge and/or experience. Some of this new input is modified to "fit" into the existing frame of reference (assimilation). In other cases, the frame of reference itself is adjusted to accept new perspectives (accommodation). The result is a constantly evolving frame of reference comprised of new beliefs and attitude systems. The attitude systems prevailing at any given time will determine the types of behaviors, if any, that are engaged in.

The model (Figure 1) attempts to recognize many components which are necessary to achieve the desired environmental behavior by the citizen. An internal L of C is not proposed as the panacea to correct our past failures in environmental education, but rather as an additional component which may contribute to future successes. The relationships proposed (Figure 1) have been useful in suggesting a number of recommendations for environmental education curriculum development, teaching methods and research. For example, the needs for research suggested by the paradigm include the need to...

1. develop valid and reliable instruments which measure situation specific (i.e., L of C in environmental problem solving) rather than generalized expectancy of reinforcement.

2. determine the types of experiences and knowledge needed to develop general and situation specific internal expectancies.

3. identify variables (knowledge, experiences) which impinge on environmental action taking and the extent to which each variable contributes to action.

4. determine the extent of causal relationships which may exist between internal L of C and various problem-solving attributes.

The paradigm and literature reviewed further suggest that environmental educators should...

5. provide citizens with experiences intended to develop or reinforce an internal L of C in environmental problem solving by: (1) using case study involvement which models effective action taking; (2) avoiding action taking experiences which reinforce externality in citizens because of unreasonable expectations or through lack of positive feedback; (3) using methods such as positive feedback, inquiry teaching, and student participation in decision making which enhance student self-image and confidence in problem solving abilities.

6. provide citizens with evidence that achieving results with environmental actions is skill-related rather than chance-determined.

7. consider the L of C of citizens when dealing with environmental action components so that the most productive teaching methods may be selected.

8. develop students' internal expectancies of control in specific classroom situations which will transfer to similar life style situations related to environmental quality.

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ENVIRONMENTAL ACTIVISM, PHASE III: THE BURDENS OF RESPONSIBILITY

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Abstract. *Environmental education must respond to a new phase in citizen involvement in public environmental affairs. Successes of activism have entailed responsibility for unforeseen consequences that environmentalists have not always accepted. Education for environmental action must now address these consequences, consistent with a holistic, evolutionary view of mankind's environmental predicament.*

Addressing a conference of the American Public Power Association, Governor of Washington Dixie Lee Ray "... berated federal politicians and a 'new class' ... that is uneducated in free enterprise and the sciences," which she said "...threaten America's orientation to capitalism, growth and technology" (Seattle Times, 1979). And writing to Audubon Magazine, a correspondent declared that: "The American public has finally become disgusted with Stop-Everything Environmentalists--SEEs for short" (Audubon, 1980). He alleged that:

> Since the early 1970s, the SEEs have seized every legal opportunity to stop resource development. They seldom bother to learn the facts or analyze the need for a project. They just want to stop it as quickly as they can and move on to their next personal vendetta. In the process, they have grossly misused hardwon environmental legislation.

The essence of these and similar charges is that "environmentalists" are irresponsibly obstructing solutions to America's energy and natural resource needs. The argument is made that the environmental protection movement has gone too far; that court action and regulation are stopping economic progress for ideological and self-serving reasons unrelated to environmental quality. Attacks on environmental action groups have been launched from both right and left of the political spectrum, and some foundations have backed away from support of environmental groups and causes.

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Attacks upon environmental activists are not new. Shortly after the environmental movement began to show legislative strength, a reactive literature of innuendo and implication emerged questioning the honesty of environmentalists' motivation (Newhaus, 1971; Grayson and Shepard, 1973). Anti-environmentalist broadsides described environmentalists as upper-middle class elitists interested only in protecting their economic and aesthetic principles from contamination by the poor, the black, the blue-collar working classes, and business enterprises that disfigure the environment but provide the jobs, energy, or material goods that people need (Briggs, 1976; Tucker, 1977). These opinions were occasionally voiced by politicians representing hard-line anti-environmentalist constituents and by some supercilious scientists who regarded ecology as a nonscience and the protection of nature as an exercise in naive emotionalism. Even editors of the prestigious journals Science and Nature lent support to ill-founded attacks upon environmental action and protection measures which, had they occurred in their own fields of expertise, they might well have found unacceptable (Maddox, 1972; Fairfax, 1978; Schindler, 1976; Simon, 1980).

To understand and explain this reaction is certainly a part of environmental education, and yet this task has not yet been accomplished. It cannot be accomplished here; but I believe that we can identify some of the causes of anti-environmentalist reaction, can see where environmental activists may have been remiss, and determine what remedial action may be indicated. First, however, some basic clarifications are required.

There are few self-styled anti-environmentalists. Some of the most acerbic critics of environmental action claim to be true conservationists, reasonable as contrasted to a lunatic fringe, subversives, and SEEs. There are some scientists and more economists who deny the existence of any general environmental problem, arguing that the world has always been changing and that man and nature will adapt to whatever the human ingenuity brings forth. From this viewpoint, the protection of endangered species is sentimental foolishness as the species will become extinct anyway, and protection wastes funds that might help needy people or advance real scientific research.

It appears from opinion analysis that a large part of the American public is not persuaded by these arguments (Mitchell, 1978). Popular support for environmental protection measures remains high and is periodically reinforced by new environmental disasters of which Love Canal, Three Mile Island, and the Great Mexican oil spill are examples. Nevertheless, the apparently most unqualified support accorded earlier environmental legislation no longer exists. In some sectors of society, "environmentalist" has become a bad word and environmental protection a polarizing issue. Opposition to environmental protection measures is more articulate and better organized than in earlier years, and environmental action tends more and more to impinge upon life styles and economic growth.

Environmental activists are now being asked to pay the price of success, a price that some had not anticipated and others have not been sure that they were obliged to pay. This obligation is not created by intemperate or attention-seeking critics of environmentalism, although they have given it visibility. It arises out of the honest doubt of relatively unbiased citizens who are being asked to choose between conflicting claims of environmental protectionists and of economic interests, notably of developers, industrialists, and public works enthusiasts. Unfortunately, these conflicting claims are not easily reconciled. They express differing values and differing assumptions regarding preferable futures. Very often their premises are not demonstrably true or false, leaving the relatively neutral citizen no objective basis for choice. Nonetheless, there often is a valid public environmental interest at stake, and with few but inevitable exceptions, environmental defenders are not just another self-interested pressure group.

The environmental protection movement has thus entered Phase III in which activists must go beyond their own first premises and values and consider the basis of opposing arguments, and seek out ways by which the conflicting positions may be altered to obtain an environmentally desirable conclusion. This could lead beyond regulation and management to technoeconomic systems change. The case for Phase III environmentalism was made in 1975 by Carl Pope when he argued that "a new synthesis needs to be defined in place of unacceptable choices between growth or no growth, jobs or no jobs, sprawl or open space" (Pope, 1975). A more recent and complex analysis of environmental activism in transition has been undertaken by Denton E. Morrison (1980), who notes that "The leading edge of thought in environmentalism is that the current mode of environmental regulation, however necessary for the short and mid-term, must in time be supplanted by broad social transformation in the direction of soft technology."

Phase I of environmental protection seldom considered the environment comprehensively. It was exemplified by the conservation movement prior to 1960 and was focused primarily upon specific aspects of the environment, as in the protection of endangered species of animals and plants, conservation of water, soil or forests, and reclamation of wet or arid lands for agriculture. Campaigns against commerce in egret plumes, protection of the North Pacific fur seals, and establishment of the U.S. Forest Service are familiar examples of Phase I environmental action.

The transition to Phase II, the environmental movement from 1960 to 1980, was gradual. But it illustrates how environmental education was effective in changing many people's perceptions of the world and ultimately in changing their values. A symbolic date for the transition may be 1941 when the National Audubon Society's Bird Lore became The Audubon Magazine. The conceptual groundwork for a broader ecological view of the environment was being laid in the universities by such scholars as Aldo Leopold at the University of Wisconsin, Lawrence Palmer at Cornell, Paul Sears at Yale, and Victor E. Shelford at the University of Illinois. Of course, there were many others and their numbers grew. Conservationists such as Fairfield Osborn (Our Plundered Planet, 1948) and William Vogt (The Road to Survival, 1948), in books that are regrettably nearly as relevant today as when written, sought to arouse public awareness of a rapidly deteriorating global environment. There were thus "environmentalists" before the term was invented, or before nationwide and international movements occurred. By 1963 when Rachel Carson's Silent Spring appeared, there was sufficient overt evidence of environmental disaster that the personal experience of people in large numbers made credible warnings that had previously made little impression.

There were many dissatisfactions and nascent fears (aroused particularly by biomedical findings) that coalesced into the environmental movement of the 1960s. Environmental action, Phase II, was initially a spontaneous, grassroots, decentralized citizen initiative. It did not have unified ideology beyond the general conviction that the human environment was threatened, that the threat was global, and that public action was necessary to stop or reverse it. Legislators and public officials felt citizen pressure for action, but the precise nature of that action was seldom specified. The public seemed to want something done about the environment, but it was not quite sure just what should be done or what the costs of action might be. More focused, issue-oriented, environmental groups found reinforcement in this amorphous groundswell of public sentiment. And it now seems clear that many people failed to understand that a quality environment, like any other desirable thing, has costs. Most significantly, few people seemed to realize that the causes of environmental deterioration were often to be found in their own life styles and ambitions.

Phase III emerged as this realization became evident, when environmental laws and regulations began to bump against the normal life habits and expectations of ordinary people. It is the initial success of the environmental movement in obtaining statutory and regulatory protection for the environment that has led to a politics of confrontation.

In the present phase of environmental activism, the challenge is not so much to obtain protective legislation and regulation as it is to make these measures work to achieve their objectives without creating unwanted side effects and generating destructive political opposition.

The environmental activists must now do what they have admonished others to do--to take a systems approach to environmental problems--to think holistically about the problem including its social, economic, and political aspects. Some environmental activists have already begun to do this, but it imposes a burden of learning, of communicating, and of evaluating alternatives that many environmentally concerned individuals will find difficult to bear. Nevertheless, broadened approaches to environmental protection are being taken.

One of these is environmental mediation. Pioneered by Gerald W. Cormick, the adaptation of labor mediation techniques to generally more complex environmental disputes has provided one process and structure through which all facets of an environmental dispute may be examined, with a view to finding a generally satisfactory solution instead of a victory for one adversary or the other with collateral issues left unresolved (Baldwin, 1978; Patton, 1977; McCarthy, 1976; Fanning, 1979). Environmental mediation is a Phase III process because it causes the environmental protectionist (as well as the environmental changer) to consider the total consequences of the proposed environment-affecting action and to participate in seeking the best available solution to an environmental problem having significant social, economic, and political implications.

The most clearly defined example of a Phase III effort has been the National Coal Policy Project, put together in 1976 by Gerald L. Decker, corporate energy manager of Dow Chemical Company, and Laurence I. Moss, a former president of the Sierra Club (Carter, 1977, 1978; Alexander, 1978). In a neutral setting provided by Georgetown University, a team of environmental and industrial mining experts undertook a comprehensive study of the coal industry to separate the areas upon which agreement existed, or could be reached, without great difficulty from those areas in which the concerns of environmental quality and energy production from coal seemed fundamentally at odds. The results of the study were generally encouraging. Substantial areas of agreement, or possible agreement, were discovered and a clearer picture emerged of the problems upon which the basis for agreement was not apparent (National Coal Policy Project, 1978). These problems could become objects of further study. Meanwhile, the areas of dispute and possible litigation may have been significantly reduced.

Efforts at joint environmental-industrial problem solving have been made with some success in other areas, notably in the siting of industrial facilities, highway routing, and forest management (McCloskey, 1977). If as many as a quarter of environmental disputes could be resolved through cooperative study, the saving in time, money, and effort would be enormous and the prospects for less adversarial handling of other issues would be improved.

Phase III environmental education ought to provide critical study of these cooperative and other efforts and to assist students in perceiving the full dimensions of an environmental controversy, without diminishing commitment to the essential requirements of environmental protection. The ability of future citizens to play informed and constructive roles in environmental policy problem solving could mean more environmental protection rather than less.

Researchers, writers, and teachers in environmental studies need also to continue, and to increase, contacts with and assistance to educators in agriculture, engineering, forestry, mining, and business management. For example, UNESCO has for several years been promoting the environmental education and training of engineers through an international multidisciplinary working group (Caldwell, 1977).

Environmental education programs across this country have begun to take Phase III circumstances into account. But two difficulties are encountered. The first is the formidable problem of identifying and properly interrelating the critical issues in any environmental controversy. Merely to require students of environmental science or policy to take courses in economics or law may fall short of equipping them to deal comprehensively with environmental issues. There is still much work to be done in coherent curriculum. If we are serious about achieving a holistic approach to environmental problems, we will have to find ways to develop more effective interaction among academic specialists and to enlarge opportunities for cross-disciplinary learning. Summer workshops would be one way to do this. Some efforts in this general direction have been made, but more are needed.

The second difficulty in implementing a Phase III approach is encountered in those cases where conflicts are irreconcilable. There are major policy areas involving, among others, questions of land use, transportation, energy, and species preservation where no amount of joint problem solving, mediation, or compromise can resolve differences. Perhaps the best that can be done here is to clarify the opposing positions and to analyze the consequences toward which each position leads. Where confirmed evidence points unmistakably to outcomes that would maintain or enlarge future options, or where the degradation of the biosphere is threatened, environmental education may appropriately assume an advocacy role. I cannot regard advocacy as inappropriate to environmental education when the destruction of the biosphere is clearly at stake.

Those of us professionally engaged in the development of environmental studies share in this burden of Phase III of environmental action. It is our function to help prepare people to meet its challenge. But we are not wholly free from the earlier need to induce a public awareness of environmental circumstances and issues (Goldsmith and Hochbaum, 1975). It does not appear to me that the means--financial and institutional--to support the level of effort needed is proportionate to both needs. I hope that the National Association for Environmental Education may lead efforts to bring environmental awareness and a recognition of responsibility for environmental protection into a coherent relationship. To do so would contribute to actualizing the precept stated in Section 101 of the National Environmental Policy Act "...that each person has a responsibility to contribute to the preservation and enhancement of the environment."

Environmental educators might profitably give more attention to multiple impact analysis as a systematic way of approaching environmental issues in the Phase III context. Daneke and Delli Priscolli (1979) have given us a very useful survey of the uses of social planning, and the implied lessons could be applied with equal justification to environmental policy and planning. The environmental policy curriculum could draw more often upon the literature of policy analysis in addition to its present reliance upon research in environmental impact analysis.

A concluding note of caution may be prudent. Because better ways may be found to achieve environmental protection than through adversary conflict does not mean that the case of each participant in a cooperative effort is equally meritorious. On occasion the merit may be equal, but rarely so if those concerned with environmental protection have thought through the environmental issue in its full dimensions and have sought to practice what they have preached to others--a holistic perspective on human needs and behaviors in relation to the continuing viability of the Earth.

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A FRAMEWORK FOR ENVIRONMENTAL EDUCATION CURRICULUM PLANNING AND DEVELOPMENT

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Abstract. *The purpose of this paper is to describe: (1) the research effort which led to the formulation and validation of the* *Goals for Curriculum Development in Environmental Education*, *and (2) how the "Goals" can be used for environmental education curriculum planning, development, and evaluation.*

Introduction

It is generally agreed by curriculum specialists that, irrespective of the subject, goals are needed to provide a sense of direction for curriculum development and instruction. VandeVisse and Stapp (1975, p. 96) have expressed the need for goals in environmental education. They have warned that, "...without a clear statement of goals, an environmental education program would become a series of unrelated experiences, focusing on limited program objectives." Unfortunately, as Roth (1976, p. 7) has noted, "the presence of environmental education in public school curricula can often be characterized by loose organization and little sense of direction."

Although general goals for environmental education (e.g., to develop environmental awareness, knowledge, attitudes, skills, etc.) have been described, the writers have long noted the need for more definitive subgoals to guide curriculum development. Recent studies such as Childress' National Profile of Environmental Education Curricula (1978) can be used to document the inconsistency between the goals expressed for, and used in, environmental education programs and projects, and those recommended by documents such as the Belgrade Charter(1975) and the Tbilisi Declaration (1977). This inconsistency may be due, in part, to the inherent difficulties confronting a curriculum developer charged with the task of translating general goals into manageable instructional objectives. In order to help curriculum

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developers and practitioners overcome these difficulties, the writers decided to develop a framework of more definitive subgoals to guide environmental education curriculum development.

The writers began the development process by adapting Harvey's (1977) superordinate goal for environmental education. This provided the overriding or general goal toward which all subgoals were directed. An analysis of the literature and research conducted at Southern Illinois University at Carbondale indicated that a framework of goals for environmental education must include four levels: Level I. Ecological Foundations; Level II. Conceptual Awareness; Level III. Investigation and Evaluation; and Level IV. Environmental Action Skills. The writers developed subgoals for each of these four levels and then subjected the original Goals for Curriculum Development in environmental education to two validity assessments. The goals were revised on the basis of recommendations received from a validity panel consisting of five nationally recognized environmental educators. The revised goals follow.

Goals for Curriculum Development in Environmental Education[1]

> The Superordinate Goal: ...to aid citizens in becoming environmentally knowledgeable and, above all, skilled and dedicated citizens who are willing to work, individually and collectively, toward achieving and/or maintaining a dynamic equilibrium between quality of life and quality of the environment.[2]

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[1] This document represents the final draft of the goals subsequent to validation. The final validity assessment was conducted by a panel of five professional environmental educators. This panel was composed of Drs. Robert S. Cook, John Disinger, Robert George, Harold McKenna, and R. Thomas Tanner.

[2] Adapted from Gary D. Harvey, A Conceptualization of Environmental Education. In J. L. Aldrich, A. M. Blackburn, and G. A. Abel (Eds.), A Report on the North American Regional Seminar on Environmental Education. Columbus, OH: SMEAC Information Reference Center, 1977.

Level I. Ecological Foundations Level:

This level seeks to provide the receiver with sufficient ecological foundations knowledge to permit him/her to eventually make ecologically sound decisions with respect to environmental issues.

The Ecological Foundations Level would minimally include the following conceptual components:

A. Individuals and populations.

B. Interactions and interdependence.

C. Environmental infliences and limiting factors.

D. Energy flow and materials cycling (biogeochemical cycling).

E. The community and ecosystem concepts.

F. Homeostasis.

G. Succession.

H. The human being as an ecosystem component.

I. The ecological implications of human activities and communities.

Level II. Conceptual Awareness Level--Issues and Values

This level seeks to guide the development of a conceptual awareness of how individual and collective actions may influence the relationship between quality of life and the quality of the environment...also, how these actions result in environmental issues which must be resolved through investigation, evaluation, values clarification, decision making and finally, citizenship action.

Goals at this level are formulated to provide opportunities for receivers to conceptualize...

A. ...how human cultural activities (e.g., religious, economic, political, social, etc.) influence the environment from an ecological perspective.

B. ...how individual behaviors impact on the environment from an ecological perspective.

C. ...a wide variety of environmental issues and the ecological and cultural implications of these issues

D. ...the viable alternative solutions available for remediating discrete environmental issues and the ecological and cultural implications of these alternative solutions.

E. ...the need for environmental issue investigation and evaluation as a prerequisite to sound decision making.

F. ...the roles played by differing human values in environmental issues and the need for personal values clarification as an integral part of environmental decision making.

G. ...the need for responsible citizenship action (e.g., persuasion, consumerism, legal action, political action, ecomanagement) in the remediation of environmental issues.

Level III. Investigation and Evaluation Level:

This level provides for the development of the knowledge and skills necessary to permit receivers to investigate environmental issues and evaluate alternative solutions for remediating these issues. Similarly, values are clarified with respect to these issues and alternative solutions. Goals at this level are presented in two components.

Component A: Goals for Component A are to develop in receivers...

A. ...the knowledge and skills needed to identify and investigate issues (using both primary and secondary sources of information) and to synthesize the data gathered.

B. ...the ability to analyze environmental issues and the associated value perspectives with respect to their ecological and cultural implications.

C. ...the ability to identify alternative solutions for discrete issues and the value perspectives associated with these solutions.

D. ...the ability to autonomously evaluate alternative solutions and associated value perspectives for discrete environmental issues with respect to their cultural and ecological implications.

E. ...the ability to identify and clarify their own value positions related to discrete environmental issues and their associated solutions.

F. ...the ability to evaluate, clarify, and change their own value positions in light of new information.

Component B: Goals for Component B are to provide receivers with opportunities to...

G. ...participate in environmental issue investigation and evaluation.

H. ...participate in the valuing process in a manner as to permit the receiver to evaluate the extent to which his/her values are consistent with the superordinate goal of achieving and/or maintaining a dynamic equilibrium between quality of life and quality of environment.

Level IV. Environmental Action Skills Level--Training and Application

This level seeks to guide the development of those skills necessary for receivers to take positive environmental action for the purpose of achieving and/or maintaining a dynamic equilibrium between quality of life and the quality of the environment. Goals at this level are presented in two components.

Component A: The goal for Component A is to develop in receivers...

A. ...those skills which will permit them to effectively work toward ends which are consistent with their values and take either individual or group action when appropriate, i.e., persuasion, consumerism, political action, legal action, or ecomanagement.

Component B: The goals for Component B are to provide receivers with opportunities to...

B. ...make decisions concerning environmental action strategies to be used with respect to particular environmental issues.

C. ...apply environmental action skills to specific issues, i.e., to take citizen action on one or more issues.

D. ...evaluate the actions taken with respect to their influence on achieving and/or maintaining a dynamic equilibrium between quality of life and the quality ofthe environment.

Assumptions Made by the Developers

The following assumptions have been made relative to the goals:

1. That the goals for curriculum development in environmental education are appropriate for use in guiding both formal and nonformal environmental education curriculum development efforts.

2. That a "receiver" can be thought of as any person, of any age, who can be reached through either the formal or nonformal educational sectors.

3. That the superordinate goal is philosophically correct as stated. That this goal represents the most appropriate direction for environmental education if environmental education is going to meet the tremendous challenges facing mankind both today and tomorrow.

4. That ecological foundations are critical to any environmental education program as prerequisite or corequisite cognitive knowledge. That ecological concepts are an integral part of environmental education. Despite this premise, it remains cogent to make certain that receivers distinguish between environmental education and ecology per se.

5. That, regardless of the importance of specific instructional methods such as outdoor education, environmental interpretation, and acclimatization, these are not a part of the substantive structure of environmental education per se.

   Therefore, ancillary goals representing these activities directly do not appear here although a number of the goals for curriculum development in environmental education might be facilitated by the use of these and other methodologies.

6. That some level of "environmental sensitivity" is probably critical to the receiver's being willing and/or able to engage profitably in Levels II, III, and IV of this set of goals. Irrespective of this assumed prerequisite, the developers have arbitrarily omitted goals dealing with sensitivity on several grounds. These are:

   A. Sensitivity would have to be represented as foundational.

   B. Sensitivity per se cannot be operationalized in in a manner as to provide for any measurable criterion level of affect.

C. Every individual will enter the EE process with a unique set of affective predispositions, generated by the individual's own background of experiences.

D. Like values clarification, sensitivity will, in part, result from EE activities themselves. In particular, judiciously developed instructional programs in ecological foundations and conceptual awareness should measurably assist in the sensitization process.

7. The process of valuing, values clarification and moral reasoning are implicit in the goals, particularly III and IV.

8. That environmental action is, in fact, represented by the five categories of action as stated in the goals (or in combinations of these categories). The assumption is also made that these action categories (or combination of them) are exhaustive.

9. That the concept of maintaining and/or achieving a dynamic equilibrium (homeostasis) must be interpreted from both cultural and ecological perspectives. That said equilibrium may well result in a distinct compromise between quality of life on one hand and quality of the environment on the other. The curriculum developer must be constantly aware of this in order to produce curricular materials that look rationally at both the cutlural and ecological costs involved in achieving a true equilibrium.

10. That the phrase, "...to provide receivers with opportunities to apply environmental action skills to specific issues" implies no more than what is stated. That an educator cannot ethically force a receiver to take action but, instead, should provide mechanisms whereby action can be taken if desired.

11. That instructional objectives would be generated under each subordinate goal during curriculum development.

12. That environmental education is an interdisciplinary pursuit and that numerous disciplines must be reflected in the generation of any set of goals for curriculum development. Only in this manner can environmental education help receivers to successfully meet the challenges facing them as world citizens.

Developer's Initial Content Validity Assessment

The developers initially assessed the content validity of their goals by comparing the goals expressed at each level of the document against the five (5) categories of environmental education objectives proposed at the Tbilisi Intergovernmental Conference on Environmental Education in 1977. The Tbilisi objectives follow:

AWARENESS: to help social groups and individuals acquire an awareness and sensitivity to the total environment and its allied problems.

KNOWLEDGE: to help social groups and individuals gain a variety of experiences in, and acquire a basic understanding of, the environment and its associated problems.

ATTITUDES: to help social groups and individuals acquire a set of values and feelings of concern for the environment and motivation for actively participating in environmental improvement and protection.

SKILLS: to help social groups and individuals acquire the skills for identifying and solving environmental problems.

PARTICIPATION: to provide social groups and individuals with an opportunity to be actively involved at all levels in working toward resolution of environmental problems.

The validity comparison grid will be found in Figure 1.

Results of the Validity Panel Assessment

The use of a validity panel is an accepted and recommended means of establishing content validity (Ary, Jacobs and Razavieh, 1972; Kerlinger, 1973). Further, this same procedure has been recommended by Saylor and Alexander (1974) for defining and validating subgoals such as those included in the Goals for Curriculum Development in Environmental Education. A more complete description of the validity panel assessment follows.

In 1978 and subsequent to the developers' initial content validity assessment, they submitted the goals to a validity panel consisting of seven nationally recognized environmental educators for their evaluation.

Tbilisi Objectives: 1 Awareness	2 Knowledge	3 Attitudes	4 Skills	5 Participation	Developers' EE Curriculum Goals by Level
					Level I. Ecological Foundations Level
X	X				All Subcomponents (A-I)
					Level II. Conceptual Awareness Level Subcomponent:
X	X				A
X	X				B
X	X				C
X	X				D
X	X	X			E
X	X	X			F
X	X	X			G
					Level III. Investigation and Evaluation Level Subcomponent:
X	X		X		A
X	X		X		B
X	X		X		C
X	X		X		D
X		X	X		E
X	X	X	X		F
X	X	X	X	X	G
X		X			H
					Level IV. Action Skills Level Subcomponent:
			X		A
			X	X	B
				X	C
				X	D

Figure 1: Developers' Validity Assessment - A Comparison of the Goals for Curriculum Development in Environmental Education to the Tbilisi Conference Categories of Objectives (1977).

A comprehensive instrument was developed to assess the validity of the goals. The instrument was sent with a copy of (1) the goals, (2) the assumptions, and (3) the developers' initial validity assessment to the validity panel. The developed instrument contained a number of categories to which the panelists were asked to respond as appropriate. In an attempt to standardize the validity assessment, the developers requested the panelists to initially assume the superordinate goal to be conceptually correct as stated. The developers asked the panelists to make this initial assumption so that they would analyze the subordinate goals in the context of the superordinate goal. However, this did not mean that the panelists could not disagree with the superordinate goal as stated. In fact, the panelists were also asked specifically to assess the superordinate goal. In additional directions given to the panelists, the developers asked them to assume that the four levels of goals were not necessarily exhaustive or appropriate as classified in the document. The developers also pointed out that it was entirely possible that they could have failed to recognize a critical element that should have "level status" in the model. The validity panelists were asked to provide their suggestions regarding these variables. Further, the panelists were asked to respond specifically to the following items:

1. Content Validity--Subordinate Goals: To what extent do you perceive that the subordinate goals in this model represent the substantive structure of the superordinate goal as stated?

2. Content Validity--Superordinate Goal: To what extent do you perceive that the superordinate goal is valid for use in curriculum development in environmental education?

3. Syntax:

   A. To what extent is the sequencing from Level I through Level IV logical? That is, is the "level hierarchy" appropriate?

   B. To what extent is there logical sequencing within each level?

4. Subjective Analysis: To what extent do you believe that this model represents a suitable framework for curriculum development in EE?

5. Recommended Goals and/or Levels: Are there other goals and/or levels perceived as critical?

Completed validity assessments were received from five of the seven panelists. In general, the comments received from the panelists were consistent. The consistency of the comments greatly facilitated the process of revising both the goals and the assumptions made by the developers regarding the goals. The revision process was completed during the spring of 1978. The revised goals and the assumptions regarding the goals are presented herein.

Applying the Goals

The utility of the Goals for Curriculum Development in environmental education lies in their application. Basically, the goals exist as a framework within which specific performance objectives can be written by the curriculum developer from which a curriculum for environmental education can be developed. As far as the writers can determine, no environmental education curriculum has ever been developed in precisely this manner. This may explain why the literature abounds with challenges by professionals, to the community as a whole, to produce syntactically sound curricula which transcend the "awareness level" of receiver achievement.

Although environmental education curricula abound throughout the world, it is evident that most curricular packages are produced largely on the basis of developer bias and intuition. Many such packages were developed even before any consensus was reached relative to the parameters of environmental education per se. It would be the writers' recommendation, therefore, that new curriculum development projects are needed and that these projects be responsibly produced with environmental issue investigation and the remediation of issues as major goals. The utilization of the Goals for Curriculum Development in environmental education would certainly facilitate this process.

Figure 2 presents a curriculum model based on the goal levels. This conceptual scheme illustrates how a curriculum scope may be operationalized from the goal levels and integrated through grades (vertical organization) and across appropriate disciplines (horizontal organization). Development of the curriculum scope would require the expansion of each goal component into specific objectives in cognitive and affective domains.

The goals not only provide a basis for developing curriculum objectives, but to some extent specify teaching strategies as well. If the curriculum is to achieve Component B of Levels III and IV, teaching strategies must be implemented which provide receivers with the opportunities to participate in environmental issue investigation, evaluation, and decision making.

The writers have also found that the Goals for Curriculum Development can be used for analyzing and evaluating EE materials currently in existence. One such analysis is presented here.

In 1978, a one-year program for environmental education was published entitled Investigation and Action Skills for Environmental Problem Solving. The program is composed of a set of six (6) modules written by H. Hungerford, R. A. Litherland, R. Ben Peyton, and A. M. Tomera. The modules are published by Stipes Publishing Company, 10 Chester Street, Champaign, Illinois 61820. This program's intent is to assist receivers in acquiring those skills needed to become effective issue investigators and responsible citizen activists. Individual module titles are as follows:

Module I:	Looking into Environmental Problems
Module II:	Studying Environmental Problems Using Secondary Sources
Module III:	Using Surveys, Questionnaires, and Opinionnaires in Environmental Investigations
Module IV:	Interpreting Data in Environmental Investigations
Module V:	Studying an Environmental Problem
Module VI:	Environmental Action Strategies

Subsequent to the development of the Goals for Curriculum Development in environmental education, the writers decided to compare the modules against the goals in order to determine which goal levels were represented by that program. Such an analysis could assist the program's developers in an evaluation of the modules and provide indications of where the modules might need subsequent revision.

A partial report of that analysis appears here in Table 1 entitled, "Goal Analysis of the Investigation and Action Skills Modules." The performance objectives for each module are accounted for in this analysis (by number because space does not permit an iteration of each objective). Although some objectives could be included in more than one goal level, the writers arbitrarily chose to place each objective into the one level that appeared to be the most appropriate. The column entitled "Other" contains those objectives that deal specifically with skills directly associated with areas such as math and language arts.

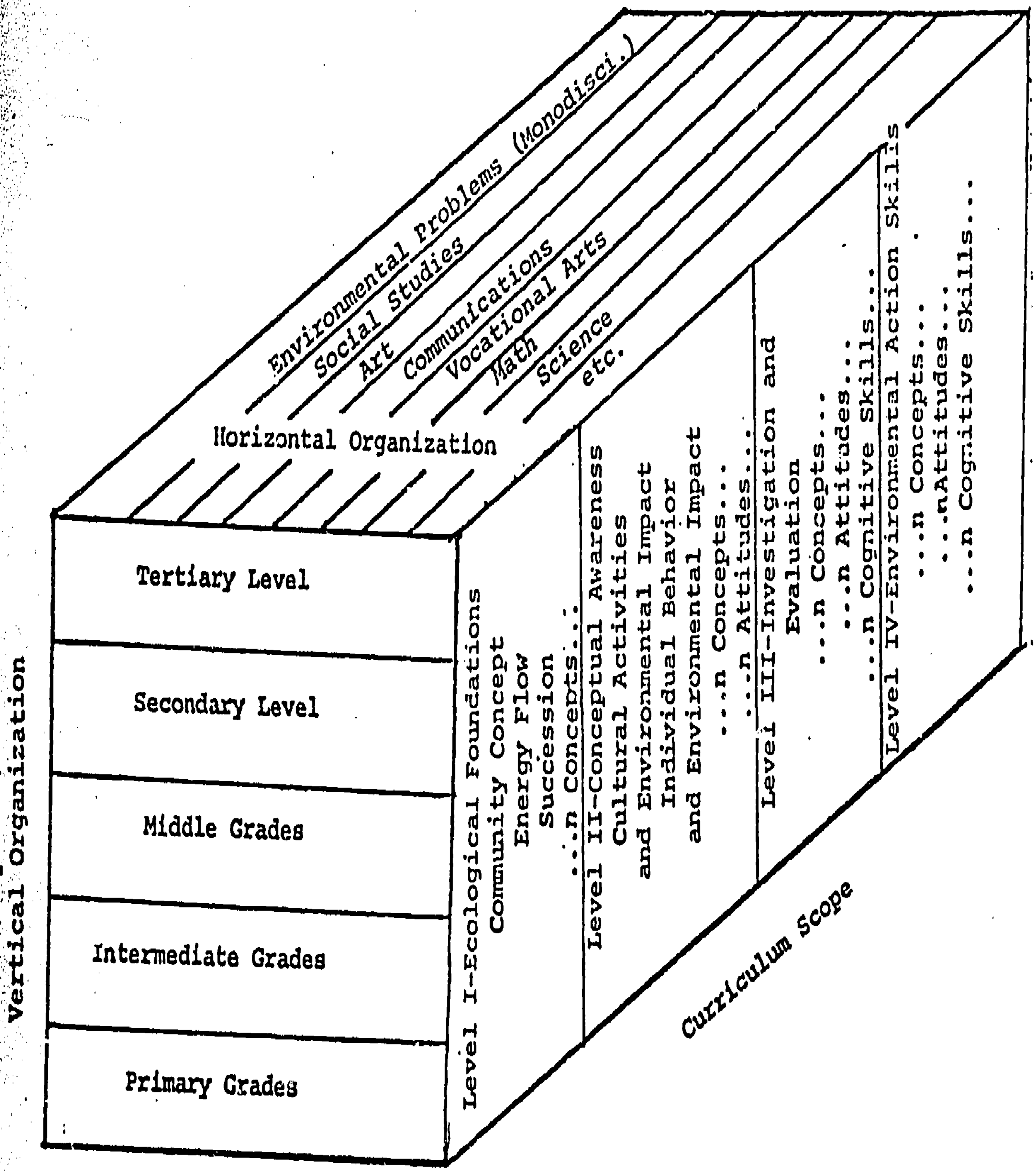

Figure 2. A conceptual model illustrating the integration of the curriculum scope through grade levels and across subject areas within grade levels utilizing the goals as iterated in this document.

In summary, much of the curriculum planning for environmental education has been based upon the use of "hunches," as Childress (1978) has noted. The writers believe that the responsibilities of environmental education are too great...the time too short...and practitioners' skills too few to allow curriculum development to remain a matter of intuition. Therefore, the writers recommend that the Goals for Curriculum Development in Environmental Education be utilized to guide curriculum planning and development in the field. Further, the writers recommend that existing EE programs be analyzed to determine the extent to which they meet the goals.

Table 1. Goal Analysis of the Investigation and Action Skills Modules.

	Goals By Level				
The Modules (Read Down)	Level I Ecological Found's	Level II Awareness Level	Level III Investigation/Evaluation	Level IV Action Skills	Other
I	5	6, 7, 10, 11	12, 13, 14, 15, 16, 17		1, 2, 3, 4, 7, 8, 9
II		4	1, 2, 3, 5, 6, 7, 8, 9		
III			1, 2, 3, 4, 5, 6, 7, 8		
IV			1, 3, 4, 5, 6, 8	2, 7	
V			All		
VI		1, 2, 3, 4, 5, 6, 7		8, 9, 10, 11, 12 13, 14, 15, 16, 17, 18, 19, 20, 21	

Note: The modules were written on the assumption that the reciever groups using them would already have experienced instruction in ecological concepts.

NOTE: Each of the Investigation and Action Skills Modules was developed using performance objectives. In the table, the numbers listed across from each Module represent a specific performance objective for that Module. The numbers for these objectives have been listed under the Goal Level which they address (e.g., Module I performance objective 5 addresses Goal Level I Ecological Foundations). Through the use of this type of analysis it is possible to determine which of the Goal Levels are addressed by a particular EE program.

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AN ASSESSMENT OF TEACHERS' UNDERSTANDING AND USE OF "GOALS FOR CURRICULUM DEVELOPMENT IN ENVIRONMENTAL EDUCATION"

Randall Champeau[1], Michael Gross[2], and Richard Wilke[2]

Abstract. *A questionnaire was administered to central Wisconsin teachers to assess their comprehension of the "Goals for Curriculum Development in Environmental Education." Also assessed was whether teachers felt schools should be responsible for addressing the Goals and whether they had the knowledge, skills, and resources to accomplish the Goals. These results are presented.*

Introduction

The "Goals for Curriculum Development in Environmental Education" (Hungerford, Peyton, and Wilke, 1980) were written to aid educators in incorporating environmental education into formal and informal educational programs. These goals were developed to further define the general goals formulated at Belgrade (1975) and Tbilisi (1978) international conferences.

The need for this definitive statement of goals is substantiated by the Childress (1978) study. Childress found that educators were addressing the awareness and ecological foundations of environmental education. However, little attention was given by educators to developing investigation and action skills regarding environmental issues. This was inconsistent with the recommendations of the Belgrade and Tbilisi reports.

Hungerford, et al. (1980, p. 43), stated that these inconsistencies "may be due to inherent difficulties confronting a curriculum developer charged with the task of translating what are very general goals into manageable instructional objectives." Childress further noted that translating the general goals into instructional objectives many times results in the use of "hunches" as a basis for curriculum planning.

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The general goal and major subgoals developed by Hungerford, _et al_., were used as a basis for this study. Research subjects were presented with a less technical version of the original goal statements. The versions of the Hungerford, _et al_., goals used in the study follow:

> _General Goal of Environmental Education_: To aid citizens in becoming environmentally knowledgeable and, above all, skilled and dedicated citizens who are willing to work, individually and collectively, toward achieving and/or maintaining a dynamic equilibrium between quality of life and quality of the environment.
>
> _Subgoal Level I of Environmental Education_: To provide students with sufficient ecological foundations knowledge to permit them to eventually make ecologically sound decisions with respect to environmental issues.
>
> _Subgoal Level II of Environmental Education_: To guide the development of a conceptual awareness of how individual and collective actions may influence the relationship between quality of life and quality of the environment...also, how these actions result in environmental issues which must be resolved through investigation, evaluation, values clarification, decision making and finally citizenship action.
>
> _Subgoal Level III of Environmental Education_: To provide for the development of the knowledge and skills necessary to permit students to investigate environmental issues and evaluate alternative solutions for remediating these issues and alternative solutions.
>
> _Subgoal Level IV of Environmental Education_: To guide the development of those skills necessary for students to take positive environmental action for the purpose of achieving and/or maintaining a dynamic equilibrium between quality of life and quality of the environment.

Since teachers are primarily responsible for implementing any educational program, it is important that environmental educators determine if teachers understand the Goals for Curriculum Development in Environmental Education and have the knowledge and motivation to apply them. No previous research has been done which addresses these specific questions.

This research was undertaken to determine teachers' understanding, knowledge, and motivation regarding the Goals for Curriculum Development in Environmental Education. Specifically, the objectives of this study were to:

1. determine if a selected sample of teachers could comprehend the superordinate and major subgoals as stated in the "Goals for Curriculum Development in Environmental Education,"

2. determine if a selected sample of teachers perceive the achievement of the Goals should be an important component of every student's education,

3. determine if a selected sample of teachers perceive they possess the knowledge and skills necessary to assist students in achieving the Goals,

4. determine if a selected sample of teachers perceive a need exists for teacher workshops designed to provide educators with the knowledge and skills needed to assist students in achieving the Goals,

5. determine if a selected sample of teachers perceive there is a need for K-12 curriculum materials designed to aid students in achieving the Goals,

6. determine if a selected sample of teachers perceive they individually need curriculum materials which could be used to assist their students in achieving the Goals,

7. determine if grade level of instruction or area of instruction relates to:

    a. a comprehension of the Goals by the teacher,

    b. teacher's perceived need for achievement of the Goals by all students,

    c. teacher knowledge and skills necessary to assist their students in achieving the Goals,

    d. teacher's attitudes regarding the need for workshops designed to provide educators with the knowledge and skills needed to assist students in achieving the Goals,

    e. teacher's attitudes regarding the need for K-12 curriculum materials designed to aid students in achieving the Goals,

    f. teacher's attitudes regarding their individual need for curriculum materials which could be used to assist their students in achieving the Goals.

Methods

Instrument Development

A Likert-type instrument was developed to collect information necessary to accomplish the objectives of this study. Six statements were applied to the general goal proposed by Hungerford, Peyton, and Wilke and to each of their four major subgoals:

1. I fully comprehend this goal as stated.
2. I believe that the achievement of this goal should be an important component of every student's education.
3. I possess the knowledge and skills necessary to assist my students in achieving this goal.
4. I believe a need exists for teacher workshops designed to provide educators with the knowledge and skills needed to assist students in achieving this goal.
5. I believe there is a need for K-12 curriculum materials designed to aid students in achieving this goal.
6. I have a need for curriculum materials which I can use to assist my students in achieving this goal.

After each statement, the teacher was instructed to circle the response on a five-point Likert scale ranging from strongly agree to strongly disagree which best reflected how he/she felt about that statement. Information was also requested regarding the teacher's level and area of instruction.

Face and content validity for the test instrument was assessed by a panel of two environmental educators and two statisticians, each holding a doctoral degree in their specialty field. The instrument was revised in accordance with recommendations made by the panelists. The final instrument was determined to have face and content validity by all panelists.

Cronbachs Alpha Reliability Coefficients were calculated for each of the problem/statements used in the test instrument. All of the reliability coefficients obtained fell between .70 and .90. Based upon the reliability coefficients obtained, the researchers concluded that the instrument was internally consistent and reliable.

Data Collection

The instrument was administered by mail to 300 K-12 teachers. Using a random numbers table, the teachers were randomly selected from 3,100 teachers in 24 public and private school districts located in Cooperative Educational Services Agency Number 7 (CESA 7) serving eight central Wisconsin counties. A follow-up mailing of questionnaires was made to nonrespondents. A total of 129 usable questionnaires were returned (43 percent).

Data Analysis

Frequency distributions were computed for each of the 30 items. A Chi-square statistic was calculated comparing grade level and area of instruction vs. responses on the assessment items. Mean responses were also calculated for grade level and area of instruction for each of the 30 items.

Results

Tables 1-6 present frequency distributions for the six statements as they relate to the general goal and the four major subgoals of the "Goals for Curriculum Development in Environmental Education."

The analysis of statements 1, 2, 4, 5, and 6 in corresponding tables shows that the majority of respondents agree or strongly agree with the statements. In other words, most teachers comprehend the goals, believe the achievement of the goals is important to every student's education, believe a need exists for goal-related teacher workshops, believe there is a need for goal-related curriculum materials and believe that they personally have a need for goal-related curriculum materials. Respondents tended to be neutral to or disagree with the statement "I possess the skills necessary to assist my students in achieving this goal" (Table 3). This supports the perceived need for goal-related workshops (Table 4).

A Chi-square statistic was calculated ($\alpha = .05$) comparing grade level and area of instruction vs. responses on the assessment items (Champeau, 1979). Analysis revealed no statistically significant relationship for either independent variable and their responses. No significant relationship between grade level and subject matter area of the teachers and their attitudes toward and their understanding of the goals was exhibited.

Mean responses were calculated for gra` level and subject matter area (Champeau, 1979). Cross tabulation of mean responses vs. grade level and area of instruction further verifies that there is little apparent relationship between the independent and dependent variable. One exception is the 13 science teachers who responded to this instrument. This group tended to agree or strongly agree that "I have the knowledge and skills necessary to assist my students in achieving the goals."

Table 1

Frequency Distribution of Responses to the Statement "I fully comprehend this goal as stated."

	General Goal	Sub-goal 1	Sub-goal 2	Sub-goal 3	Sub-goal 3
Strongly Agree	42.2%	37.5%	27.0%	27.0%	27.2%
Agree	51.6	58.6	57.9	57.9	62.4
Neutral	3.1	0.8	11.9	11.9	7.2
Disagree	2.3	2.3	4.8	2.4	2.4
Strongly Disagree	0.8	0.8	0.8	0.8	0.8

Table 2

Frequency Distribution of Responses to the Statement "I believe that the achievement of this goal should be an important component of every student's education."

	General Goal	Sub-goal 1	Sub-goal 2	Sub-goal 3	Sub-goal 4
Strongly Agree	39.1%	39.1%	25.0%	27.2%	25.8%
Agree	53.9	56.3	61.3	54.4	61.3
Neutral	5.5	3.9	12.1	16.0	10.5
Disagree	1.6	0.8	1.6	2.4	2.4
Strongly Disagree	0.0	0.0	0.0	0.0	0.0

Table 3

Frequency Distribution of Responses to the Statement "I possess the knowledge and skills necessary to assist my students in achieving this goal."

	General Goal	Sub-goal 1	Sub-goal 2	Sub-goal 3	Sub-goal 4
Strongly Agree	2.4%	3.1%	1.6%	2.4%	2.4%
Agree	38.1	33.9	34.1	30.1	30.1
Neutral	37.3	35.4	38.2	42.3	43.1
Disagree	21.4	26.8	25.2	23.6	22.8
Strongly Disagree	0.8	0.8	0.8	1.6	1.6

Table 4

Frequency Distribution of Responses to the Statement "I believe a need exists for teacher workshops designed to provide educators with the knowledge and skills needed to assist students in achieving this goal."

	General Goal	Sub-goal 1	Sub-goal 2	Sub-goal 3	Sub-goal 4
Strongly Agree	28.1%	27.0%	22.6%	24.2%	21.8%
Agree	56.3	53.2	54.8	49.2	59.7
Neutral	12.5	18.3	20.2	22.6	17.7
Disagree	2.3	1.6	1.6	4.0	0.8
Strongly Disagree	0.8	0.0	0.8	0.0	0.0

Table 5

Frequency Distribution of Responses to the Statement "I believe there is a need for K-12 curriculum materials designed to aid students in achieving this goal."

	General Goal	Sub-goal 1	Sub-goal 2	Sub-goal 3	Sub-goal 4
Strongly Agree	33.1%	29.7%	22.6%	26.6%	20.2%
Agree	58.3	58.6	63.7	54.8	63.7
Neutral	6.3	9.4	12.1	16.1	12.9
Disagree	2.4	2.3	1.6	2.4	3.2
Strongly Disagree	0.0	0.0	0.0	0.0	0.0

Table 6

Frequency Distribution of Responses to the Statement "I have a need for curriculum materials which I can use to assist my students in achieving this goal."

	General Goal	Sub-goal 1	Sub-goal 2	Sub-goal 3	Sub-goal 4
Strongly Agree	18.1%	18.8%	15.4%	18.5%	18.5%
Agree	52.8	52.6	54.5	47.6	53.2
Neutral	18.9	22.7	25.2	27.4	21.8
Disagree	9.4	6.3	4.9	6.5	6.5
Strongly Disagree	0.8	0.8	0.0	0.0	0.0

Discussion and Recommendations

The most important finding of this investigation is that the majority of teachers in central Wisconsin see the "Goals for Curriculum Development in Environmental Education," as an important component of educational programs. On the other hand, most central Wisconsin teachers feel they do not have the training or instructional resources to accomplish the Goals. This would appear to be a clear mandate for teacher inservice and environmental education curriculum projects which address the Goals. It is also apparent that such efforts should be broadly focused, addressing all grade levels and disciplines. An exception would seem to be that science teachers may not require intensive inservice programs in order to help them to address the Goals.

One might hypothesize that the results of this study could be generalized to other populations in other geographical areas. The authors recommend that further research be conducted regarding this hypothesis. This information would be valuable for the justification and implementation of environmental education programming in schools, or other educational settings.

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LAND USE

M. Kealy Salomon and Alan M. Schwartz, AN EXPERIMENT IN LAND-USE CONTROL: THE ADIRONDACK PARK AGENCY.

AN EXPERIMENT IN LAND-USE CONTROL: THE ADIRONDACK PARK AGENCY

M. Kealy Salomon[1] and Alan M. Schwartz[1]

Abstract. *The Adirondack Park, located in northeastern New York State, is the largest park in the lower 48 states; it is bigger than Yellowstone, Yosemite, and the Everglades combined. Although 40 percent of the land within the Park is public and has been protected by the "Forever Wild Clause" of the New York State Constitution since the late 1800s, over 60 percent of the six million acre park is private land and until 1972 had virtually no land-use controls. In 1971 the New York State Legislature, fearing large-scale developments that might adversely affect the Park, created the Adirondack Park Agency (APA) to create plans for the regulation of both public and private lands. The Private Land-Use and Development Plan was approved by the Legislature in 1973 and gave the APA authority to control the intensity and quality of development for the approximately three and one-half million acres of private land. Over one-half of this land was "zoned" one unit per 42 acres. Bitter opposition to the Agency was common in the region. Changes in the APA Act and regulations during their first eight years are reviewed. Specific areas include changes in legislation affecting the Act, revisions in permit processes, new nonregulatory elements in the Agency's work program, and progress in the development of local land-use programs. The views and actions of the local citizens concerning these issues are considered. In addition, issues critical to the future success of the Agency and this experiment in private land-use control are identified.*

The Adirondack Park is located in the northeastern section of New York State (Figure 1). The Park includes six million acres of land (most of it unspoiled wilderness) which makes it roughly equal to the size of Vermont. Nevertheless, the population of the area is only 112,000 permanent residents and 90,000 seasonal residents.

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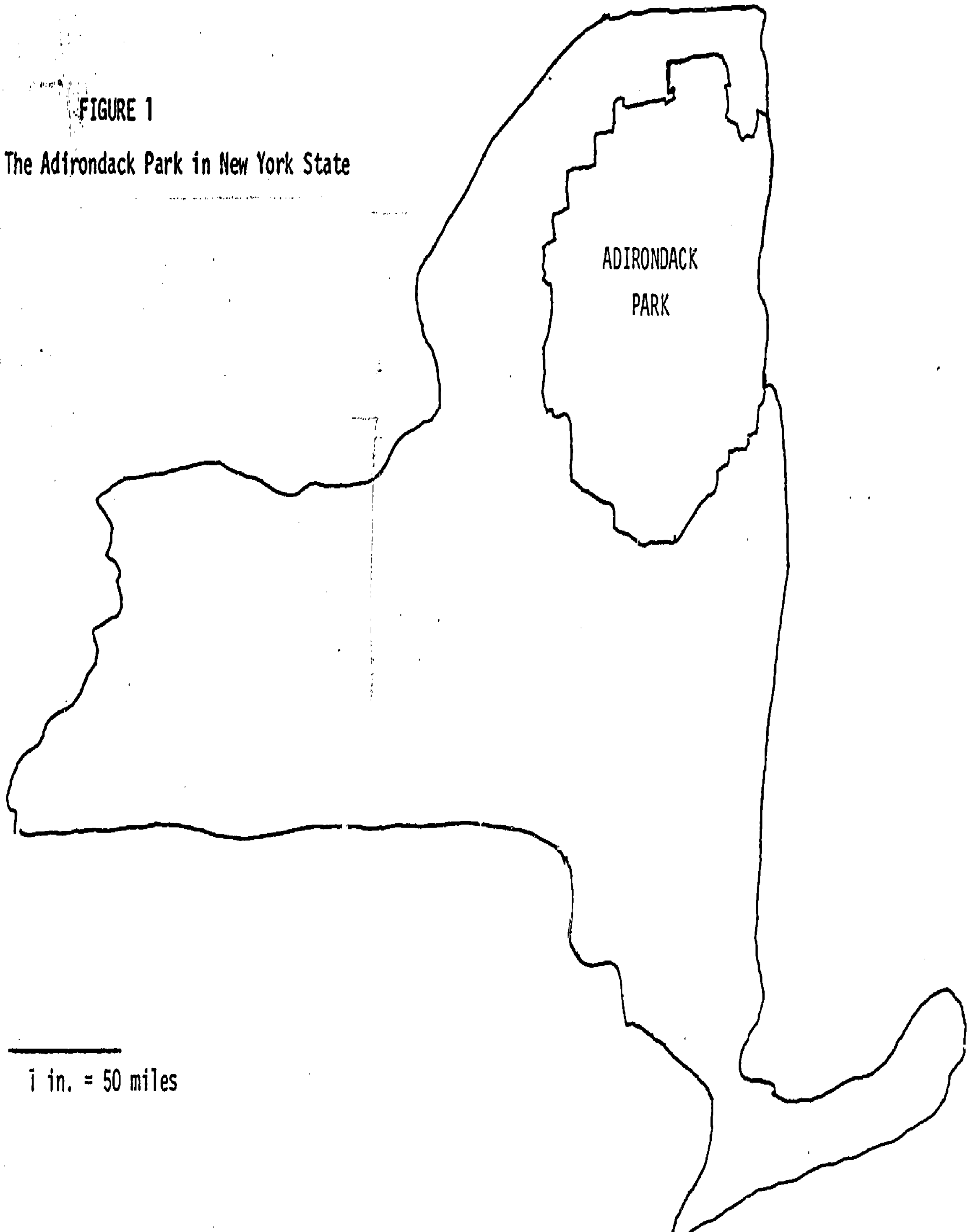
FIGURE 1

The Adirondack Park in New York State



Approximately 60 percent of the land within the borders of the Park is privately owned, while the remaining 40 percent is included in the Adirondack Forest Preserve owned by the State. A map of the area resembles a haphazard mosaic of state and privately-owned lands (Figure 2). All or part of 15 villages, 92 towns, and 12 counties are within the imaginary "blue line" of the Adirondack State Park.

The wilderness character of much of the Park has attracted tourists and outdoor enthusiasts from other parts of the country for over a century. The first real threat to the character of the Adirondacks came from the timber industry in the late 19th century. During that period, large tracts of land were leased or sold to logging companies and the virgin forests were cut. Alarmed at the rate at which state forest land was disappearing, in 1895 the state legislature adopted what is now Article XIV of the State Constitution. The opening section has remained unchanged:

> The lands of the State, now owned or hereafter acquired constituting the forest preserve as now fixed by law, shall be forever kept as wild forest lands. They shall not be leased, sold, or exchanged, or be taken by any corporation, public or private, nor shall the timber thereon be sold, removed or destroyed.

Despite increasing pressures for various uses, the simplicity of the law has provided over 80 years of protection for the state lands within the park.

The next major threat to the Adirondacks came in the middle of this century. As leisure time and surplus capital became more widespread, the Adirondack Mountains attracted an increasing number of tourists from all social classes. Although large portions of the wilderness within the Park were protected by state law, many fragile and important areas were adjacent to or interrupted by private land. As long as private landowners resisted development there would be no problem. But 500 land owners, mostly lumber companies, controlled almost half the total private land. Thus, the fate of the entire mix of public and private open-space land rested in the hands of a relative few. Pressure for large-scale development was increasing; the State of New York could no longer be certain that the Adirondack Park would escape the tourism/development boom that was already engulfing other areas of the country (Sullivan, 1975).

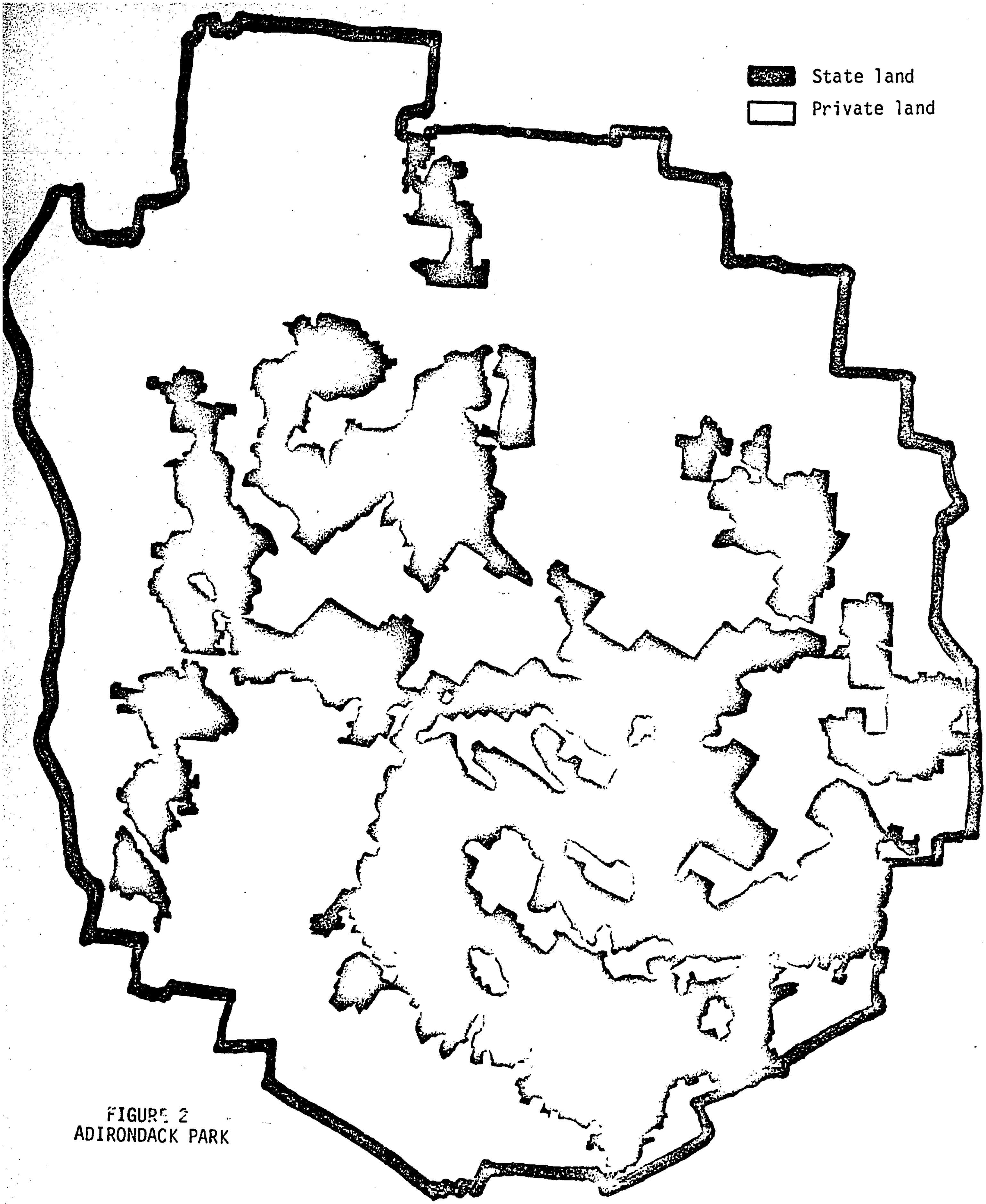


FIGURE 2
ADIRONDACK PARK

In 1968 Governor Nelson Rockefeller created the Temporary Study Commission on the Future of the Adirondacks, and charged it with the responsibility for developing a long-range policy for the state lands and for suggesting measures that would ensure that the development of private lands would be appropriate and consistent with the long-range goals (Temporary Study Commission, 1971). The Commission produced a report that outlined 181 recommendations pertaining to all aspects of the Park. The first three recommendations dealt with the creation of an Adirondack Park Agency which would be responsible for developing and implementing land-use plans for both the public and private lands within the Park. The Adirondack Park Agency (APA) Act was passed by both the Senate and the Assembly in 1971.

The APA is an independent agency within the State of New York Executive Department. It consists of eight private citizens, appointed by the Governor for four-year terms, and three state officials, namely the Commissioners of the Department of Environmental Conservation and the Department of Commerce, and the Secretary of State. Five of the private citizens must be permanent residents of the Park and three must reside permanently outside the Park. Not more than one may be appointed from any of the 12 Park counties, and not more than five may be affiliated with the same political party (Adirondack Park Agency, 1971a).

The APA first produced the State Land Master Plan which was submitted to Governor Rockefeller for approval in 1972. Legislative approval was unnecessary because the plan dealt solely with management of the state lands. The seven land-use classifications of state land and the guidelines for their use were designed to maintain the Adirondack Park lands in as natural and unspoiled condition as possible.

The checkerboard separation of state and private lands within the Park meant that the stringent controls imposed by the APA for the state lands were really of little value if the general character of the surrounding private lands were destroyed by development pressures. After the State Land Master Plan had been approved, the APA set to work on the much more difficult task of developing a land-use plan for the privately-owned lands. The Adirondack Park Land-Use and Development Plan was submitted to the state legislature in 1973. There were attempts to defeat the bill, but when strong pressure from Governor Rockefeller made passage seem certain, the representatives for the area asked for a year delay to study the plan in depth. Governor Rockefeller believed that the delay would result in hurried and uncontrolled development of the type that the plan was meant to halt and he vetoed the delay. A few months later the bill was passed by the Legislature creating the most stringent land-use controls governing private land anywhere in the

United States. The fervent desire for passage of this bill by a politically powerful governor was the decisive element in the enactment of the Private Land Plan.

The plan called for six classifications of land use: hamlet, industrial, moderate intensity, low intensity, rural use, and resource management. Hamlet areas are most often the population centers of the Park and they may or may not be incorporated villages. The hamlet areas are those locales where the APA plan calls for the majority of future growth and intensive development of tourists facilities so that the rest of the Park will remain relatively unspoiled. For these reasons there are no restrictions on land use, development, or intensity guidelines. Industrial areas are large areas outside the hamlets. They are sites for existing or potential industrial development, mainly mining operations. The overall objectives of the plan are to encourage continued operation of existing industry and to provide suitable locations for potential new industries. Industrial use areas, like hamlets, have no overall intensity guidelines, but conflicting land uses are discouraged.

Moderate and low-intensity areas are those where growth and development cannot be of the same magnitude as hamlet areas. When planning development in these areas, biological, physical, and public considerations play an important role. Land-use in moderate intensity areas allows for 500 units/sq. mile (1.3 acres/unit), and that in low-intensity areas is still more restrictive, allowing 200 units/sq. mile (3.2 acres/unit). Moderate and low-intensity areas are usually found in the vicinity of hamlets and have relatively easy access to roads and the shoreline.

Rural-use areas are those areas where natural resource and public considerations necessitate more restrictive land-use and development plans. The objective in these areas is to encourage land use that is compatible with natural restrictions and consistent with the preservation of open spaces. Primary uses of the land are residential and agriculture, and the maximum density may not exceed 75 units/square mile (8.5 acres/unit).

The most restrictive class of private land within the Adirondack Park is the resource management class, where there is a great need to protect and preserve the open-space characteristics due to pressing natural and public considerations. The purpose of the resource management classification is to protect fragile ecosystems and prevent large-scale development in an area where it might detract from the aesthetic qualities of an unspoiled wilderness. Land-use in resource management areas is primarily limited to agriculture and forestry operations with a small amount of residential development permitted. Overall intensity guidelines were set at 15 principal structures/square mile (42 acres/unit). Fifty-three percent of all private land is classified as resource management areas (Adirondack Park Agency, 1973). The percent of total private land and the intensity of development in each is summarized in Table 1.

Table 1

Private Land-Use Classification

Land-Use Area	% of Total Private Land	Acres/Unit	Units/ Square Mile
Hamlet	1.9	no limit	no limit
Moderate Intensity	3.0	1.3	500
Low Intensity	8.1	3.2	260
Rural Use	34.0	8.5	75
Resource Management	53.0	42.1	15

In addition to the classification of private lands, the Land-Use and Development Plan also defines regional projects and delineates shoreline restrictions. "Projects of a certain size and type and in certain locations assume regional importance. This means that they have a broader area of impact and concern than just on the town in which they are proposed to be located" (Adirondack Park Agency, 1979b). The APA has review authority over all regional (Type A) projects. The type of activities classified as regional vary depending on the classification of the land. In hamlets, very few projects are considered to be regional, whereas in resource management areas nearly all development projects are considered to have regional impact. Once a town has an APA-approved local land-use plan, it gains control Of Class B projects (smaller-scale activities), and the APA maintains control over the larger and more sensitive proposals which are termed Class A projects. In the last seven years of the program only seven towns have developed APA-approved plans.

For those lands that border a body of water, the APA has set minimum lot width and building setbacks that vary according to the classification of the land. These shoreline restrictions apply to all lakes, ponds, rivers, and streams. The restrictions were designed to help protect the many miles of shoreline from being destroyed, and to preserve the wilderness character of the surrounding lands. Thus, the Adirondack Park Agency is not as concerned with completely halting growth in the Adiron dacks as it is with directing future growth into areas with natural conditions capable of absorbing the impacts.

Opposition to the APA has been very vocal from the outset. The year-round residents of the Adirondack Park were against the idea of state intervention, and many groups were formed in an effort to voice opposition. The vast majority of local and county governments within the Park have gone on record in opposition to the land-use planning authority of the APA. An active citizen's grop called the Adirondack Citizen's Rights League was formed soon after the completion of The Private Land-Use and Development Plan to rally local opposition and push for repeal of the Act. It was never very clear if the opposition's major concern was the intensity of the controls or the infringement of a state agency into what had been local concerns, but the fervor of the opponents was never in doubt. For example, public hearings on the private land became shouting matches and a few isolated incidents of violence occurred. On one occasion, an intruder was arrested attempting to torch the Agency's headquarters, and on another, employees found a large pile of manure on the Agency's doorstep with a sign, "We've taken yours long enough, have some of ours."

The effect of the local citizen opposition was counteracted by strong support for Adirondack preservation from all major urban areas of the state. Local opposition probably played a relatively small role in the changes in Agency rules and regulations, the Agency's staff and their way of relating to local citizens, but these have changed over time. Any bureauracy has difficulty in implementing new, untried programs, and the problems surrounding the APA and the administration of its new, complex, land-use control program resulted in "horror stories" during its formative years. These include: unreasonable delays in issuing permits, preventing a rural family from living above its newly-built store, and alleged arrogance by the young staff members responsible for project reviews. Although there was no groundswell of local support for the Agency, there is now a demonstrable acceptance of and/or acquiescence to both the Act and the Agency. Specific areas in which this can be noted are: the changes in the thrust of legislation proposed by Adirondack legislators to alter the Act or Agency, streamlining and increased efficiency of the permit process, and the additional work programs that include areas outside the regulatory interests of the Agency. Perhaps the most important indicator of the success or failure of the Agency is its ability to entice local governments to work with it and to develop local land-use plans.

Since casting their vote against the creation of the APA in 1971, a group of local legislators have been involved in a continuing battle either to abolish or substantially weaken the Agency. When one examines the bills submitted by these legislators, some revealing trends emerge. In 1974, less than one year after the Private Land-Use Bill was signed by the Governor, eight pieces of legislation concerning the Agency were introduced in the New York State Legislature. The only bill to become law involved a minor change in the procedure by which changes in the land-use map would be made. All other bills either did not get out of committee or did not pass both houses of the Legislature. Most of these proposed bills made such substantial changes that the Private Land-Use Plan, in effect, would have been eliminated, and the powers of the Agency eviscerated. One bill provided for the elimination of all of the development density regulations which are the very heart of the Land-Use and Development Plan.

The attempts to abolish the Agency or to reduce substantially its land-use control powers have continued through every legislative session. The support of the State Legislature, however, has been unwavering, and though legislation to abolish the Agency is still introduced yearly by the same few Adirondack legislators (perhaps as a token gesture for some members of their constituency), many more legislative bills introduced by these Adirondack legislators are aimed at more subtle diminution of the Agency's powers. In each legislative session local legislators have tried to shift the balance of membership to include more local residents. In 1974 and 1975, legislation was submitted to add two more full-time residents and require the chair of the Agency to be a full-time resident. In 1976, a bill to require that local appointees be chosen from a list provided to the Governor by elected local officials, passed both houses of the Legislature, but was vetoed by the Governor. Another bill that same year required more local resident members, all of whom would be elected by local people rather than appointed. Bills in 1977 and 1978 also tried to place more elected local officials on the Agency. By 1979, however, the suggested changes were more modest. Proposed legislation to increase total Agency membership would have resulted in a corresponding increase in the number of members from within the Park. A bill to limit the number of terms on the Agency was also introduced to reduce the influence of the strong environmental appointees originally on the commission who now have over six years experience and additional clout in Agency decision making. Thus, over time, local legislators have supplemented their basic thrust of eliminating nonPark resident Agency appointees, with more modest proposals to increase local representation on the Agency.

The drive for increased local representation will not end quickly. In 1979, Governor Hugh Carey recommended to the Legislature the appointment of a millionaire oil company executive to serve as one of the Park resident Agency members. Although he had a legal address within the Park, this individual resided for most of the year in Manhattan. The individual's appointment to the Agency was not approved by the Senate because of alleged financial wrongdoings. The suggestion, however, that this individual could represent the views of Park residents infuriated residents and legislators from the area. While no legislative changes in Agency membership have succeeded, proposals to increase local representation no doubt will continue to be made.

Other trends in legislation point out even more dramatically the tacit acceptance of the Agency. In 1974, legislation was introduced to abolish the intensity guidelines of the Private Land-Use Plan; in 1979 a bill proposed by the same legislators would have allowed two contiguous landowners to pool their development densities. Another bill submitted in 1979 would have allowed developers who had avoided environmentally sensitive areas a 20 percent increase in their allowed building density. Thus, new legislation reflects the desire for more subtle changes in the Act or Agency, making state control more palatable for local residents.

The most recent legislative events that suggest new attempts at cooperation between supporters of the Agency and Park residents concerns the way the Agency makes changes in its intensity guidelines. This legislation is being sponsored by local Adirondack legislators who have consistently opposed the Agency, and by legislators who are known as "friends of the Agency." This is the first time since the creation of the Agency that a bill initiated by local residents has been submitted by such a diverse group of legislators with the endorsement of the Agency.

A second area where the Agency has changed significantly is in its permit process. In the early days of the Agency there were great delays in issuing permits. This infuriated local residents attempting construction projects. In some cases, the permit review process was so lengthy that residents' plans could no longer be accomplished within the same short Adirondack construction season. Laws and regulations were enacted in 1979 to require the Agency to notify an applicant within 15 working days as to whether his application was complete or whether additional information was required. Within 90 days of the notice of a completed application, the APA must approve (with or without conditions) or disapprove a permit application. The median time for a permit decision for a single-family dwelling was reduced in 1979 to 19 days. The maximum time was 52 days. The mean time for a two-lot subdivision in 1979 was 17 days, while the major projects ranged from 1 to 170 days with a median time of 38 days (Adirondack Park Agency, 1979a).

A third area that illustrates the changes made by the Agency to assure its continued existence is the expansion of its work program outside the regulatory area. The Agency has now developed an expanded educational program on basic Park information. Although the Agency has always vowed that "the ultimate future of the Park rests in the hands of the residents and visitors," and that "it is an essential element of the Agency's program and responsibility to keep the public adequately informed as to the beauty and tranquility of the region," only recently has it had the luxury of allotting more staff time to this endeavor. Although in the past a staff person has theoretically been charged with "Park education," the major job of "Agency education" has been an all-consuming first priority. The continual controversy generated by misunderstandings, incorrect rumors, and an overly complex law, kept Agency personnel from pursuing any general education programs. Recently, however, significant new efforts have been made in education programs concerning the natural beauty of the Park, its fragile ecosystems, and its flora and fauna.

The Agency considers all these changes proof of its flexibility and will note with pride its overwhelming permit approval record; in 1979 of 381 applications submitted, only 6 were denied. These figures belie the fact that almost all permits have conditions attached which include: building setback, location of septic facilities, areas which may not be developed, etc. Many permits have more specific conditions. The role of a conditional approval on the quality of development is difficult to assess because the present permit system does not require notification once the project has been completed. In addition, the Agency is unable to determine how many project ideas were never submitted simply because of the existence of the Agency. According to Robert Flacke, the present Commissioner of the New York State Department of Environmental Conservation, the APA has discouraged "the fast buck developer" from considering the Adirondacks as a suitable target for easy profits (Flacke, 1978). The Agency also has no way of knowing how many proposals that are approved are scrapped because the sponsor finds the conditions attached to the permit unacceptable. The only sure way the Agency has of knowing that it has applied restrictions that are deemed to be excessive by the project sponsor is when the conditions result in litigation. This is relatively rare, however, because few Adirondack residents can afford the time and expense, or have the expertise, to pursue litigation.

Unfortunately, it is not only difficult to determine the negative impacts of the conditional permits on development, but it is also difficult to determine the effect of the conditions on safeguarding environmental quality.

Theoretically, the conditions result in setback from shoreline, proper placement of sewage facilities, etc., that will improve and protect environmental quality. Even if one assumes the conditions are rigorous and defined well enough to prevent environmental degradation, protection of environmental quality will occur only if the conditions are enforced. In reality, however, the Agency until very recently has had only one enforcement officer to cover the six million acres of Park land. In the words of one Agency official, "We just haven't had the time to follow up on our permits. Our enforcement officer has all he can do just to investigate the violations that are called in to the office."

The most critical test of the success of the Agency is its ability to get communities to develop local plans using Agency guidelines. After the Land-Use and Development Plan was adopted by the New York State Legislature in 1973, the Adirondack Park Agency had control over most planning activities and land-use decisions in the Park. The original intention, however, was for the state to form a partnership with the local governments. The APA statute provided for State assistance to local planning boards under the auspices of the Agency. The basic purposes of this provision were to increase the capability of local governments in the area of land-use control; to establish a two-tiered organization of land management and review of regional projects; and to provide a basis for amendment and refinement of the land-use map (Adirondack Park Agency, 1978).

The APA is willing to relinquish jurisdiction of some local planning decisions, but not until the municipalities have adopted a land-use plan that is consistent with the goals of the APA. In an effort to encourage local communities to work on land-use programs, the APA offers several incentives. When a town is granted APA approval, it benefits from refinement and redistribution of overall intensity guidelines and local review of Class B regional projects. There are also State funds available from the APA that have been specifically designated for use in the planning process by local governments. The Agency also offers its staff as a resource for technical information and advice.

The controversy and resentment that accompanied the creation of the Adirondack Park Agency was, for many years, the force behind the lack of local planning efforts. Adoption of an Agency-approved program was considered an endorsement of the APA and most municipalities made a concerted effort to avoid planning with the Agency. Through the years the need for local planning has become, for many towns, a more important issue than the existence of the Adirondack Park Agency. The number of planning boards has more than doubled since 1971, and many towns have developed master plans and/or subdivision regulations, sanitary codes, and zoning ordinances (Davis and

Liroff, 1978). The simple presence of regulations enforced by the state has had a tremendous impact on uncontrolled growth. Developers purposely limit the size of projects in hamlet areas so they will avoid classification as a regional project and the resultant review by the Adirondack Park Agency. The APA continues to be a subject at many local hearings, but the discussion usually centers on technical questions of Agency approval, monitoring, and the two-tiered partnership, rather than on the existence of the Agency. According to the Agency legal counsel, Robert Glennon, a new attitude has emerged: "Now that you're here, what can you do for us?" The conflict is far from resolved, but its effect on the local planning program has been greatly reduced.

Despite Agency encouragement and aid to local planning boards only seven towns within the Park have APA-approved plans that have also been adopted by their respective town boards. Sixty-eight of the remaining 100 municipalities have planning programs in various stages of completion. Not all of the municipalities presently working on land-use plans seek APA approval as the final goal. Some boards believe that they are writing a plan for their specific community and there is no benefit from APA approval. In some areas of the Park, opposition to the APA is still substantial, and any support of a conforming land-use plan is politically risky.

Allocation of local planning assistance funds has been based on community need and interest. Those communities which have received assistance to date are those with the largest permanent Park population, and the greatest number of regional projects. The correlations are not a reflection of conscious Agency policy, but the concern of local governments about development activity. The Agency does not expect to get 100 percent of the towns involved in land-use programs. Many of the towns do not have a great deal of development activity, and thus, the time and expense of preparing a plan may not seem beneficial.

The Adirondack Park Agency recognizes the need for continuing State commitment and aid to local planning programs. There are seminars for communities that presently have, or will soon have exclusive jurisdiction over Class B regional projects. These sessions give community officials an opportunity to apply regulations to actual Agency permit applications. There is also a special brochure outlining local planning authority, procedures, and technical considerations. These programs are aimed at making better use of natural resource information and the planning efforts that have been prepared by both the municipalities and the APA (Adirondack Park Agency, 1979a). They also represent a commitment by the State to a continuing state/local partnership in administering land-use programs in the Adirondack Park.

APA staff members involved with the local planning division believe that the views of Park residents is now at the point where even though they oppose the APA, they realize that planned development is important to their community. Ideally, an approved land-use program is to serve as the basis for a partnership between New York State and the local governments within the Adirondack Park. This partnership will help realize the goals set by the state for preserving the Adirondacks and, at the same time, help local governments plan and direct future growth and development.

While members of the Agency point to the increasing number of communities involved in Agency-sponsored local planning as an indication of increasing success, opponents of the Agency argue that the very fact that only seven communities have APA-approved local land-use plans after more than six years of effort points to failure. The recent trend in participation in APA local planning projects is given in Table 2. Also, a new strong environmental viewpoint has recently emerged to question what the Agency staff has been willing to give up in map amendments as a price to pay for local cooperation in Agency-sponsored land-use efforts. The entire question of local planning in the Park is one that must be followed closely over the next few years. Also of interest will be the development of new legal challenges to the Agency's power.

A regional planning agency with strong regulatory powers was an idea whose time had come in the early 1970s, but only was able to withstand the pressures to substantially weaken it because of a very politically powerful Governor. Interesting comparisons to this are the failure of the North Carolina State Legislature to enact similar legislation (Marden and Schwartz, 1980) and the failure of the Vermont legislature to pass density guidelines (Healy and Rosenberg, 1979), on a statewide basis. The APA was able to overcome the bureaucratic nightmares associated with learning to administer its complicated regulatory mandate. It now operates rather routinely on most regulatory questions. The extent to which the Act itself has either retarded development or preserved the environment is difficult to assess quantitatively, but most would agree that its permit process and conditional approvals have made some progress in preserving open space and protecting environmental quality.

Table 2

Status of Local Governments Assisted by Department of State or APA Planning Program

		December 31, 1978	March 31, 1980
A.	No specific program, contact ongoing through project review activities, county meetings, etc. (19 towns, 7 villages have plans or controls in effect).	32	24
B.	Initial contact made for specific planning programs.	10	8
C.	Contract, work started ("New" programs).	6	16
D.	Preliminary work (analysis) completed. Plan being prepared. Regulations and map amendments being considered.	18	15
E.	Planning elements completed.	26	25
F.	Local program approved by APA		
	1. APA approved, adopted locally	(5)	(7)
	2. APA approved, component adopted locally	(2)	(2)
	3. APA approved, program yet to be adopted locally	(2)	(2)
G.	Local program adopted by local government, program not submitted to or acted upon by APA.	4	5
H.	Local program component adopted by local government, program not yet submitted to or acted upon by APA	2	3
	TOTAL	107	107

Interesting areas for future study include the ability of the Agency to increase its planning partnership with local governments and the degree the Agency is willing to moderate its strong environmental concerns to succeed in this effort.

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ENVIRONMENTAL HEALTH

Vicki Kalmar Weisfeld, OPPORTUNITIES FOR IMPROVING THE ENVIRONMENT FOR HEALTH.

OPPORTUNITIES FOR IMPROVING THE ENVIRONMENT FOR HEALTH

Vicki Kalmar Weisfeld[1]

Abstract. *Selected opportunities are explored for making the human environment safer, more disease preventing, and more health promoting. The concept of risk factors and issues in disease prevention strategies for high-risk groups are discussed. Environmental educators' potential role in creating a more healthful environment is emphasized.*

The recent groundswell of interest in the United States in health promotion and disease prevention has been heightened by a number of factors: the identification of some risk factors for such major diseases as cancer, heart disease and stroke, which opens up the possibility of prevention; the public realization that medical care cannot cure many of these diseases, which emphasizes the critical need for prevention; and the rising cost of health care, which underscores that need. Interests in disease prevention and environmental issues share a fundamental origin--public concern for improving the quality of life. These two movements continue to overlap, primarily because so many disease risk factors are environmental. More than ever,

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[2]Certain specific preventive measures save many times their costs--immunizations, fluoridation, family planning, and a few others. But, at least in the short run, comprehensive disease prevention programs are likely to increase the nation's health care budget, by increasing direct costs for services aimed at prevention, while continuing to meet responsibilities to care for those who need medical treatment. However, successful preventive efforts might well reduce the indirect costs of illness--the loss of valuable goods and services that are not produced because the person who would have produced them was ill, injured, disabled, or died prematurely. In the very long run, successful prevention will increase the number of elderly individuals, who do make greater demands on national resources, including health care resources, and for whom planning in the social services and health sectors of society should begin now.

environmental educators have a potentially great and challenging role in health promotion and disease prevention efforts. This paper will try to identify some of these areas of opportunity.

Despite recent advances in scientific understanding, the precise environmental contributors to certain diseases are yet to be identified, and the means to determine the balance of preventive strategies that will work best in particular circumstances still must be developed. Some of these problems will be resolved through the results of biomedical research and some by ongoing discussions of appropriate environmental health policy. Environmental educators could play a pivotal role in such discussions.

Risks to Good Health

The current increased interest in disease prevention comes at a time when, by most standards, the U.S. population is healthier than it has ever been. An American born in 1900 could expect to live to age 47; one born in 1978 could expect a lifespan of over 73 years (U.S. National Center for Health Statistics, 1979). This increase in life expectancy at birth has been achieved largely by the conquest of most of the infectious diseases that used to kill infants and young children.

Today's leading causes of death are heart disease, cancer, stroke, injuries, and violence. These disorders have multiple, interacting causes; yet, they are not inevitable. Their prevention is a different and sometimes more complex matter than preventing the acute infectious diseases.

Each person faces a somewhat different risk of illness or injury. At birth, everyone has a certain likelihood of developing particular health problems because of heredity, the socioeconomic background of parents, and the health status, lifestyle, and care of the mother during pregnancy. Through life, the probability of experiencing health problems changes as circumstances change, becoming greater or lesser as people are exposed to varying environmental influences, adopt certain behavior patterns, and receive specific preventive health services.

The probability of acquiring disease or suffering an injury is influenced by "risk factors." For most serious diseases there are many risk factors. Certain factors--such as cigarette smoking or severe emotional stress--increase the likelihood of acquiring several different diseases. Many risk factors work together synergistically; an example is the greatly increased probability of death from lung cancer faced by asbestos workers who smoke cigarettes (Selikoff, Hammond, and Churg, 1968).

A better public understanding of the concepts of health risks is sorely needed--how risks interact, how to respond prudently to uncertainties, how to assess risks for an individual. Environmental educators who incorporate risk reduction concepts in their public education efforts are taking an important positive step.

Kinds of Risk and Their Amelioration

Biological Risk. In general, disease results from an interaction between an individual's unique genetic endowment and the total environment in which he or she functions. Heredity plays a part in the susceptibility to certain mental disorders, infectious diseases, and common chronic diseases, in addition to those disorders normally considered inherited. The relative contributions of genetic (intrinsic) and environmental (extrinsic) factors vary widely from condition to condition. The effects of past disease also may increase biological risk to subsequent disorders.

Environmental Risk

Factors in the physical environment that increase the risk of ill health include contamination of air, water, and food; workplace hazards; radiation exposures; excessive noise; dangerous consumer products; unsafe highway design; or urban congestion. During the past hundred years, human activities have changed the physical environment rapidly, much beyond the capacity of the human organism to respond with evolutionary adaptation. While much of this change is ordinarily considered desirable--and called "progress"--many new health hazards have been created thereby. Indeed, the very rapidity of change, as it affects basic human activities and relationships, itself may be a hazard (Levi, 1979).

The socioeconomic environment includes such factors affecting health as income level, housing, and employment status. The poor face more and different health risks than do people in the economic middle class, because of: fewer and poorer quality medical services, including preventive services; fewer options for coping with problems of all kinds; a more hazardous physical environment; greater stress; less education; and inadequate income to spend on good nutrition, safe housing, and other basic needs. A critical component of the socioeconomic environment that affects health is family structure. Abrupt changes in sociodynamics--such as the death of a spouse--create severe emotional stress and have been associated with physical illness and even premature death (Rabkin and Struening, 1976; Buell and Eliot, 1979).

Behavioral Risk. A continuing source of confusion about the contribution of the environment to the development of ill health has been the broad definition of environment used which encompasses all factors extrinsic to the individual, including "behavioral" factors. Thus, the commonly quoted estimates that up to 90 percent of human cancers and 80 percent of heart disease deaths are due to environmental factors include the contributions of diet, cigarette smoking, and alcohol use to disease rates.

Many of today's most serious health problems are linked with "excessive" behavior--too much smoking, drinking, and eating, driving too fast, or striving to achieve too much. Yet, even these behavioral responses have environmental substrates. The view that such factors are wholly under individual control is too simplistic. The health consequences of personal behavior choices often are not apparent. Even when the implications for health are clear, options are not always available, or healthful choices may be difficult to make--consider the trouble people have quitting smoking, or the peer pressures on adolescents to indulge in risky behavior. Personal behavior choices are made in the context of a social environment that glamourizes excessive behavior through advertising, the mass entertainment media, and other, more subtle means. Society supports industries producing unhealthful products, has enacted or enforced laws against certain behavior unevenly, has provided ambiguous messages about the kinds of behavior that are acceptable and has not ameliorated some of the socioeconomic and other stressful conditions that foster unhealthy decisions.

Still, the emphasis on personal responsibility for health is in many ways a positive step toward helping people recognize their own role in maintaining good health. A societal commitment to take supportive environmental actions and provide appropriate preventive personal health services, particularly for those individuals and population groups most in need, is also essential.

Personal Health Services. Inadequate personal health care services, or inadequate access to them, can put people at greater risk of ill health.[3] Leading examples of preventive personal health services are immunizations (primary prevention) and screening for disease (secondary prevention).

Environmental approaches to health promotion and disease prevention have a proven record of success and great potential for future benefits, partly because they are "passive" and do not depend on individual responses.

A Safer Environment

"Accidents"--a misnomer, according to injury control experts--are often believed to be isolated random events that occur by bad luck or fate. In fact, many injuries can be avoided through changes in environmental conditions or agents (primary prevention), or the injuries sustained can be reduced by environmental modifications (secondary prevention).

In the United States in 1978, there were an estimated 107,930 deaths from unintentional injuries (about half of which involved motor vehicles) and 48,580 deaths from homicide and suicide (U.S. National Center for Health Statistics, 1979). Injuries are the leading cause of death for Americans between ages 1 and 42; among those 15 to 24, almost 75 percent of deaths are from injuries. In addition, over 74 million nonfatal injuries occur annually (U.S. National Center for Health Statistics, 1978). Injuries cost the nation over $62 billion in 1977, not including costs for police and fire department protection (National Safety Council, 1978).

Most of the effective measures for preventing injuries involve changes in the manmade environment that automatically protect everyone--even people who make mistakes or fail to take adequate precautions--such as insulated tools, childproof medicine containers, or nonlead base paints (Baker and Dietz, 1979).

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[3] Primary prevention includes activities that promote health or are undertaken prior to the development of disease or injury, such as immunizations or automobile speed limits. Secondary prevention includes the detection of disease in early (asymptomatic) stages and intervention to arrest its progress--for example, screening for incipient hypertension or for precancerous changes in cells of the cervical epithelium. Tertiary prevention involves intervention after the development of a clinically manifest disease in order to reverse, arrest, or delay its progression--for example, administration of phenothiazines to prevent the recurrence of schizophrenic episodes (Task Force on Theory, Practice, and Application of Prevention in Personal Health Services, 1976).

Motor Vehicle Injuries (53,610 deaths in 1978; 1.9 million disabling injuries in 1977). One approach to preventing vehicle collisions is to reduce the number of miles traveled by automobile through encouraging use of safer modes of transportation--air, rail, or bus. Lower speeds reduce both the number and severity of crashes; the national 55 mph speed limit has been credited with saving an estimated 5,000 lives each year.

Impact-absorbing automobile bodies and padded passenger compartments reduce injuries when a collision occurs. Small cars are involved in more frequent collisions and--when crashes occur--the risk of injury and death is greater (Robertson and Baker, 1975). Use of combined lap and shoulder belts reduces the likelihood of serious injury or death by about 60 percent. The best protection for infants and small children is to ride in the back seat, restrained in an infant carrier, child car seat or safety harness, although adult seat belts are preferable to no restraint (Insurance Institute for Highway Safety, 1976). The failure of educational efforts to persuade people to use restraints for either themselves (less than 20 percent of U.S. adults consistently use seat belts) or their children requires development of passive protection devices.

Highway design features can reduce the likelihood of crashes or injuries by decreasing demands on drivers and removing roadside hazards. The interstate highway system has a death rate of 1.4 per 100 million vehicle miles, compared with an overall average of 3.4 per 100 million miles, by eliminating crash-precipitating features. Many preventable deaths and injuries are caused when vehicles leave the roadway and overturn, or strike trees, embankments, or nonyielding structures, such as bridge abutments.

Firearms (31,000 deaths in 1976; estimate of injuries, from 18,000 to over 100,000 annually). Reducing the availability of firearms, particularly handguns, would reduce the number and severity of personal injuries (Mahler and Fielding, 1977; Browning, 1976; Newton and Zimring, 1969); either assaults or suicide attempts are less likely to be fatal if attempted without firearms, and firearm accidents also would decrease. Nonlethal bullets, such as those developed for police use in crowd control, are suitable for most private handgun use, but do not put handgun owners and their families at risk of death or serious injury.

Falls (15,000 deaths and 14 million injuries annually). Environmental measures to prevent injuries from falls can focus either on preventing the fall itself--by attention to safer walking surfaces and footgear, better illumination, handrails, and window guards--or on reducing the potential for injury--by reducing the distance people fall (safety nets for construction workers) or by modifying the surfaces they fall against (heavily padded carpeting, rounded edges and corners on furniture).

Violence (27,500 suicides and 21,080 homicides in 1978). Violent acts are more prevalent in the United States than other developed countries; why this is true is more complex and subtle than the explanations commonly offered. Eliminating alcohol abuse would significantly reduce the amount of violence; eliminating guns would reduce its severity. Emphasis on violence as an injury control problem makes it a matter of concern to health professionals and health educators, as well as law enforcement officials.

Suicide. In the United States, self-destruction is accomplished principally through firearms, drugs, and motor vehicle exhaust gases. Preventing suicide depends on changing the environmental factors that cause severe personal distress, providing social supports for individuals and families, and making the means of accomplishing self-injury less accessible. It is not true that a person considering suicide will find the means to do so, regardless of preventive measures. In England, when the carbon monoxide content of gas piped to homes was reduced, both accidental deaths and suicides dropped markedly. What had been the most common means of committing suicide was almost eliminated--without a compensating increase in suicide by alternate means (Hassall and Trethowan, 1972).

A Disease-Preventing Environment

Some environmental actions to prevent disease have been extremely successful. They are the most promising approach to preventing occupation-related disorders and perhaps some forms of nonoccupational cancer. However, numerous contentious public policy questions surround these prevention efforts. One deserving special consideration results from the increasing ability to identify people at genetic risk of acquiring disease when exposed to a harmful environmental agent. These subjects are discussed in this section in the context of specific examples.

Fluoridation--A Successful Environmental Strategy for Preventing Disease

Evaluations of two decades of U.S. experience with controlled water supply fluoridation conclude that few public health measures have been as unequivocally effective against widespread disease (Walsh, 1977). Fluoridation has proved to be a safe, inexpensive and highly beneficial preventive measure. Nevertheless, half of the U.S. population does not drink water containing optimal amounts of fluoride. Because fluoridation depends on community interest and support, and must compete for limited public funds, effective community education regarding this prevention strategy is required (Nightingale, Cureton, Kalmar, and Trudeau, 1978).

Reducing Workplace Health Hazards

Occupation-related disorders are almost wholly preventable. The populations involved are (or could be) relatively well defined. The hazards to which they are exposed are (or could be) enumerated and measured. The knowledge gained by studying workers' health experience has potential usefulness beyond its immediate application in the workplace. The occupational environment is a natural laboratory for assessing the potential effects of hazards on the general population, which is exposed to many of the same agents, although in much smaller doses.

Occupational exposures to toxic chemicals and physical hazards (noise, radiation, sunlight, vibration) can produce long-term damage to the brain and other critical organs, or produce cancers, birth defects, or genetic changes transmissible to future generations. Exposures can also increase the frequency of stillbirths, spontaneous abortions, reduced fertility and sterility. Occupational stress has measurable deleterious effects on health (Caplan, Cobb, French, et al., 1975; Zaleznik, Ondrack, and Silver, 1970; and U.S. Department of Health, Education, and Welfare, 1973).

Each year 100,000 Americans die from occupational illnesses, and 390,000 new cases are recognized. However, the true extent of occupational disease is undoubtedly much larger because the link between job and disease is often unrecognized or unreported.

Occupational hazards can be controlled through modifications of work environments or modifications directed at workers and their behavior, or some combination of these. Modification of work environments--the manufacturing plant, processes, and materials used--is probably the best long-term approach and for known hazards is essential. These preventive strategies rely heavily on the efforts of employers, but also need the support of employees, unions, environmental educators and health professionals, bolstered by government regulatory actions.

As with preventing injuries, passive protection is more likely to be effective. Personal protective equipment is often uncomfortable or otherwise inconvenient for workers to use. Differential pay for jobs deemed more hazardous, or allowing overtime work in hazardous jobs, requires employees to choose between long-term risk to health and immediate financial benefits. Likewise, if hazardous industries are concentrated in one geographic area or located in otherwise economically depressed communities, workers attracted by relatively good pay and steady employment have little choice about refusing risky jobs.

The Occupational Safety and Health Act of 1970 mandates that workers be protected from workplace hazards, but implementation of the law has been slow and has yet to affect occupational health in the United States substantially (U.S. General Accounting Office, 1977).

Technologies to monitor exposures and control known or putative hazards continue to be inadequate to the needs of modern industries, which use more than 30,000 chemicals and multiple sources of physical energy--microwaves, nuclear isotopes, lasers, and ultrasound. Unless exposures are monitored, the extent of any hazard posed by these agents, either alone or in combination, will be nearly impossible to assess. Those professionals concerned about health hazards in the environment must keep the demands for information about exposures strong.

Identification of People at High Risk

A rapidly growing area of scientific research, which holds great promise for the prevention of some environment-related disorders, examines the way environmental exposures produce different effects in different individuals, due to variations in genetic susceptibility. As an example of the potential application of such knowledge to disease prevention, people with a genetically determined deficiency of the alpha-1-antitrypsin enzyme are especially susceptible to pulmonary emphysema (Bodmer and Cavalli-Sforza, 1976; Vogel and Motulsky, 1979). These people, for whom heightened health risk can be demonstrated, may be responsive to targeted anti-smoking education efforts and should be informed about avoiding other respiratory hazards.

There are many practical problems associated with the ability to identify people at risk. People might rather not know their risk status (Kolata, 1980a), or employers might use this information to deny work opportunities to particularly susceptible people, rather than eliminating a hazard. (In recent years, some industries using lead have denied at least certain kinds of jobs to nonsterilized women of childbearing age.) Individuals probably have a rather wide range of responses to an environmental hazard. Simplistic disease prevention policies, such as job prohibitions, therefore not only raise right-to-work issues, but also may be scientifically unsound.

Other related problems which apply to the field of toxicology in general are raised by the capacity to detect minute quant[illegible] of substances (in parts per trillion in some cases and the necessity of using animals to test possible hazar[illegible] substances. The former capacity can create almost insurm[illegible]able control problems if an absolute prohibition of a substance is required by law. In animal tests, interspecies differences may produce misleading results. Some industries, fearing increased regulation, have fostered public skepticism about animal testing by funding expensive, well-organized advertising campaigns cynically supporting "free choice." These self-serving campaigns undermine the public's general ability to evaluate risk and take prudent actions. Targeted disease prevention efforts, based on genetic differences, may not prompt such strong reactions.

A Health-Promoting Environment

Environmental educators and health professionals concerned about the environmental context of disease and injury should also consider the environment's potential to promote and protect health.

The socioeconomic environment is a major factor in health promotion and protection, and a social action component is a necessary part of any comprehensive health promotion program (Institute of Medicine, 1978). This imperative arises from the social history of the United States, which has produced numerous disadvantaged population groups. In the past, these groups have been chiefly poor and minority peoples. Today, elderly citizens constitute an additional, large number of neglected (and poor) people; the number of illegal aliens has increased; and children who receive inadequate care are a frustratingly large portion of those with preventable developmental disabilities. Disadvantaged groups have long found traditional, curative care services inaccessible because of financial, language, and other barriers. Medical and dental services that emphasize prevention are even more difficult for them to obtain.

Today most microbial disease agents, as well as many physiochemical agents, are nearly ubiquitous. Yet, all people exposed or with a recognized risk factor (including genetic susceptibility) may not develop overt disease (Kolata, 1980b). An explanation for this variability that has gained credence in recent years is that certain aspects of the social environment affect the etiology of disease (Cassel, 1975).

In numerous epidemiologic studies that have employed varying designs and that have used different populations, health outcome measures, and stress indicators, there have been shown to be a wide variety of physical and mental disorders whose onset seems to be precipitated by environmental stressors (such as moving or unemployment). The degree of a community's social disintegration, a family's lack of social supports, and the number of stressful events in the life of an individual have been found to affect illness-related work and school absences (Cassel and Troler, 1961; Downes, 1945), the occurrence of complications of pregnancy (Nuckolls, Cassel, and Caplan, 1972), and life expectancy (Berkman and Syme, 1979). The latter finding, in which people who were most isolated had a 2.3 (for men) or 2.8 (for women) times greater chance of dying during the nine-year study period than those with more extensive social contacts, was independent of self-reported physical health status, socioeconomic status or health practices (cigarette smoking, consumption of alcoholic beverages, obesity or others).

Although a long-range goal must be to improve the general social environment and reduce undesirable psychosocial stressors, a more feasible immediate goal is to provide social supports and improve access to them. Educators and health professionals can become more aware of available sources of social support and use them to benefit their clients or patients. They also can work for public policies that strengthen or encourage the development of natural support systems, particularly the family. Natural support systems may be effective in mediating stress and also can be a major influence on the use of health services and in gaining compliance with medical regimens (Hamburg and Killilea, 1979).

Conclusion

This paper has only begun to explore the challenge of preventing disease and injury and promoting health through environmental actions. The timing for a comprehensive national program in this area is probably inauspicious, inasmuch as the costs of environmental control are now more readily demonstrated and more vociferously opposed than the potential benefits are supported. These benefits can be more firmly established through biomedical and toxicological research on environmental hazards, epidemiologic research on exposed human populations, cost-benefit analyses with regard to existing hazards, technology assessment of potential new hazards, and public policy research on alternate means to achieve environmental health goals. The effort to gather information about environmental hazards, forecast their effects or calculate the preventable portion of the nation's disease and injury rates--in fact, any effort to study the future--is justified only by the ameliorative actions that such investigations prompt.

As this paper has demonstrated, many activities that would improve the environment for health are relatively modest. Broad changes in society at large are another matter. Yet, the lack of these changes cannot be ignored as a cause of ill health. Nor need this causal relationship be indirect. The present unstable world political situation can indeed be expected to affect the incidence of stress-related disorders, but much more importantly, it directly affects the probability of survival of humans and their environment. For that reason, preventing nuclear war, possibly "the most important public health problem in all of history" (Hamburg, 1979), is also an environmental health problem of the greatest significance.

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ATTITUDES, VALUES, JUDGMENTS, AND AWARENESS

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MEASURING ATTITUDES TOWARD ENVIRONMENTAL ISSUES: THE SEMANTIC DIFFERENTIAL TECHNIQUE. THE CASE OF HUNTING

Lei Lane Burrus-Bammel[1]

Abstract. *Data generated from 48 hunters, 47 nonhunters, and 38 anti-hunters were analyzed by an Euclidean "D" formula, chi-square test, and a sign test of probability. Results indicated an overall significant difference (.05) between groups in response toward a possible object of a hunt and the activity of hunting. Both a "Semantic Geography Model" and profile patterns illustrated this attitude difference.*

Statement of Objectives

The major objectives of the investigation were twofold: first, to determine whether or not the semantic differential (S.D.) would be a useful technique for wildlife and other environmental attitude studies, and second, to determine whether or not hunters, nonhunters, and anti-hinters would vary in response toward a possible object of a hunt (white-tailed deer, Odocoileus virginianus) and the activity of hunting.

Introduction

The hunter has been stereotyped as callous, illiterate, blood thirsty, and sexually inadequate, while the antihunter has been viewed as neosentimental, illogical, naive, and biologically ignorant (Shaw, 1975:6). Research data indicate that one's view of hunting is related to gender, that childhood and adult hunting behaviors are correlated, and that there is some debate over whether place of residence during childhood relates to adult hunting participation (Sofranko and Nolan, 1972; Hendee and Potter, 1975; Kellert, 1976). These studies found that certain factors do or do not correlate with one's position on hunting, but they do not inform the reader as to the specific values, beliefs, or attitudes held by various groups.

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Hunting attitude studies have been rather limited in scope, often restricted to current user groups reflecting upon game regulations (Eisele, 1973), effects of hunter density (Kennedy, 1974), accessibility (Potter, et al., 1973), or reasons for hunting (More, 1973). Fewer investigations have considered attitudes towards animals to determine how they are perceived and treated (Kellert, 1975). The majority of research has centered on identifying and describing various groups such as Texas hunters (Berger, 1974), Nevada hunters (Garrett, 1970), Michigan shooting preserve users (Greene, 1970), Maryland forest hunters (Kennedy, 1974), and Maine sportsmen (Lobdell, 1967). Hendee and Potter (1971:387) commented that "even with the best methodology, the potential contributions of purely descriptive hunter studies are limited and leave more important questions unanswered."

Hunting proponents are concerned with the activity's longevity. This concern might be due to reports that list the proportion of hunters among all outdoor recreationists as decreasing (Hendee and Potter, 1971) and the antihunting sentiment in the general population as increasing (Applegate, 1973, 1975).

Methods

Wildlife and other environmental studies have been primarily limited to agree/disagree or Likert-type questions (strongly agree, agree, undecided, disagree, strongly disagree) (Edwards, 1957:149-152). The first type has a narrow response range that limits the sensitivity of the technique. There is serious doubt that the distance between the possible Likert responses (foils) represents equal intervals. This problem is intensified when values are assigned for quantitative purposes (i.e., strongly agree = 1, agree = 2, strongly disagree = 5). The previously mentioned problems are avoided with the S.D.; it is a quick, efficient means of getting quantifiable responses from large sample, it represents a standardized technique, it can be easily replicated, and it facilitates the responses of subjects who may not be too articulate in describing their reactions (Mindak, 1961).

There are three stages to constructing the S.D. technique: 1) determine the concept or words to be evaluated; 2) select the polar adjectives (e.g., good-bad, strong-weak, active-passive); and 3) establish the desired number of undefined scale positions. Polar adjective pairs can be selected from Osgood's Factor Analyzed List, which contains 76 pairs (Osgood, et al., 1957:53-61).

Factor analyses indicated that semantic space was multidimensional (Osgood, et al., 1957). However, dimensions were neither equally important nor equally effective in differentiating among items judged. The three most dominant factors were evaluative, potency, and activity. Usually, three polar word pairs are selected to represent each of these three important factors. Selected word pairs should have maximum loading for one of the three factors and be low on the others (Figure 1). Loading information for 76 standardized polar pair adjectives can be found in Osgood's Factor Analyzed List (Osgood, 1957:53-61).

	Evaluative	Potency	Activity	Others
good-bad	1.00	.00	.00	.00
masculine-feminine	-.14	.47	.03	.16
active-passive	.17	.12	.98	.00

Figure 1. Example of factor loading for three commonly used polar pairs.

Word placement varied so that one end of the scale would not contain all of the favorable, potent, or active meanings, thus avoiding position habits (Figure 2). The seven scale positions can be scored from right to left +3, +2, +1, 0, -1, -2, -3 or +1 to +7.

Printed on the questionnaire were the following directions: "For each pair of words, place a check at a point on the line which best matches your feelings about the subject in capital letters."

HUNTING

good	___:	___:	___:	___:	___:	___:	___:	bad
feminine	___:	___:	___:	___:	___:	___:	___:	masculine
passive	___:	___:	___:	___:	___:	___:	___:	active
wise	___:	___:	___:	___:	___:	___:	___:	foolish

Figure 2. Example of varied word positions.

Administration of a 100-item S.D. questionnaire (e.g., ten concepts, ten scales each) should take 10 to 15 minutes. Standardized techniques have been utilized to establish reliability and validity measures (Snider and Osgood, 1969).

Results

Questionnaire responses from 134 West Virginia University students were separated into three classifications: hunters (n = 49), nonhunters (n = 47), and antihunting (n = 38). The most common method of data manipulation is profile analysis. Profiles are formed by plotting group mean responses for each polar word pair (Figures 3 and 4). The probability that all response means of one group would consistently fall to one side of all response means of another group (no crossover patterns) is P = .001 (Isaac and Michael, 1971:105). This was the case when hunters were compared to either nonhunters or antihunters on the concept "hunting" (Figure 3). Chi-square frequency comparisons were made among the groups in order to determine whether or not the groups varied on the total "concept," all word pairs (Table 1), and which polar word pairs, if any, were significant indicators of attitude differences (Tables 2 and 3). The chi-square test showed that each group significantly (.01 or .05) varied from the others on each of the concepts (white-tail deer and hunting) when all scales (word pairs) were considered (Table 1).

Plotted average evaluative, potency, and activity values (Table 4) for each group on each concept will yield a model of semantic space (Figure 5). Once again a chi-square test of significance can indicate existing between-group differences on the three isolated factors (E, P, A). Groups significantly (.01) varied on evaluative and potency factors of hunting (Table 5). Only hunters vs. nonhunters significantly (.05) varied on the factor of activity.

Between-group and between-concept differences can also be established by inserting the three factor values (Evaluative, Potency and Activity) in a generalized linear distance formula. The greatest Euclidean (linear distance) diffrence between groups occurred when those with antihunting sentiments were compared with hunters (D = 3.67) (Figure 5). The distance between the hunters and nonhunters (D = 1.64) was less than the distance between the nonhunters and those with antihunting sentiments (D = 2.29). The distance between the two concepts, white-tailed deer and hunting, increased from hunters (D = 1.6), to nonhunters (D = 2.37), to those opposed to hunting (D = 4.21) (Figure 5).

Figure 3. Profile Analysis of "Hunting"

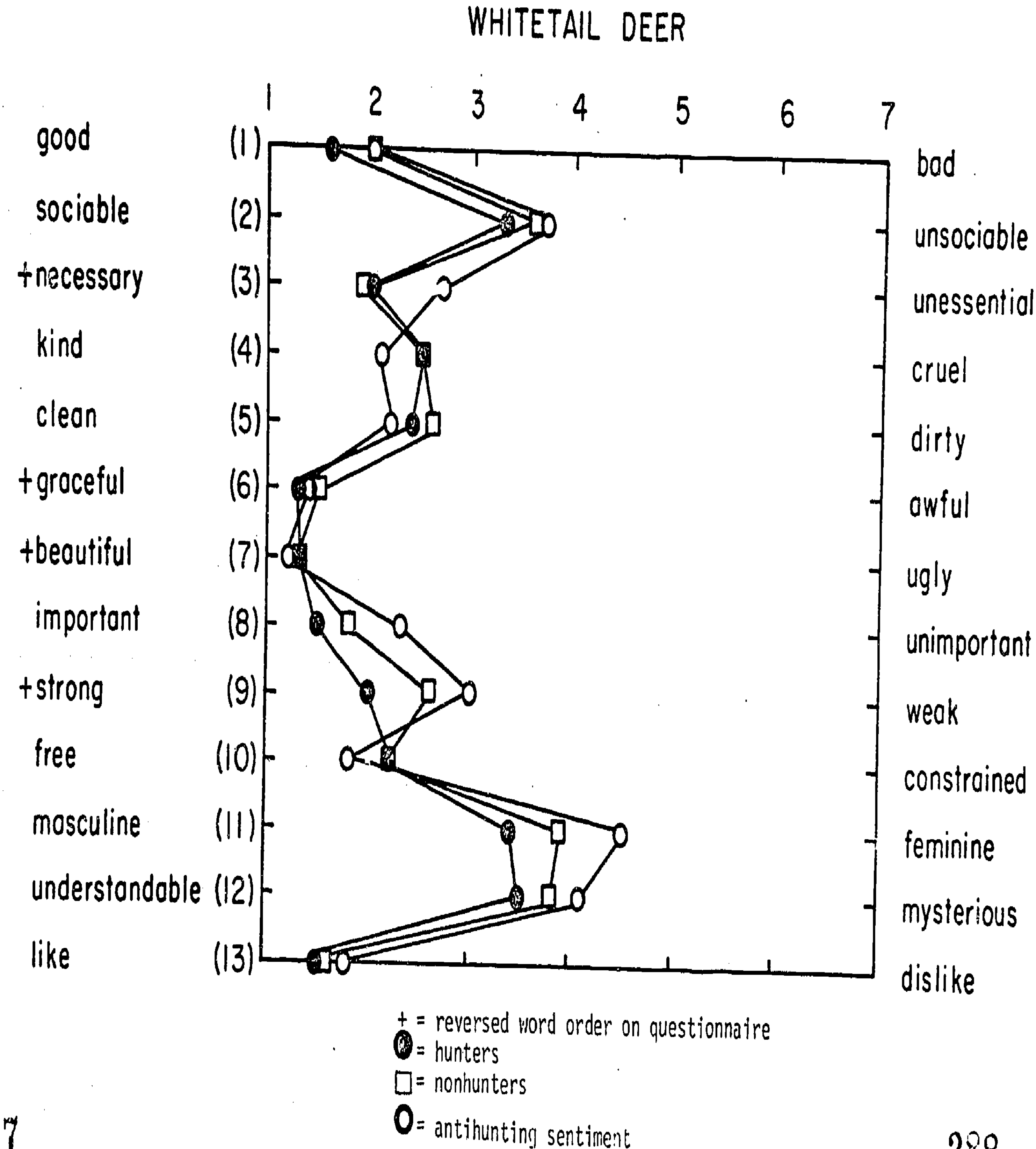

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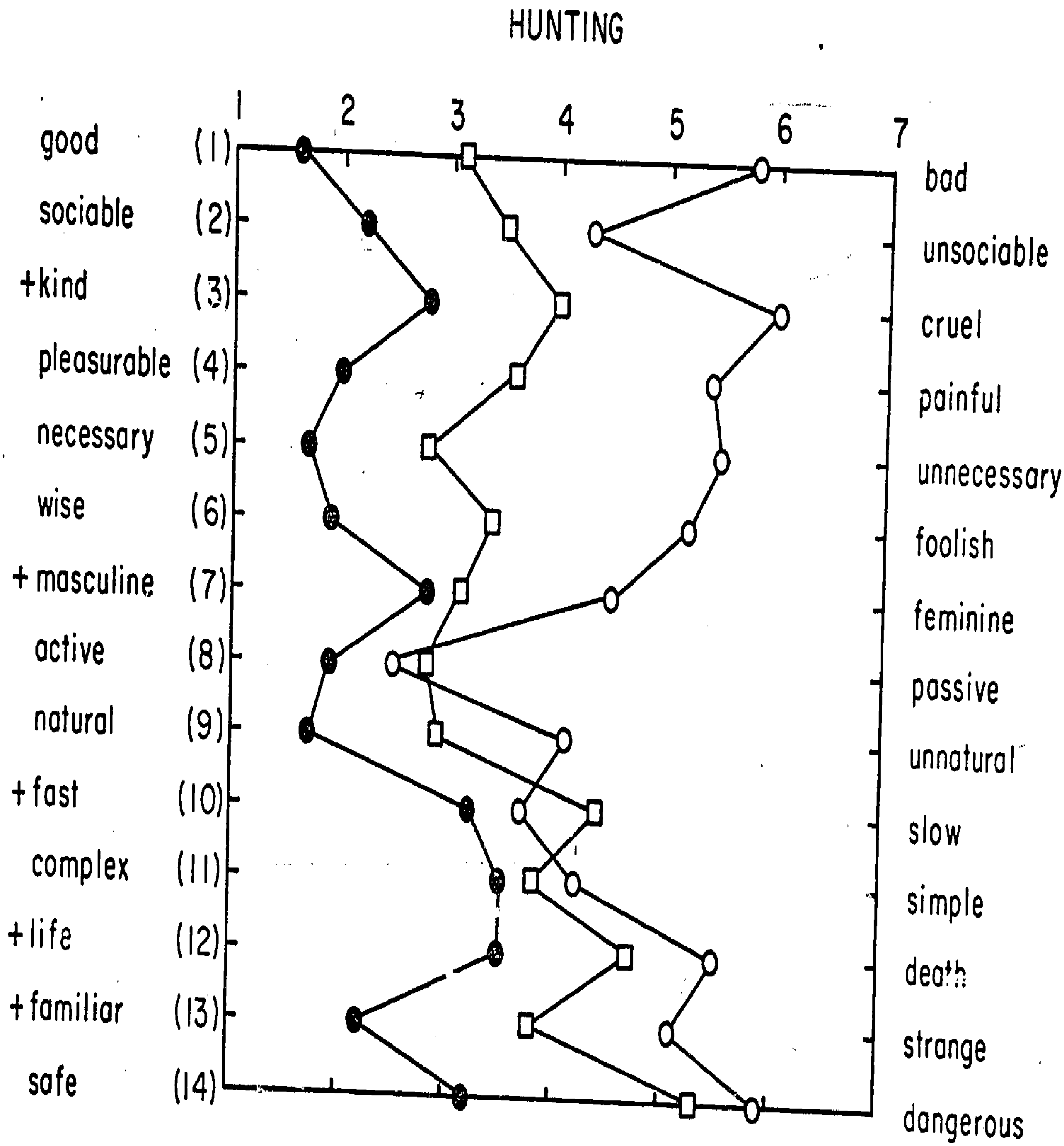
Figure 4. Profile Analysis of "White-tailed Deer"



+ = reversed word order on questionnaire
● = hunters
□ = nonhunters
O = antihunting sentiment

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Table 1. Between group chi-square values

Hunters vs Nonhunters				Nonhunters vs Antihunting				Antihunting vs Hunters			
x^2	df	N_1	N_2	x^2	df	N_2	N_3	x^2	df	N_3	N
Hunting											
126.49[a]	6	669	637	71.43[a]	6	637	507	27.98[a]	6	507	699
Whitetail deer											
15.69[b]	6	608	550	13.31[b]	6	550	474	16.88[a]	6	474	608

a Significant at $p < 0.01$, 6 df 16.812
b Significant at $p < 0.05$, 6 df 12.592

N_1 = Hunters
N_2 = Nonhunters
N_3 = Antihunters

Table 2. Between group chi-square "whitetailed deer" polar pair analysis

Word pair	Hunters vs nonhunters				Nonhunters vs antihunting				Antihunting vs hunters			
	x^2	df	N_1	N_2	x^2	df	N_2	N_3	x^2	df	N_3	N_1
1	9.01	4	48	44	1.98	4	45	38	9.84	4	38	48
2	5.07	6	47	43	.93	6	43	38	1.75	6	28	47
3	9.59	5	46	45	9.06	4	43	25	16.94[a]	5	25	46
4	1.00	5	47	42	3.89	5	45	37	2.98	5	37	47
5	5.81	5	46	42	3.36	5	42	37	6.61	5	37	46
6	5.59	4	46	41	4.24	4	41	36	4.17	4	36	46
7	5.50	4	46	45	5.48	3	45	36	2.52	4	36	46
8	6.35	5	46	43	5.50	5	43	37	5.38	5	37	24
9	9.15	6	45	44	4.49	6	45	38	12.83[b]	5	38	45
10	3.62	6	47	39	12.79[b]	6	39	37	7.41	6	35	47
11	9.49	6	45	44	6.19	6	44	38	18.14[a]	6	38	45
12	13.90[b]	6	47	43	12.94[b]	6	43	36	8.11	6	36	47
13	4.67	4	46	44	10.07	4	44	35	4.56	4	35	46

a Significant at $p < 0.01$, 6 df 16.812, 5 df 15.086

b Significant at $p < 0.05$, 6 df 12.592, 5 df 13.388

N_1 = Hunters
N_2 = Nonhunters
N_3 = Antihunters

Table 3. Between group chi-square "hunting" polar pair analysis

Word pair	Hunters vs Nonhunters				Nonhunters vs Antihunting				Antihunting vs Hunters			
	x^2	df	N_1	N_2	x^2	df	N_2	N_3	x^2	df	N_3	N_1
1	27.40[a]	5	49	47	43.84[a]	6	47	37	67.51[a]	6	37	49
2	27.04[a]	6	47	47	14.09[b]	6	47	38	25.98[a]	6	38	47
3	19.40[a]	6	47	44	36.38[a]	6	44	37	50.57[a]	6	37	47
4	28.72[a]	6	47	46	29.33[a]	6	46	37	44.69[a]	6	37	47
5	15.56[a]	6	48	47	37.17[a]	6	47	37	62.00[a]	6	37	48
6	28.60[a]	6	48	47	27.51[a]	6	47	36	58.90[a]	6	36	48
7	1.94	4	47	46	4.12	4	46	37	2.41	4	37	47
8	12.15[b]	5	45	46	4.16	5	46	36	11.40[b]	5	36	45
9	23.79[a]	6	47	47	14.42[b]	6	47	36	45.55[a]	6	36	48
10	17.64[a]	6	42	45	6.79	6	45	36	7.50	6	36	42
11	18.94[a]	6	45	46	10.96	6	46	35	7.21	6	35	45
12	10.72	6	45	46	6.67	6	46	36	24.01[a]	6	33	45
13	30.01[a]	6	47	47	17.86[a]	6	47	32	41.72[a]	6	32	47
14	33.43[a]	6	46	46	8.10	5	46	37	41.39[a]	6	37	46

a Significant at $p < 0.01$, 6 df 16.812, 5 df 15.086

b Significant at $p < 0.05$, 6 df 12.592, 5 df 13.388

N_1 = Hunters
N_2 = Nonhunters
N_3 = Antihunters

Table 4. Mean group values on the semantic differential's major factors

	White-tailed deer			Hunting		
	Evaluation	Potency	Activity	Evaluation	Potency	Activity
Hunters	2.1	1.5	2.2	1.9	1.2	1.6
Nonhunters	1.9	1.1	2.2	.5	.9	.3
Antihunting	1.9	1.9	1.8	-1.3	1.9	1.8

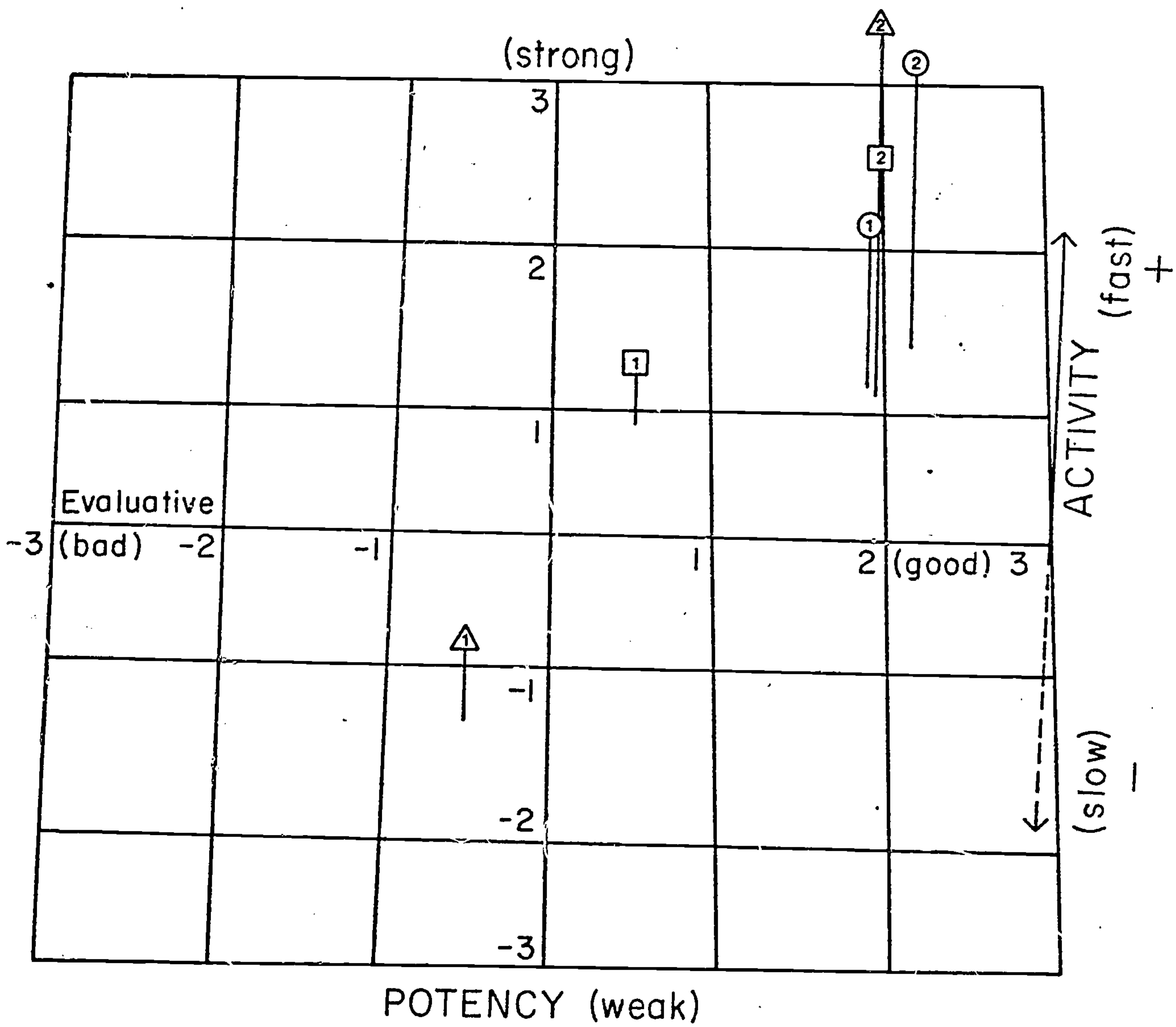
Table 5. Between group differences on semantic properties of hunting

	Hunters vs nonhunters				Nonhunters vs antihunting				Antihunting vs hunters			
	x^2	N1	N2	df	x^2	N2	N3	df	x^2	N3	N1	df
Evaluative	32.78[a]	47	45	3	33.02[a]	45	37	4	68.11[a]	37	47	6
Potency	50.0[a]	47	45	4	44.82[a]	45	37	3	53.94[a]	37	47	3
Activity	9.59[b]	47	45	4	1.12	45	37	3	7.43	37	47	4

a significant at $p < 0.01$, 3 df 11.34, 4 df 13.28, 6 df 16.81

b significant at $p < 0.01$, 4 df 9.49

Figure 5. Three Dimensional "Semantic Geography" of the Terms Hunting and White-tailed Deer*



*The beginning of the line is located on the Evaluative-Potency plane, the solid line indicates the relative Activity value between 4 and 7.

1 = Hunting

2 = White-tailed deer

○ = Hunters

□ = Nonhunters

△ = Antihunting sentiment

Discussion

Hendee and Potter (1971:383) expressed concern about applying appropriate behavioral research skills to wildlife-people problems. Biologically trained wildlife personnel usually are not equipped with necessary specialized social research skills.

> A first reflection of broadened professional education might be a change in the appalling scarcity of articles in wildlife journals on human behavior aspects of wildlife (Hendee and Potter, 1971:391).

The semantic differential technique can indicate significant differences within and between various groups and demonstrate which specific items contribute most to the variance. Those data can be analyzed in several ways depending upon the situation and the objectives. The important aspect is that specific "meaning" can, in various dimensions, be attached to either an animal or an activity, whereas the common scales (Likert type) used in wildlife and other environmental attitude studies, produce one-dimensional data, i.e., agree/disagree or good/bad. Open-ended questions, which are also frequently applied to wildlife studies, cannot validly be quantified with equal intervals between various responses. This is not a problem with the S.D. Another common technique is the interview, but large blocks of time are necessary, the answers are somewhat dependent upon the subject's verbal ability, and there are the additional problems of interviewer bias and the subject reporting what is either socially acceptable or what the person thinks the interviewer wants to hear.

The S.D. analysis demonstrated that although the three groups had similar overall responses to "deer" (Figure 4), they significantly (.05 or .01) varied (Table 1). The hunters responded near the neutral position on the hunting life-death polar word pair (Figure 3) which supports other studies which indicate that the kill is only one of the reasons for hunting (Hendee and Potter, 1975). It might be that hunters have become defensive and that there is a difference between what they actually feel and what they report. Research has pointed out that what people say they do differs from that they actually do. Attitudes could be subject to the same reporting, specially on controversial topics.

Hendee and Potter (1975:148) pointed out that managers and hunters would be able to "minimize their vulnerability to criticism" by "knowing more about the basis for antihunting sentiment." Game managers and hunters concerned with improving public opinion should note that hunting Item 14, safe-dangerous, was significant (.01) in two of the three comparisons (Table 3). Danger might have been viewed in terms of human, animal, and/or property damage. This type of attitude might be changed through use of the media. Shaw and Gilbert (1974) found that television equalled personal experience as the major influence contributing to antihunting sentiment; movies were fourth and magazines fifth. One could survey various groups to determine points of difference on specific issues and then plan an appropriate communication program to either educate or propagandize.

Deer polar word pair 12 (understandable/mysterious), was the only item which significantly (.05) differentiated hunters from nonhunters and nonhunters from antihunters (Table 2). Kellert (1976:37) found that hunters revealed greater knowledge of animals. That could explain why those who opposed hunting scored the deer more toward the mysterious and weak end of the scale than did either hunters or nonhunters. Obviously those with an antikill attitude would view the prey, subjected to technological advances in weaponry, as being overpowered, while hunters might have been impressed with the strength factor which allows winter survival and swift travel.

The S.D. has had widespread application in many fields and it seems, from this investigation, that the technique can supply needed attitudinal information as well and establish semantic interpretation of wildlife activities and environmental concerns. S.D. surveys could illustrate and quantify attitudes, both in order and with the amount of distance between rankings.

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MAKING VALUE JUDGMENTS: A QUESTION OF COGNITIVE DEVELOPMENT?

Anton E. Lawson[1]

Abstract. *A significant percentage of students fail to make the transition to the formal stage of cognitive development during adolescence. This failure may limit one's ability to make well-reasoned value judgments. Instruction to enhance this ability may have to take into account the limitations of concrete thinkers to be successful.*

Introduction

A major aim of environmental education is to develop students who, as future participants in a democratic society, will make informed, well-reasoned decisions when faced with difficult environmental issues. Hence a major concern of environmental educators is to develop educational programs and teaching techniques for doing so. Needless to say, the environmental educator faces an extremely difficult task. The intent of this paper is to identify key variables that influence a person's behavior in environmental decision-making situations and to discuss in some detail what is presently known about one of those variables-cognitive level. Implications for educational practice will also be discussed.

Important Variables

What variables influence environmentally responsible behavior? Roth (1979) argues that one of the most significant variables is what the student knows, in other words the understanding of relevant concepts divided into categories such as ecology, economics, politics, adaptation, and psychology. Borden and Schettino (1979) tested the hypothesis that factual knowledge and feelings are independent variables both influencing environmentally responsible action. Their findings indicated that increased concern about the environment did not lead to the seeking of knowledge. Conversely, the acquisition of environmental facts did not seemingly result in increased affective reactions. They concluded that both affective and cognitive variables are important and suggested that until more is known, it would be prudent to attempt to deal with both in educational program.

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To better understand the affective variables in environmental decision making, Baker, Doran, and Sarnowski (1978) attempted to profile individual's environmental values. They found environmental values to be largely independent of general values. A number of environmental educators such as Stapp (1973), Bennett (1974-5) and Knapp (1973) have advised use of the values clarification approach (Raths, Harmin, and Simon, 1966) as a means of dealing with environmental values in the classroom. Miles (1978) argues that Kohlberg's stages of moral development also represent a possible approach to the problem of studying values. In a somewhat different vein, Cummings (1974) places the act of decision-making at the center of his approach to environmental education. And finally, Lawson and Wollman (1977) found students' ability to make informed, well-reasoned judgments in social and environmental contexts related to their stage of cognitive development in Piagetian terms.

Thus a number of identifiable variables such as conceptual knowledge, stage of moral development, specific sets of values, and stage of cognitive development, can be identified as potential contributors to environmentally responsible behavior. Kaufman (1970) has proposed a summary equation for moral decision-making situations that may prove helpful as a means of considering the contributions of the respective variables to the final behavioral outcome.

Kaufman's equation can be stated as follows:

$$BP = f(iV + U + H)$$

Where: BP is the behavioral potential or behavioral outcome, V is the subject's values or attitudes specific to the situation,

i is the "idealism" or commitment of the subject, which expresses the probability of his behaving in terms of his values,

U is the utility of the choice, expressed as the algebraic sum of positive consequences multiplied by their probabilities of occurrence, minus the negative consequences multiplied by their probabilities,

and H is habit accountable to previous behavior or modeling in similar situations.

Note that V, U, and H are all situation-specific. Only i, which can be viewed as a function of moral development in Kohlberg's sense (Kohlberg and Turiel, 1971) is considered as generally constant from situation to situation. When i is low, as at moral stages 1 and 2, iV is diminished, leaving U and H to dominate the behavioral outcome. On the other hand, with i is high, as in Kohlberg's stages 5 and 6, then iV is increased and will contribute significantly more to the outcome. Values (V), of course, are crucial. Presumably the work in values clarification in environmental education can significantly enhance the development of environmentally sound values. This, however, has yet to be demonstrated (cf. Lockwood, 1978).

Recent reviews of the effects of values clarification and moral development on school curricula are found in articles by Lockwood (1978), Biggs (1976), Graham (1976), Miles (1978) and Phillips and Nicolayev (1978). For purposes of the present discussion it is sufficient to say that while both fields of values clarification and moral development face considerable theoretical difficulty, they both have sufficient intuitive appeal to warrant further work by educational researchers.

Utility of choice (U) is a complex factor. Yet at its core is the examination of alternatives and rational consideration of their consequences. Certainly this weighing process requires knowledge of alternatives and their consequences, hence conceptual knowledge is essential. Not only is conceptual knowledge essential but the mental habit of comparing alternatives may also be essential. Perhaps this is where the mental operations of the formal reasoner play a role. Unfortunately the H, or habit variable, may also prove of importance in environmental decision making. One may full well recognize the potential problems associated with certain past behaviors yet the convenience and simple habit of those behaviors may prevent positive change.

Viewed with Kaufman's summary equation in mind, the job of the environmental educator can be restated and clarified. The job becomes one of facilitating the development of advanced moral reasoning, a sound set of environmental values, conceptual understandings, and formal stage reasoning. Although this seems a tall order, Kaufman's equation suggests that a failure in any one of these areas may lead to environmentally irresponsible behavior. Attention will now be turned to the possible role played by cognitive development in environmental decision making.

Cognitive Development During Adolescence

If it is the case that part of the environmental decision-making process involves the rational examination of alternatives, their consequences, and the weighing of these consequences then it becomes meaningful to ask when such rational behavior originates. At this point in time no satisfactory answer to this question can be given. Nonetheless there are sufficiently compelling theoretical and empirical reasons to believe it is related to the development of what Piaget has called formal reasoning (e.g., Inhelder and Piaget, 1958; Kohlberg and Turiel, 1971; Lawson and Wollman, 1977; Peel, 1971; Lawson, Karplus and Adi, 1978; Graham, 1976; Biggs, 1976). Thus a closer examination of Piaget's theory is warranted.

Within Piaget's theory, cognitive development across adolescence is seen to involve a gradual transition from the predominantly "real world" and restricted descriptions of the child to the more mature hypothetical and tentative explanations of the adult. Adolescence is seen as a time in which higher-order cognitive operations develop from a complex interaction of the subject's own attempts to cognitively assimilate his varied physical and social experiences. Reasoning patterns such as the isolation and control of variables, combinatorial, proportional, probabilistic, and correlational reasoning develop as a means of generating and testing hypotheses about that world. Further, according to Inhelder and Piaget (1958), personalities and a mature system of values develop along with the development of formal reasoning. As Inhelder and Piaget state:

> First, feelings relative to ideals are added to inter individual feelings. Secondly, personalities develop in relation to social roles and scales of values derived from social interaction (and no longer only by the coordination of exchanges which they maintain with the physical environment and other individuals)...it is important to see how closely these two essential affective aspects of adolescence are interwoven with the transformations of behavior brought on by the development of formal structures (1958: 348).

Thus adolescence is not only a time of cognitive development but of affective development as well. Importantly for Piaget, the emergence of formal operations is the mechanism responsible for both.

What evidence exists to support the hypothesis that the reasoning patterns of Piaget's hypothetical formal thinker develop during adolescence? Further what evidence exists to support the hypothesis that this development is linked to the ability to make well-reasoned value judgments? A good deal of evidence has been gathered to support the hypothesis that formal reasoning develops during adolescence. Inhelder and Piaget's classic 1958 volume The Growth of Logical Thinking from Childhood to Adolescence contains numerous formal tasks and protocols which demonstrate the acquisition of more advanced reasoning patterns (formal schemata) with age. However, Inhelder and Piaget made no systematic attempt to randomly sample large numbers of subjects at various ages and they failed to report percentages of subjects responding correctly or formally to their various tasks. Therefore, from their work, it is not possible to determine how prevalent any type of reasoning is for any particular age group. However, other researchers such as Longeot (1965), Raven (1973), Burney (1974) and Lawson (1978) have developed batteries of formal tasks and written problems and have found increasingly successful performance with advancing age during adolescence.

One of the most comprehensive attempts at accessing the development of reasoning patterns across adolescence was reported by Lawson, Karplus and Adi (1978). Lawson, Karplus and Adi administered problems requiring proportional, probabilistic, and correlational reasoning to 507 carefully selected subjects spanning the entire age range of adolescence--roughly ages 11.5 to 20.0 years. They found that only 10 percent of the youngest subjects (6th graders, mean age = 12.9 years) responded correctly to the proportional reasoning problem but 80.4 percent of the oldest subjects (college students, mean age 19.6 years) solved the problem. The respective percentages for the probabilistic and correlational reasoning problems were similar. The percentages for all of the age groups (6, 8, 10, 12 and college) for all problems are shown in Figure 1.

The data reveal not only that formal reasoning patterns develop in more and more subjects with increasing age during adolescence but they also reveal considerable heterogeneity at any one age. For example, even at the sixth grade level some subjects responded with correct choices and well-reasoned explanations indicating competence with formal reasoning patterns. On the other hand, even in the college sample some subjects responded incorrectly and offered only incomplete, confused and illogical explanations indicating poorly developed formal reasoning. The rather abrupt increase in percentage of correct responses given to the reasoning items between eighth and tenth grade suggests a possible transition period. Yet the more linear increase in percentages seen for the correlational reasoning items suggests more of a gradual and even tempo of development.

Is Cognitive Development Linked to Value Judgment?

Lawson and Wollman (1977) administered three Piagetian tasks (the conservation of weight, bending rods, and balance beam) to a heterogeneous sample of early adolescents (N = 53, mean age = 11.6 years, range = 10.6 to 12.8 years) and found them

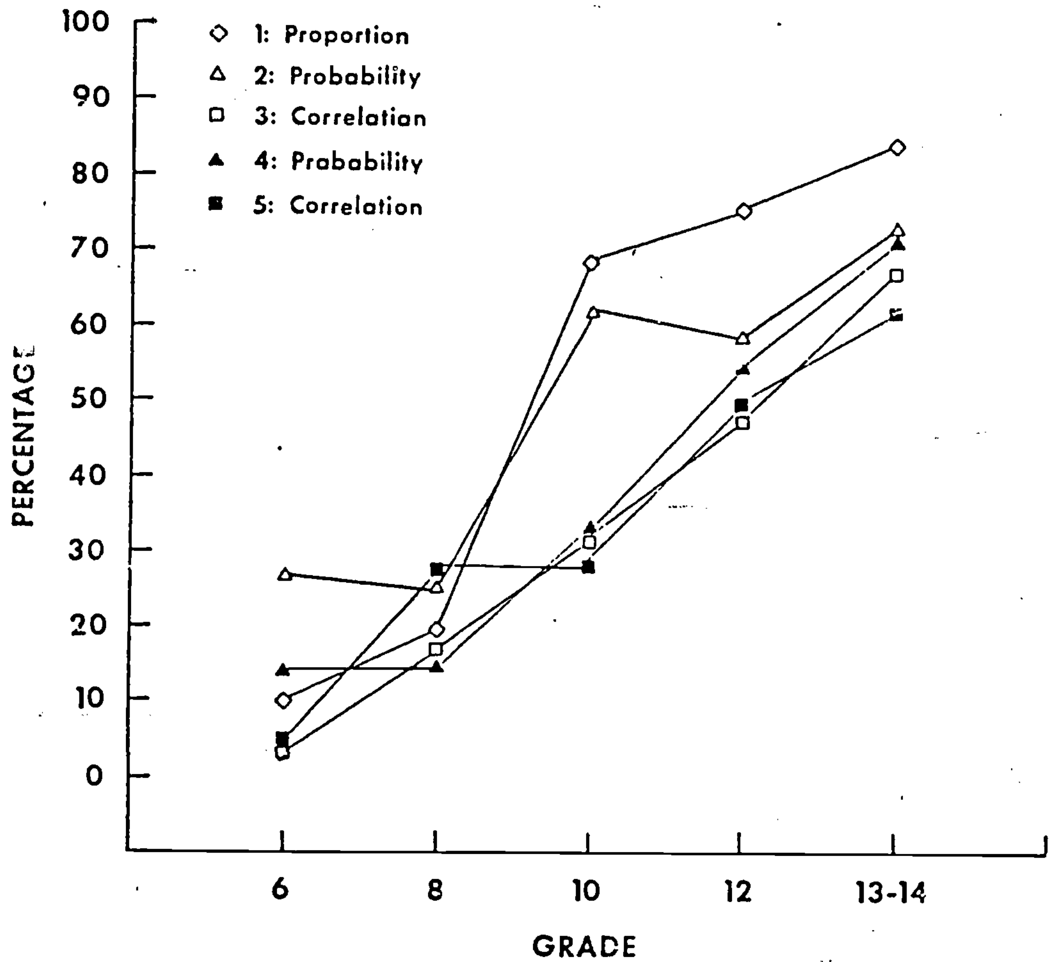

Figure 1. Percentages of subjects in grades 6, 8, 10, 12 and college who successfully responded to written problems requiring proportional, probabilistic, and correlational reasoning. Two problems requiring probabilistic and correlational reasoning were administered (Lawson, Karplus and Adi, 1978:470).

to span the entire range of cognitive development from early concrete operational to late formal operational. In tape recorded individual interviews Lawson and Wollman administered a series of five problems, developed by Peel and his students (Peel, 1971), that assessed subjects' ability to make critical value judgments in social contexts. Two of the five value problems were as follows. (Three other value problems are found in the Appendix.)

New Roads (Anderson, 1967). Two men were arguing about a new road to be built. One said, "It is a terrible thing. Why should we spend thousands of dollars and spoil the countryside just so that a few selfish motorists can speed along at 60 miles an hour? And think how many people are likely to be killed on the roads this year." The other man said, "I am glad they are building this road. I will be able to take my family to the seaside much more quickly."

Question: Should new roads be built? Why do you say that?

The Art Treasures (Peel, 1971). All large cities have art galleries and Mexico is exceptionally rich in art treasures. Many people travel to Mexico, especially to enjoy these old paintings, books and sculptures. Floods in Mexico recently damaged many of these great works. Old paintings are rare, valuable, and beautiful and should be kept in a safe place.

Question: Are the people of Mexico to blame for the loss of the paintings and art treasures? Why do you say that?

Following Peel's methodology, the subjects' tape-recorded responses were categorized into one of three categories: (1) restricted, (2) circumstantial, and (3) imaginative.

Table 1

Categories of Responses and Means for Each Value Problem*

Category	Value Problems				
(point value)	Driving Lessons	New Roads	Art Treasures	Cigarette Smoking	Railroad Station
Restricted (1)	10	12	15	8	6
Circumstantial (2)	36	25	31	36	46
Imaginative (3)	8	17	8	10	3
Mean	1.96	2.07	1.87	2.04	1.94

*(Lawson and Wollman, 1977:401.)

Mean scores for the five value problems were then calculated for subjects categorized into each of the Piagetian cognitive development substages (early concrete, late concrete, early formal and late formal) (Table 2). The nine early concrete subjects, for example, had a mean score per problem of 1.53 which indicates about half of their responses were restricted and about half were circumstantial. The five late formal subjects on the other hand, had a mean score per problem of 2.4 which indicates that about half of their responses were circumstantial and about half were imaginative. Importantly out of the 145 opportunities that the 29 early and late concrete operational subjects had to generate imaginative responses (five opportunities per subject), such responses were generated only 14 times (9.6 percent). This is an important result in that it indicates that imaginative responses, responses which go beyond the given information and examine alternatives and their consequences, are something quite out of the realm of the concrete thinker. This type of response appears even out of the realm of most of the early formal thinkers in the sample. In only 21 of the 100 opportunities that the 20 early formal thinkers had to generate imaginative responses did they do so (21 percent).

Table 2

Means and Standard Deviations of Value Problem Scores for Subjects in Concrete and Formal Substages of Cognitive Development*

Cognitive Development Substage	-----Value Problems----- N	Mean	SD
Early Concrete	9	1.53	.18
Late Concrete	20	1.92	.58
Early Formal	20	2.14	.31
Late Formal	5	2.40	.37

*(Lawson and Wollman, 1977:403.)

Scores on the five value problems were then summed to obtain a single score (5-15) for each subject. An analysis of variance was then conducted using substage of cognitive development as the independent variable and the summed score on the value problems as the dependent variable. The analysis revealed a statistically significant relationship, $F(3,50) = 4.59$, $p < 0.01$. Further, a principal components analysis of the data was conducted. Principal components analysis is a multivariate technique which is often considered a first-stage solution in factor analysis. The technique mathematically attempts to reduce a set of many measures to a smaller number of factors by extracting weighted sums of the measures which account for a maximum amount of the variance of the total set. Analysis of the present data showed the Piagetian tasks and the value problems loading on a single component which accounted for over 60 percent of the variance. Again this indicates a good deal of common variance between the Piagetian tasks and the value questions.

The Implications of These Findings for Environmental Education

Raths, Harmin, and Simon (1966:38-39) argue that adults can help children develop and clarify their own values by doing the following seven things:

1. Encourage children to make choices, and to make them freely.

2. Help them discover and examine available alternatives when faced with choices.

3. Help children weigh alternatives thoughtfully, reflecting on consequences of each.

4. Encourage children to consider what it is that they prize and cherish.

5. Give them opportunities to make public affirmations of their choices.

6. Encourage them to act, behave, live in accordance with their choices.

7. Help them to examine repeated behaviors or patterns in their life.

But as the data reported by Lawson and Wollman (1977) indicate, the discovery and examination of alternatives and the thoughtful consideration of their consequences is something that concrete and even early formal operational students seldom if ever do. Does this mean that they are essentially unable to examine alternatives and their consequences? As Piaget has argued, cognitive and affective development appear to be closely related. Thus affective development may in fact require prior development of important cognitive operations. Piaget has argued that it is the development of his combinatorial system of 16-binary operations and four fundamental structures of thought called Identity, Negation, Reciprocity, and Correlativity (INRC group) which is at the heart of both cognitive and affective development during adolescence. Nonetheless, little support has been generated for this position (cf. Wollman, 1979).

If Piaget's combinatorial system and INRC group are rejected then what mental processes might account for the observed link between the cognitive and affective aspects of adolescence? It seems reasonable to assume that the mental processes are the very ones involved in taking into consideration alternatives and examining consequences. For example, in the Piagetian bending rods task, the subject must first identify variables that might affect the bending of metal rods, such as rod length, thickness, and metal type, and then conduct controlled experiments to test the effect of each variable. The tests would involve a realization that one rod may be bending more than another for any one or more of several reasons. Thus to be certain that any one variable makes a difference in the bending, one must be certain that the other alternatives are held constant. Likewise in a problem such as Peel's New Roads problem this would involve an awareness of extenuating circumstances such as the number of persons likely to use the new road, the importance of going to the destinations along the road, the amount of pollution produced by the cars using the road, and so on. In other words, the link between cognitive and affective development need not be Piaget's combinatorial system and INRC group but it might simply be: (1) a knowledge of alternative positions and their consequences gained through experience and, (2) the mental habit of weighing those alternatives one against the other until the most reasonable one can be chosen in light of their imagined consequences.

This view is entirely consistent with the values clarification and moral development view that situations that allow students to confront problems, share experiences and views, examine alternatives, weigh consequences, and search for resolutions would do much to enhance responsible decision-making skills. A note of caution, however, seems in order. Values clarification and moral development teaching approaches that have been tried in the past and have included only verbal classroom discussions have largely been unsuccessful (Lockwood, 1978). One of the few teaching approaches that showed significant development in students was one in which eighth grade students not only discussed moral issues in class but engaged in role-playing, creating moral dilemmas, and in interviewing persons in the school and community at large (Paolitto, 1976). Although Paolitto did not assess level of intellectual development of her subjects, it is safe to assume that many of them were concrete operational. The fact that her treatment included much more than mere verbal discussions and actually engaged her subjects in first-hand concrete experiences might have been the crucial difference between her success and others' failures. The suggestion is that if your classes contain concrete operational subjects, then your attempts at values clarification and moral development might well require much more than verbal instructional techniques (e.g., the discussion of moral dilemmas and environmental-economic-political issues).

Summary

Concrete operational students display an important limitation. They find it extremely difficult to sustain reasoning in the absence of objects or recent experience. They often lose track of verbal arguments of even modest length. They do considerably better with short statements and when words refer to objects or pictures, or better still to objects which they have manipulated themselves. As Wollman (1978:15) stated, "At the extreme, objects are more than helpful, they are necessary. Hence the term 'concrete'."

Due to this limitation it seems reaonsable to hypothesize that concrete operational students require first-hand experiences for intellectual and affective development. As Inhelder and Piaget (1958:250) characterized it, "...concrete thought remains essentially attached to empirical reality." Thus for concrete thought to be extended it would seem that one must begin within the empirical reality of the child and only then present hypothetical extensions of that reality for discussion and debate. For the environmental educator to successfully achieve the aim of developing students who will make informed well-reasoned decisions when faced with difficult environmental issues, it may be imperative that instructional materials be designed that take the limitations of the concrete thinker seriously.

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APPENDIX

Driving Lessons (Brydon, 1967). Most young people want to be able to drive a car. There are too many cars on the roads already in this country and more drivers would only make the position worse.

Question: Should young people be given lessons on driving in their last year at school? Why do you say that?

Cigarette Smoking (Brydon, 1967). At the present day many people die from cancer. Cigarette smoking is said to be the cause of lung cancer and yet tobacco is freely sold throughout the country. Any person over the age of 16 can spend as much money as he likes on buying cigarettes.

Question: Should cigarette smoking be banned by the government? Why do you say that?

The Railroad Station (Peel, 1979). Mt. Pleasant is a large town with a busy railroad junction which attracts boys and girls who are interested in watching trains. Scottsville is a small place not far away and many people who live in Scottsville do their shopping in Mt. Pleasant because there are many more shops. The railroad company has recently decided to close the Scottsville station and run no more trains from there to Mt. Pleasant.

Question: Should the Scottsville station be closed? Why do you say that?

EXPECTED CONSEQUENCES, ENJOYABILITY, AND OTHER EVALUATION SCALES

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Abstract. *The staff and 36 participants of the West Virginia Forest Industries Camp responded to attitude, knowledge, expected consequences, enjoyability, and organization scales on a pre-post program basis. Results indicated significant (.05, .01, or .001) correlations between attitude and knowledge change scores, learning and enjoyability, enjoyability and perceived organization, learning and post expectations, plus the staff and campers perception of what happened during the week.*

Learning is a complex phenomenon. Typically residential, day, and school environmental programs have cognitive and affective objectives, be they stated or inferred. Evaluation of past programs has indicated that both attitudes and knowledge levels can be significantly altered during an environmental program (Kidd, Burrus-Bammel, and Bammel 1978); that nonparticipants did not exhibit such changes during the same time period (Burrus-Bammel, Bammel, and Kidd, 1979); that measured changes in the experimental camp group did not significantly decline over a set period of time (Burrus-Bammel, 1978; Bammel and Hanson, 1978). Other investigations, not necessarily conducted in environmental programs demonstrated that novel information is given processing priority; that information processing is enhanced when more than one modality is involved; that nontraditional techniques such as simulation games, puppetry, and field trips can be as or more effective than the standard lecture method for presenting knowledge-based material; that fear messages stimulate more attitude change than either factual or neutral messages.

Environmental evaluation researchers have previously investigated attitude and/or knowledge changes over time, their relationship to each other, the effectiveness of various teaching techniques but three variables, enjoyability, expected consequences, and organization have been previously neglected.

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WEST VIRGINIA FOREST INDUSTRIES CAMP

The purpose of this study was to determine 1) the relationship of enjoyability to attitudes and knowledge, 2) the relationship of expected consequences to attitudes and knowledges, 3) the relationship of organization to attitudes and knowledges, 4) the relationship of expectations before the residential camp program with reports of what actually happened during the program, 5) the camp staff's ability to predict participants' expectations, 6) the correlation between the campers' and staff's reporting of what actually was accomplished during the program and 7) the usefulness of enjoyability, expected consequences, organization and other profile data.

Camp Pocahontas

Each year the Cooperative Extension Service supports a number of what could be called "environmental education" programs, one of which is the West Virginia Forest Industries Camp. This camp is sponsored by West Virginia University, Cooperative Extension Service, West Virginia Forests Inc., the forest industries of West Virginia, and other public agencies (the West Virginia Department of Agriculture, Natural Resources, Soil Conservation Service, and the U.S. Forest Service).

The camp's main goal is to impart to the participants a fundamental philosophical attitude which approaches the environment in which people live as a total system. The major component is the natural system upon which is imposed the social, political, and economic systems. The teaching program focuses upon developing a specific understanding of the Eastern Hardwood Forest ecosystem. Participants are encouraged to see that the forest can be used to produce the goods and services required by people without destroying its place in the system of nature. Selected campers are predominantly rural high school students 16 to 20 years of age, each having been recommended by a forester, teacher, or other youth leader. Final selection is based upon written recommendations and statements of interest by the individual applicant.

> During the week at Camp Pocahontas, the participants were isolated from the usual types of media such as television, radio and newspapers. The campers did receive illustrated evening lectures, and took part in on-site role playing where groups assumed defensible single-use advocacy positions and sought to harmonize differences with other single-use groups. Field trips included tours

of wood products plants to demonstrate the progress from log to finished wood product, and on-site practical demonstration with campers installing transects and recording data that provided a picture of the forest, plants, animals, and historical use. By the close of the session the individuals had received information of the tangible benefits of wood, water, recreation, as well as the intangible aesthetic influences. The one-week camp dealt with knowledge of the processes that maintain the ecosystem, with the awareness of injurious agents, with multiple use, and with social action processes. As a result, they became aware of the complexities of forest land management, and of the opportunities and responsibilities associated with forest ownership (Kidd, Burrus-Bammel and Bammel, 1978:13).

Evaluation

Established camp procedure includes administration of a written objective test at the beginning of the week to determine attitudes, conceptual knowledge, factual knowledge and expectations. This same instrument, with an added enjoyability scale, was given again at the close of camp in order to establish whether or not any change had occurred, and if change had occurred, the direction and degree of that change.

Attitudes have been defined as "a relatively enduring organization of beliefs about an object or situation predisposing one to respond in some preferential manner" (Rokeach, 1975:134). Attitudes in this study were determined by the subject's score for favorable or unfavorable responses to 16 Likert-type statements on a variety of environmental topics (Appendix A). Response foils included SA (strongly agree), A (agree), SWA (somewhat agree), DK (don't know), SWD (somewhat disagree), D (disagree), and SD (strongly disagree). Numerical values 1-6 (no value assigned to a DK response), 6 denoting the multiple use concept, were assigned to each response according to the desired, multiple use, answer. A reliability coefficient of .84 was determined in 1976 when there were only five response foils instead of the 1979 seven. Seventeen true-false and eight multiple choice items comprised the 1979 knowledge test (Appendix B). The reliability coefficient, established in 1976 for the first 15 true-false items, was .90. The overall test (attitude and knowledge) validity coefficient of .92 was established in 1976 by a panel of three experts.

Two enjoyability measures were calculated. The first measure, labeled Enjoyability I, resulted from one general question: "How enjoyable (on a scale of 0-100, low enjoyability to high) was the overall camp experience?" The second measure, Enjoyability II, resulted from averaging responses to a series of specific questions that related to actual program activities such as tree identification, forest policy debate, ecosystem session, etc. (Table 5). These questions had also been rated on a 0-100 scale.

Pre-camp expectations were determined by averaging responses (1-7, low to high) to 23 statements (Appendix C). These same statements, with the verb tense changed to the past tense (Appendix D), were repeated at the end of the camp to determine how effective the program was at meeting the various expectations. There was also one general question which asked, "How well were your camp expectations met? (0-100, 0 = not met at all, 100 = extremely well met)." This factor was labeled Expectations II. In addition, the campers were asked "In general, how much do you think you learned (0-100, 0 = nothing, 100 = a great deal) during this camp experience?" (labeled Learned Value) plus "How would you rate (1-5, awful to excellent) the overall organization of this week?" Four other specific points were included on the same 1-5 scale (1 = awful, 2 = poor, 3 = OK, 4 = good, 5 = excellent):

1. Pre-camp information (camp location, what to bring, etc.
2. Evening programs.
3. The daily teaching schedule.
4. The day-to-day routine of moving from one activity to the next.

Averaging responses from the five statements yielded an organization value.

The camp staff was requested to estimate "What do campers come expecting?" and "What do you think was accomplished at camp?" by responding to the pre and post-camp expectation statements (Appendices C and D).

Results

Attitude and Knowledge. West Virginia Forest Industries Camp staff has been formally conducting evaluation procedures for five years, less formal methods for 20 years. Participants in the 1979 program, as in the previous years, improved significantly (.001) between pre and post attitude and knowledge tests (Table 1). Percentages on the knowledge test were transformed to arcsin values. Previous studies (Kidd, Burrus-Bammel and Bammel, 1978; Burrus-Bammel, 1978) have indicated that significant changes do not occur within a control group during the same period of time and that the significant changes are maintained over an extended period of time by the camp group. In 1979 however, unlike 1976, a significant (.05) relationship was found between knowledge and attitude on the posttests. In 1976 the significance level was only .1 (Table 2).

Table 1

Within Group Paired "t" Test

Test	Pre-Test X	Post-Test X	df	"t"
Attitude	60.543	75.571	34	9.139*
Knowledge	40.098	54.052	34	10.925*

*Significant at .001 level.

Table 2

LINEAR REGRESSION WITH ANOV
CORRELATION BETWEEN ATTITUDE AND KNOWLEDGE

GROUP	ATTITUDE		KNOWLEDGE					
	$\overline{X}$	SD	$\overline{X}$	SD	F-ratio	R	df	sig.
1976 Exp. Group Pre-Test	59.778	5.270	9.167	2.408	.752	.147	34	
1976 Exp. Group Post-Test	67.528	7.137	12.778	1.869	3.643	.311	34	.1
1976 Control Group	62.621	5.388	10.483	2.530	.948	.184	27	
1979 Pre-Test	40.098	8.171	60.543	8.903	1.904	.234	33	
1979 Post-Test	54.052	7.918	75.571	11.700	4.984	.362	33	.05

Table 3.

CAMPERS' AND STAFF'S PRE- AND POST-EXPECTATION VALUES

Pre-Test $\bar{X}$		Post-Test $\bar{X}$			
C	Staff	C	Staff	#	Item Description
5.92	5.57	5.68	5.50	1.	Identify West Virginia Trees
5.71	6.00	6.60	6.25	2.	Learn about forest related jobs.
5.24	5.86	6.57	6.37	3.	Talk with natural resource managers.
5.66	5.86	6.86	6.38	4.	Do things I've never done before.
5.68	4.86	6.34	6.13	5.	Better understand things forests provide
5.87	5.29	6.08	4.88	6.	Learn necessities required for a forest.
4.68	5.34	5.51	5.38	7.	Learn about myself and others.
5.47	5.43	6.66	6.38	8.	Practice forestry skills and equipment.
4.84	3.71	5.63	5.75	9.	Be intellectually challenged.
5.03	4.00	5.43	5.13	10.	Learn about wildlife biology program.
4.82	5.14	5.54	4.88	11.	Learn about 2 year technical forestry program.
5.42	5.14	5.83	5.38	12.	Learn about 4 year professional forestry program.
5.32	4.57	5.57	5.25	13.	Learn about recreation program.
5.24	4.86	5.51	4.63	14.	Learn about environmental program.
5.10	5.86	6.91	6.88	15.	Visit a working wood products plant.
5.63	3.29	6.63	6.13	16.	Learn about an interacting forest system.
5.28	6.00	6.17	5.63	17.	Time to discuss personal questions.
5.55	4.14	6.31	5.13	18.	See effects of forest management practices.
6.18	6.71	6.46	5.88	19.	Discover personal interest in forestry careers.
5.37	3.29	5.68	5.13	20.	Be more useful to society by learning natural systems.
5.29	5.00	6.46	6.38	21.	Be with other who share common interests.
5.71	4.14	5.88	5.88	22.	Learn of wildlife in forest areas.
5.29	4.86	6.48	6.13	23.	Observe natural resource and wood industry people on the job.

Table 4

CORRELATIONS: LINEAR REGRESSION WITH ANOV

FACTOR	X	SD	F	R	df
Enjoyability I	93.435	7.051	1.189	-0.232	21
Knowledge	27.850	8.237			
Enjoyability II	79.199	8.018	0.003	0.01	32
Knowledge (pre-post diff.)	28.311	8.762			
Enjoyability I	93.435	7.051	2.159	0.305	21
Attitude (pre-post diff.)	14.130	8.588			
Enjoyability II	79.199	8.108	2.561	-0.272	32
Attitude (diff.)	15.852	8.829			
Learned Value	91.656	8.365	0.238	0.089	30
Knowledge (diff.)	27.851	8.827			
Learned Value	91.656	8.365	7.644	0.451**	30
Post Expectation	6.155	0.595			
Learned Value	91.656	8.365	2.266	0.265	30
Post Expec. II	91.468	8.281			
Learned Value	93.136	8.493	18.500	0.693***	20
Enjoyability I	93.136	7.066			
Post Expec. II	91.824	8.178	2.099	0.248	32
Attitude (diff.)	15.852	8.829			
Post Expec. II	91.824	8.178	0.665	0.143	32
Knowledge (diff.)	28.311	8.762			
Enjoyability I	93.435	7.051	5.230	0.447*	21
Organization	4.130	0.507			
Attitude (diff.)	15.853	8.829	0.419	-0.114	32
Organization	4.056	0.559			
Organization	4.056	0.559	2.137	0.250	32
Knowledge (diff.)	28.311	8.762			
Enjoyability I	93.435	7.051	2.341	0.317	21
Enjoyability II	80.930	8.743			
Campers' Pre-Exp.	5.404	0.370	3.014	0.354	21
Staffs' Pre-Exp.	4.950	0.196			
Campers' Post-Exp.	6.121	0.488	45.477	0.827***	21
Staffs' Post-Exp.	5.712	0.606			

* = significant at .05 level
** = significant at .01 level
*** = significant at .001 level.

Expectation Values. Pre-camp expectation responses (Table 3) indicated that the campers highly expected (6.18) to discover whether or not they were interested in a forest-related career but did not particularly expect to either learn about themselves and others (4.68) or to be intellectually challenged (4.84). Camp staff pre-expectation values did not significantly correlate with the participants' values (Table 4). The relationship was highly significant (.001) on post-camp values (Table 4). The average response to "How well were your camp expectations met?" was 91.85 percent.

Enjoyability. Overall camp enjoyability, Enjoyability I, was 93.47 percent. Sixteen specific items yielded a range of 61.03 to 98.48 percent and a mean of 79.85 (Table 5).

Learned and Organization Variables. The average response to "How much do you think you learned during this camp experience?" (Learned Value) was 94.70 percent. Overall camp organization received an average value of 4.16 (1-5 scale) while specific aspects of the program ranged from 3.8 to 4.41 (Table 6).

Table 5

Average Percent Response to Enjoyability Items

Item No.	Percent	Item Description
1	61.03	Sunday Movie--"Time to Discover"
2	66.38	Ecosystem Session
3	70.85	Forest Succession Session
4	68.65	Habitat Requirements Session
5	78.27	Industrial Forest Management Session
6	93.50	Timber Cruise and Data Collection
7	78.12	Leaf Collection
8	86.88	Industry Tour
9	72.06	Forest Policy Debate
10	80.26	Tree Identification
11	70.84	Forest Management Decision-Making
12	85.62	Camp Fires
13	92.82	Recreational Play
14	96.00	Afternoon Field Day
15	77.78	Evening Group Sessions with Consultants
16	98.48	Sinks of Gandy Trip

1-16 $\overline{X}$ = 79.85

Table 6

Average Response to Organization Items

Item No.	$\overline{X}$	Item Description
III	4.16	Overall Organization of the Week
1	4.39	Pre-Camp Information
2	3.73	Evening Programs
3	3.80	Daily Teaching Schedule
4	4.41	Day-to-Day Activity Routine

Correlations. Various factors were analyzed by linear regression to determine the existence of any significant relationships (Table 4). Responses to the question "In general, how much do you think you learned?" (labeled--Learned Value) significantly (.05 or .01) correlated with both post expectation and Enjoyability I scores. Enjoyability I also significantly (.05) correlated with the organization factor (Table 4).

Interpretation, Discussion and Recommendations

Establishing pre-camp or pre-program expectation values can be helpful for a number of reasons, assuming that the scale items include program objectives and/or goals. Individual values could quickly inform the program director 1) whether or not applicants are compatible with the program, 2) if the publicity was accurate, 3) if the camp staff is familiar with the programs' objectives, 4) if the staff can perceive camper expectations, and 5) could possibly be used as a means for selecting desirable participants when numbers are limited. Post-program expectations can serve as a means for determining effectiveness and a tool for indicating specific strengths and weaknesses. This scale could be a part of an ongoing evaluation procedure.

In this investigation the staff underestimated the intellectual challenge (Table 3, Item 9) expected by the campers. Knowledge of this fact might allow the staff to require more from the campers. The 1979 camp staff also underestimated the participants' expectations in knowledge about an interacting forest system (Item 16) and being useful to society by learning about natural systems. These findings suggest that the staff expected the participants to be more narrow in their approach toward a forestry environmental program. The multiple use concept of the camp already was accepted by some of the participants. Results from attitude, knowledge, and expectation scales could help program directors estimate the correct beginning level instead of being over or under the participants' abilities and expectations. Inappropriate expectations could be corrected before the program.

The two enjoyability factors indicated that camp experience is more than the sum of specific activities; the overall enjoyability factor (93.47) was much higher than most of the specific activities (average = 79.85). Campers most enjoyed (Table 5) the underground cave trip--Sinks of Gandy, the forestry skills field day, timber cruise, and recreational play. These most popular activities were physical in nature, required active participation, were novel, plus mentally challenging. The least popular activity was a movie which was shown on the first night. One does need to be careful when interpreting enjoyability or any set of data. Why was the movie lower than other activities? Was it the film itself or was it a matter of when it was shown? That first evening campers might have been too excited to sit still, the room acoustics might have prevented understanding, the benches might have been too uncomfortable for that long of a stretch, etc. It was decided, at a fall staff meeting, that based upon these results, more active participation would be built into certain teaching units and that the first night's program would be made shorter.

Organization values (Table 6) indicated that the rather long evening programs might be restructured. Organization was significantly (.05) correlated to enjoyability. This might mean that young campers need and want structure in order to have a good time and to learn. Responses to "How much did you learn from the camp experience?" (average = 93.136) was significantly correlated (.001) to Enjoyability I (Table 4).

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APPENDIX A

ATTITUDE QUESTIONS

1. A forest that is managed for timber production has little use for other purposes such as recreation, wildlife, pure water.

2. It is not possible for a forest to produce timber, water, recreation and wildlife.

3. The largest portion of forest land in West Virginia should be placed in preserves to provide enjoyment for future generations.

4. The most important use of West Virginia's forest land is to produce game and fish for sportsmen.

5. Forests are for people and should be managed to provide all goods and services, timber, water, recreation, etc.

6. Clearcutting is a poor forest practice when viewed in a total forest management sense.

7. The most important use of West Virginia's forest land is to provide a place of beauty for people.

8. Society should not concern itself about how forest lands are allocated for use. Decisions should be left to the professional forester.

9. Selection cutting is a poor forest practice when viewed in a total forest management sense.

10. The most important use of West Virginia's forest land is to produce timber products for people.

11. Rational forest policy will recognize the costs as well as the benefits.

12. The most important use of West Virginia's forest is to provide a place of recreation for people.

13. Timber harvesting should not be allowed in West Virginia.

14. The wood industry of West Virginia manages its timber land to produce timber in such a way as to not destroy the other values.

15. Timber harvesting should be allowed on forested lands that are managed for that purpose.

16. The most important use of West Virginia's forest land is to provide all goods and services normally available from forest land.

APPENDIX B

CONCEPTUAL AND FACTUAL KNOWLEDGE QUESTIONS

1. A windstorm blows down trees on several acres of forest land. No changes will occur in the forest since trees were the only part destroyed.

2. Water, sunlight and soil are all necessary ingredients to the growth and development of forest plants but play only a minor role in producing adequate numbers of hawks, bobcats and other such animals.

3. Soil is a nonliving part of the forest ecosystem.

4. One effect of cutting trees on the stream ecosystem is to increase the quality of soil material that it carries.

5. Insects and other micro organisms that occur in the forest ecosystem are a menace to its existence.

6. Natural systems are separate and apart from social, political and economic systems. That is, there is no relationship of one to the other.

7. West Virginia's forest industry plays a major role in making forest management possible in many privately-owned woodlots.

8. Soils, elevation, moisture, temperature and compass direction have little effect on the kinds of trees, plants and animals that occur on that site.

9. Inventorying the forest includes recording of: tree and other plant species, quality of site relative to tree growth, topographic features and man-made structures, etc.

10. Properly located and constructed logging roads will reduce the quantity of soil material in forest streams.

11. The most desirable habitat for the white-tailed deer and ruffed grouse is greated by heavy selection harvest cuts or clearcuts.

12. Knowledge about the forest resource and its relationship to the other aspects of oir life is necessary before good forest policy can be developed.

13. In West Virginia it is usually necessary to replant with seedlings after timber has been harvested.

14. Forest fires that burn along the surface of the forest floor do not damage the larger trees.

15. An increment borer is a forest insect pest that occurs in West Virginia.

16. The best habitat for ruffed Grouse is: a) meadows and old fields, b) open mature woodland, c) thick growth, d) open pole stands, e) don't know.

17. The major factor in harvesting trees that contribute to increased levels of soil material in forest streams in: a) marking timber, b) cutting trees, c) don't know, d) aforestation, e) road building.

18. Clearings in Eastern Hardwood forests are most likely to be occupied by tree species that are: a) tolerant, b) climax, c) microcosmic, d) intolerant, e) don't know.

19. Basswood prefers a site that is: a) wet/soggy, b) dry/rocky, c) moist/well-drained, d) damp/moderately dry, e) don't know.

20. The major source of food for all forest animals is the sun.

21. Quality of forest streams is affected by: a) felling trees, b) bucking trees, c) limbing trees, d) skidding trees, e) don't know.

22. Hawks and bobcats are second-level consumers.

23. Chestnut oak prefers a site that is: a) dry/rocky, b) on a north slope, c) down next to a stream, d) don't know.

24. Intermediate harvests are possible only when a) growth exceeds mortality, b) markets are available, c) the stand is too thick, d) don't know.

25. The major component of a white-tailed deer's diet is: a) grass, b) insects, c) mast, d) browse, e) don't know.

APPENDIX C

PRE-CAMP EXPECTATIONS

I EXPECT TO:

1. learn how to identify the trees common to West Virginia.
2. find out about possible forest-related jobs.
3. be able to talk with natural resource managers (foresters, wildlife biologists, park managers, wood industry people).
4. do things that I have never done before.
5. better understand and appreciate the various things (wood products, recreation, etc.) that a forest provides.
6. learn which skills and knowledges are necessary for a forest-related career.
7. learn more about others and myself.
8. get a chance to practice forestry skills and use forestry equipment.
9. be intellectually challenged.

discover the necessary requirements to enter the following five programs:

10. a wildlife biologist program.
11. a 2-year technical forestry program.
12. a 4-year professional forestry program.
13. a recreation (wildlands administration, interpretation, etc.) program.
14. an Environmental Studies (conservation, etc.) program.

15. visit a working wood product manufacturing plant.
16. learn how a natural forest system (trees, wildlife, etc.) functions as an interacting system.
17. have some time to discuss questions and/or ideas that I have.
18. see the effects that various management practices have had on a forest.
19. discover if I'm interested in a forest-related career.
20. be more useful to society by learning about natural systems.
21. be with other people that share a common interest.
22. find out about the wildlife that exists in forest areas.
23. see natural resource managers (foresters, wildlife biologists, etc.) and wood industry people working on the job.

APPENDIX D

POST-CAMP EXPECTATIONS

WHILE AT CAMP I:

1. learned how to identify the trees common to West Virginia.
2. found out about possible forest-related jobs.
3. was able to talk with natural resource managers (foresters, wildlife biologists, park managers, wood industry people).
4. did things that I have never done before.
5. better understood and appreciated the various things (wood products, recreation, etc.) that a forest provides.
6. learned which skills and knowledges were necessary for a forest-related career.
7. learned more about others and myself.
8. got a chance to practice forestry skills and use forestry equipment.
9. was intellectually challenged.

discovered the necessary requirements to enter

10. a wildlife biologist program.
11. a 2-year technical forestry program.
12. a 4-year professional forestry program.
13. a recreation (wildlands administration, interpretation, etc.) program.
14. an Environmental Studies (conservation, etc.) program.

15. visited a working wood product manufacturing plant.
16. learned how a natural forest system (trees, wildlife, etc.) functions as an interacting system.
17. had some time to discuss questions and/or ideas I had.
18. saw the effects that various management practices have had on a forest.
19. discovered if I was interested in a forest-related career.
20. felt more useful to society by learning about natural systems.
21. was with other people that shared a common interest.
22. found out about the wildlife that exists in forest areas.
23. saw natural resource managers (foresters, wildlife biologists, etc.) and wood industry people working on the job.

A LONGITUDINAL STUDY OF FACTORS INFLUENCING VALUE PREFERENCE IN ENVIRONMENTAL PROBLEMS

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Abstract. *One hundred eight junior high students participated in a two-year longitudinal study using an environmental inventory. Factors that might potentially influence environmental value preferences as well as other self-perceived factors (concern, locus of control, knowledge, and sources of environmental information) were investigated. No significant difference, between pre and post tests, was found for most items.*

Introduction

Today's students live in a world dominated by crises, many of which are related to environmental problems. Few students, however, are aware that, in part, these crises are the result of technological development and human behavior.

Many of the crises faced today involve an environmental problem that relates to values. Flitter (1976:6-7) stated that "We need to realize that our environmental problems are rooted ultimately in our human attitudes and values." According to Swan (1971:116) "The root cause of the environmental crises is not population growth, nor our economic and political system, but human attitudes and values which motivate human decisions."

In recent years, more and more environmental education programs which relate to values and the environment are being introduced into schools. Shaver (1972) believes that the school's role is to help students develop a clear conception of what their commitments are and to relate these commitments to the basic values of society. Stapo (1971), in accord with Shaver, advocated that students exploring both the cognitive and affective domains regarding relationships and responsibility within human ecosystems.

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Education might be an important way to help solve environmental problems by developing attitudes and values in children so they may become knowledgeable, concerned, and active citizens. Environmental education, according to Miles (1978), should have a value-oriented goal that is characterized by an ecological justice. Steffenson (1975) noted that effective environmental education must enable students to think, to act, and to seek new value orientations. He stated that "students need help in verbalizing values so they can at least be examined...and compared, so other alternatives can be explored" (Steffenson, 1975:9).

If environmental education is to have affective objectives, it is essential that there be ways to measure the outcome of these objectives. Doran (1977) and Wheatley (1974) concurred that the instruments available tended to be global measures, e.g., environmental attitude surveys and environmental opinion scales. Both authors refer to the difficult task of measuring attitudes, beliefs, and values with respect to environmental education.

According to Sarnowski (1975), "the measure of values is essential for teaching environmental topics laden with value questions and issues." Furthermore, Sarnowski noted that "the information obtained from the measurement of values will enable educators to make curricular and methodological decisions for their environmental education programs" (Sarnowski, 1975:9).

It appears that environmental problems are related to human values. The role of the school in teaching environmental education programs is an important one. To date, most programs are concerned with cognitive objectives. Consequently, there is a need for more affective environmental education programs. Incorporating such objectives into school programs creates, in turn, a need for valid and effective ways of assessing affective outcomes of students.

The word "value" has no universal definition. In this research, the definition of "values" formulated by Adler (1956) et al. will be used. Adler contended that values were preferences held by people whether learned or innate, or both. Robinson and Shaver (1971) commented that values are "...not directly accessible to observation." Instead, values can be inferred from verbal statements and active behaviors. In addition, they are useful in predicting still other observable and measurable verbal and nonverbal behavior (Robinson and Shaver, 1971:408).

Review of Literature

To date, few studies (Gardner and Kleinke, 1972; Iozzi, 1978) have attempted to measure environmental value preferences of junior and senior high school students. However, some studies have attempted to measure values of teachers and college students on environmental issues.

Fazio and Dunlop (1976) developed an Environmental Chemistry Value Preference instrument (ECVP). According to the authors, the ECVP is a valid, reliable, and reasonably efficient way of assessing the value preference of college science majors, nonscience majors and chemistry teachers with respect to the chemical basis of some of our environmental problems. Three value preferences were used--humanistic, theoretical, and technological. The authors found that the highest theoretical value preferences were recorded by science majors. The nonscience major groups had higher humanistic value preferences. There was no significant difference between science majors and nonscience majors in their technology value scores. No significant difference was reported between chemistry majors and chemistry teachers.

Lunneborg and Lunneborg (1972) investigated the effects of environmental information on 25 teachers participating in a workshop as compared to a control group of 22 teachers. Among the tests administered to both groups was Allport-Vernon-Lindsey's (1960) Study of Values. This instrument measured the following six values: theoretical, economic, aesthetic, social, political, and religious. Both groups had nearly identical value profiles on the pre-test. After the workshop, a dramatic increase in the social score was noted, while economic and theoretical scores were lower.

Arbuthnot (1977) investigated 85 recyclers, 60 people from a conservative church and 60 students in a social psychology class. These three groups demonstrated divergent values, interests, attitudes, experience, and personality traits. Arbuthnot, using environmental attitude and personality traits in order to predict environmental behavior and knowledge, discovered that recyclers were more likely to belong to ecology groups and obtain information about environmental issues from sources requiring high personal effort as compared to the other groups. The recycler group was less bound to past ways of believing and acting, i.e., they have a greater belief in their own ability to exercise control over events in their own lives.

Sarnowski (1975) measured environmental values of ninth through twelfth grade students with the Environmental Values Inventory (EVI) which he developed and validated. He hypothesized that general values as measured by Allport, Vernon, Lindsey's (1970) Study of Values instrument were similar to environmental values as measured by the EVI. The results supported his hypothesis. This support was based on similarity of relationships found between the two instruments and the variables: sex, age and geographic residence. These similarities were used to support the construct validity of the EVI. Both of the aforementioned instruments were based on Spranger's (1928) system for categorizing values: aesthetic, economic, political, religious, social and theoretical.

Spranger recognized that individuals have a different order of preference of these value categories depending on their life experiences. Similarly, Sikula asserted that individuals may possess the same values but differ in the priorities they assign to them. "Value systems are merely priority patterns of values or a ranking of values along with a continuum of importance" (Sikula, 1971:282).

According to Spranger, variations in values are due to differences in the "inner" and "outer" situations of life. The "outer" or external experiences include situations in which one interacts with family, friends, church, school, and job. "Inner" or internal situations are the result of experiences unique and innate to an individual. These situations can include, in part, an individual's concern, knowledge, perception (locus of control), beliefs, and attitudes.

The variety of experiences or situations one encounters in life can be portrayed as the totality of these "inner" and "outer" situations. Since value preferences are dependent on various situations of life, one can hypothesize that "inner" and "outer" experiences can have an influence on values.

Data Collection and Analysis

This study investigated selected factors that potentially influence the environmental values of junior high students. The Environmental Inventory (EI) instrument was developed after modification of the EVI (Appendix). Among these modifications were 1) reduction of reading demands and comprehension level, 2) use of 35 mm colored slides to depict the environmental problems and the accompanying occurrence, and 3) reduction in the number of items so as to eliminate fatigue.

The EI measures students' self-perceived 1) concern about problems in the environment, 2) the chances of solving environmental problems and personally helping to solve our environmental problems (locus of control), 3) knowledge about environmental problems, and 4) source of environmental information. In addition, students' environmental value preferences were ascertained by asking them to respond to environmental problems and their occurrences (using slides) and to select one of five value-oriented solutions for each problem.

The content validity of the EI was supported by the results of the following procedures. Two reading specialists examined the inventory and concluded that it could be used effectively at the seventh grade. Several groups of the seventh and eighth grade students (different from the study's sample) viewed the slides and read the environmental problem statements. They perceived that these problems were "realistic" environmental problems and that the slides and statements were related. When asked to "group into similar piles" the action/response statements for all ten items, there was 86 percent agreement with the value categories that the statements were written to represent. A similar classification task was presented to a group of 16 environmental educators with a resulting 95 percent agreement of items to appropriate value category. Based on these findings, it was concluded that the EI was "content valid."

Subject Selection

The subjects investigated in this research attend one of the largest suburban school districts in western New York. They come from a predominantly residential community of approximately 120,000 people who are primarily Caucasian and represent a wide ethnic background.

Data were collected from one centrally located junior high school during the third week in September, 1977 and during the fourth week in October, 1979. Longitudinal data was collected from 108 students, once while they were in the seventh grade and two years later when they were in the ninth grade. Experimental mortality claimed 37 of the original 145 students, a loss of 25 percent.

The investigator administered the inventory and questionnaire to the students to standardize the data collection procedure. Data were collected while students were attending a regularly scheduled 40-minute science class. Answer sheets were machine scored.

The existence of a significant difference on the EI between the same students in seventh and ninth grade was determined by using a two-tailed test on the pre-post data. This statistic is used to indicate whether there is a time difference between two group means; the treatment in this research involves two years of schooling.

All analyses were computed by using Statistical Package for the Social Sciences (SPSS) at the State University of New York at Buffalo computer center. Statistical data were considered significant at the .05 level.

Hypotheses

Hypotheses for the existence of a significant difference between students when in the seventh and ninth grade were formulated. Null Hypothesis I states:

> There is no significant difference between seventh and ninth grade students in their:
>
> A) concern about problems in the environment
> B) locus of control
> C) knowledge about the environment
> D) sources of information about environmental problems.

Null Hypothesis II:

> There is no significant difference between seventh and ninth grade students in their environmental value preference.

Results and Conclusions

Students who participated in this study did not change significantly in regards to how they perceived their concern for environmental problems or their knowledge regarding environmental problems (Table I). They do, however, appear to have a more negative perception about the chances of solving environmental problems and personally helping to solve environmental problems. Therefore, Null Hypotheses IA and IC were accepted; Null Hypothesis IB was not accepted.

Table I

Means, Standard Deviations, and t-tests for Concern, Locus of Control and Knowledge (N = 108)

	Grade	Mean	Std.Dev.	t
Concern	7th	1.79	.58	.60
	9th	1.76	.47	
Locus of Control	7th	5.75	1.34	4.30*
	9th	6.40	1.15	
Knowledge	7th	2.87	.78	1.31
	9th	2.77	.52	

*significant at .05 level

Only responses for "science classes" were significantly different between seventh and ninth grade students. This is towards the direction of more "yes" responses for "science classes" as a source of environmental information. All other sources of environmental information (magazines, television, parents, social studies classes, and newspapers) were not significantly different between seventh grade and ninth grade students (Table II). Null Hypothesis ID was not accepted for science classes. For all the other sources of environmental information Null Hypothesis ID was accepted.

Table II

Measure, Standard Deviation and t-test for Sources of Environmental Information (N = 108)

Source	Grade	Mean	Std.Dev.	t
Magazines	7th	1.52	.52	.17
	9th	1.54	.50	
Television	7th	1.13	.48	1.09
	9th	1.08	.31	
Parents	7th	1.47	.60	.82
	9th	1.53	.50	
Science Class	7th	1.50	.54	6.53*
	9th	1.13	.34	
Social Studies Class	7th	1.51	.50	.14
	9th	1.52	.50	
Newspapers	7th	1.27	.50	1.83
	9th	1.17	.37	

*significant at .05 level

Lastly, it was hypothesized that there is no significant difference between seventh and ninth grade students in their environmental value preferences; Null Hypothesis II was accepted (Table III).

Table III

Means, Standard Deviations, and t-tests for Environmental Value Preferences (N = 108)

Value Preference	Grade	Mean	Std.Dev.	t
Aesthetic	7th	1.54	1.12	1.02
	9th	1.39	.86	
Economic	7th	1.20	.87	1.79
	9th	1.39	.96	
Political	7th	2.82	1.52	1.60
	9th	2.55	1.47	
Social	7th	2.32	1.25	1.03
	9th	2.48	1.14	
Theoretical	7th	2.11	1.21	.41
	9th	2.18	1.14	

Discussion

In essence, it appears from these results that the students who participated did not basically change regarding how concerned they were about environmental problems or about how much they felt they know about problems in and environment. However, students did appear to change in how they perceive their chances of solving environmental problems and personally helping to solve environmental problems. This change appears to be towards a slightly more pessimistic direction. One possible reason for this may be due to the highly publicized Love Canal incident and the West Valley nuclear disposal plant. Both of these facilities are located in western New York. There has been a deluge of material presented to the public via the media regarding the cleanup of both of these environmental disasters. Yet, the problems continue. Students are well aware of these environmental occurrences, the people that have been relocated, the delays in cleaning up each area, and the frustration experienced by many citizens in obtaining assistance.

With the exception of "science classes," it appears that most students felt the same in ninth grade as they did in seventh grade regarding their source of environmental information. Ninth grade students appear to perceive "science classes" as a more important source of environmental information than seventh grade students. By the time students begin ninth grade, they already have experienced a course in seventh and eighth grade science. Many topics concerning environmental/ecological events are often discussed in science classes, especially in eighth grade where a five-week unit is part of the curriculum. The greater number of "yes" responses by ninth grade students for "science classes" underscores the value of the teacher's role as a source of environmental information. It appears from this investigation that schools can perform an important role in communicating environmental information.

The results concerning the lack of a significant change in value preferences (aesthetic, economic, social, political, and theoretical) between the same students in seventh grade and later in ninth grade was surprising. According to this investigation, students' environmental value preferences were established during the elementary school years. Collection of data sometime during the primary years may reveal just when this occurs. Furthermore, it would be of interest to ascertain whether any changes will have occurred in the environmental value preferences of the same students by the twelfth grade. Many unanswered questions pose interesting possibilities for further research.

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APPENDIX

Name______________________________ Grade____ School_______________

ENVIRONMENTAL INVENTORY

Part I: This section is for gathering information about you and your general thoughts about the environ ment.

Write your NAME and SCHOOL on the answer sheet.

1. Grade: 8 _A_ 9 _B_ 10 _C_ 11 _D_ 12 _E_

2. Sex: Male _A_ Female _B_

3. How concerned are you about problems in the environment?

A	B	C
Greatly	Somewhat	Not at all

4. What do you think are the chances of solving our environmental problems?

A	B	C	D	E
Excellent	Good	Fair	Poor	Very Poor

5. My chances of personally helping to solve our environmental problems are:

A	B	C	D	E
Excellent	Good	Fair	Poor	Very Poor

6. How much do you feel you know about environmental problems?

A	B	C	0	E
Very Much	Much	A Little	Very Little	Nothing

7-12 Where have you learned information about environmental problems?

	YES	NO
7. Television	(A)	(B)
8. Science Classes	(A)	(B)
9. Magazines	(A)	(B)
0. Parents	(A)	(B)
1. Social Studies Classes	(A)	(B)
2. Newspapers	(A)	(B)

Part II: This section is to find out how you feel about certain environmental problems.

Directions: Select the statement you prefer the MOST. Fill in the correct space on the answer sheet.

13. As there is an increase in smoke from burning leaves and garbage around the home, clothes and other materials will lose their natural color and smell. What would you do to solve this problem?

A. Make colorful posters and displays which show how smoke is destroying the beauty of the neighborhood.

B. Write letters to ask people in government to take action against the burning of leaves and garbage.

C. Do science experiments to find out exactly how much damage smoke can do to clothes and paint.

D. Study about the dollars lost through this kind of damage.

E. Ask neighbors who are burning leaves or garbage to stop.

14. As there are more paper products used in the home, there will be fewer wooded areas left for picnicking and camping.

In telling the public about this problem, what do you think a T.V. program should stress?

A. How science can help us protect forests and speed up thei growth.

B. The dollars lost to camp owners due to fewer picnicking and camping areas.

C. The effects on people of not having recreational areas to visit.

D. The need for new laws to protect wooded areas and recycle paper.

E. The loss of natural beauty due to fewer wooded areas.

15. As there is more material put into the air from spraying and sanding by workers, there will be more people with breathing problems.

What do you think a good boss faced with this problem should do?

A. Continue to use the cheapest way of spraying and sanding no matter what.

B. Help get new laws passed to control how the job is done so as to reduce spraying and sanding.

C. Use only spraying and sanding tools which are safe to workers and people living nearby.

D. Cut down on spraying even though this would make an area look less attractive.

E. Find new ways to spray or sand by using laboratory research and studies.

16. As there is more careless outdoor camping and hunting, there will be fewer animals living in an area.

What do you think should be done about this problem?

A. Work for the election of politicians who support the protection of wildlife.

B. Make posters which ask people to save our wildlife.

C. Do a scientific study to find how careless hunting and camping hurt wild animals.

D. Teach kids in a summer camp about outdoor projects that do not disturb wildlife.

E. Collect money for a fund to build and protect an area for wildlife.

17. As there is an increase in the amount of smoking in crowded areas, there will be a greater risk of lung cancer to the people in these areas.

As a member of your student council, what do you think should be done?

A. Stress how the health and well-being of others are affected by smoking.

B. Pass out information from scientific research on the effects of smoking.

C. Inform smokers on how much of their money is spent on cigarette smoking.

D. Tell other students that smoking affects how they look to others.

E. Enforce more strongly the rules to control smoking in school.

18. As more noise is given off by cars, trucks, and planes, it will become harder to hear.

If several people wanted to talk to your class about this problem who should be asked?

A. A teacher who can show you how noise affects our enjoyment of music.

B. A lawyer who could tell what laws would be needed to control noise made by cars, trucks, and planes.

C. An engineer who can describe the problems of building noise-proof buildings.

D. A manufacturer who can explain how much it would cost to control the noise given off by cars, trucks or planes.

E. A health official who could discuss how you can protect yourself from the effects of noise made by cars, trucks and planes.

19. As there are more ways used by the fishing industry to catch fish, there will be fewer fish living in the water.

When you see a painting that shows a large number of fish being caught, what do you think about that?

A. An example of success using scientific means of finding schools of fish.

B. The catch shows the fishing industry business helping the economy.

C. The pleasure and enjoyment obtained from viewing this work of art.

D. Here is an industry which must be better controlled by the government.

E. The fish that are being caught will help feed many hungry people.

20. As there are more chemical sprays to control insects, there will be fewer birds in the same area.

Which group do you think should be contacted concerning this problem?

A. A farmer's group that is worried over the high cost of raising crops as a result of protecting birds that eat seeds.

B. A political party that wants to pass new laws to protect wild birds.

C. A health group that is concerned about the effects on people who may have eaten some game birds that fed on the sprayed insects.

D. A conservation club that wants to protect birds for their beauty and songs.

E. A scientific research group that wants to study new chemicals that will not harm birds.

21. As there are more machines clearing the land for farming, there will be fewer wild plants remaining.

What type of action should be taken to deal with this problem?

A. Politicians should use their power while in office to get laws passed to control the use of farm machines.

B. Hire someone to show pictures to farmers that display how machines destroy the trees, shrubs, and flowers.

C. People should be encouraged to investigate ways of farming that use fewer machines.

D. Talks should be given to clubs and social groups about protecting wild plants.

E. Someone should be hired who will compare the cost in using different types of machines.

22. As there are more buildings with glass fronts and windows, there will be an increase in the number of birds hurt or killed by crashing into the glass.

What should be done about this problem?

A. Suggest that a survey be taken to get people's feelings as to the safety of buildings having large glass fronts.

B. Propose a scientific study on the effects of large glass areas on population of birds.

C. Suggest the collection of money from owners who have a lot of glass on their buildings to be used to save birds.

D. Get builders to use stained or colored glass windows to help birds see the windows and also make the buildings look better.

E. Ask Congressmen about passing new laws that would not allow buildings to have large glass areas.

AN ANALYSIS OF THE ENVIRONMENTAL AWARENESS OF YCC CAMPERS-SUMMER 1979

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Abstract. *This paper presents findings of a nationwide survey of the environmental awareness of summer 1979 Youth Conservation Corps campers. Based on pretest-posttest mean score differences within eleven content areas, differences were found in seven areas, indicating substantial achievement for a program as brief and diverse as the YCC program.*

Background/Introduction

The Youth Conservation Corps (YCC) summer camp program is a nationwide endeavor co-sponsored by the U.S. Departments of Agriculture and Interior and the Forest Service. Its major purpose is to provide a combined program of environmental education and work projects for youth, aged 15 to 18, who are enrolled in the corps' summer camps. In pursuing this goal, the program attempts to make environmental activities as relevant as possible to various field projects in which these adolescents are involved. Beyond this common goal, however, camp programs vary greatly in terms of geographical location and work projects, and camp staffs differ widely with respect to experience, training, and educational perspective.

This report discusses the results of an assessment of the environmental awareness of YCC campers before and after their 1979 camp experience. Through the joint efforts of individuals affiliated with the Environmental Studies Center at the State University of New York at Buffalo, an assessment system for measuring environmental awareness was developed. This involved identifying the environmental awareness goals of YCC, constructing, pretesting and screening items designed to reflect these goals, the development of an item sampling plan to select items for specific tests, and the preparation of several forms of each test.

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Eleven domains of goals were developed which served as bases for the construction of individual test items. These eleven domains consisted of ten cognitive areas and one affective area, as follows (number of items in each domain appears in parentheses)[2]:

A. Nature and Natural Systems (43)
B. Relationships in Ecosystems (50)
C. Catastrophes (42)
D. Carrying Capacity (40)
E. Intrusive Role of Humans in Nature (45)
F. Wastes (46)
G. Human Management Limitations (42)
H. Renewable and Nonrenewable Resources (41)
I. Ecosystem Protection (42)
J. Environmental Policy-Making Process (38)
K. Individual Interest and Concern (52)

These domains are discussed below, grouped according to conceptual similarities.

Domain A, Nature and Natural Systems, focused on the five elements of ecosystems: land, water, air, plants, and animals. Domain B, Systemic Relationships in Ecosystems, was concerned with basic processes in ecosystems, such as the life cycle, biotic succession, and the food chain.

Four of the domains dealt with knowledge and understanding of specific concepts critical to the definition of environmental awareness. Domain C, Catastrophes, dealt with both natural catastrophes such as floods and earthquakes, and human-caused disasters like oil spills, explosions, and nuclear accidents. Special emphasis was given to growing populations and technological intervention as increasing the likelihood of catastrophes, and to ways of anticipating and controlling the effects of catastrophes. Domain D, Carrying Capacity, concerned factors which limit the carrying capacity (e.g., amount of water or nutrients) and processes which threaten it, such as population growth rates. Domain F, Wastes, focused on effluents resulting from human activities like agriculture, mining, manufacturing, and transportation. This domain also dealt with items concerning desirable practices regarding wastes, including improved waste handling

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[2]Number of items within each domain varies due to the size of the original item pools generated, and to the unequal numbers of items discarded from each domain during the development and revision process. An upper limit of approximately 50 items per domain was established for reasons of parsimony.

recycling, and use of biodegradable products. Domain H, Renewable and Nonrenewable Resources, assessed understandingand knowledge of which resources are renewable, recycling of nonrenewable resources, conservation, and increased efficiency of resource use.

Four domains focused on humans and their interactions with nature. Domain E, Intrusive Role of Humans in Nature, examined the implications of people's attempts to dominate nature. Included in this domain were items concerning results of insecticide use, chemical effluent disposal, excessive energy consumption, and the construction of cities, highways, and dams. By contrast, Domain I, Ecosystem Protection, concerned ways of minimizing human impact on the environment by such means as the preservation of endangered species and reduction of resource use. Domain G, Human Management Limitations, recognized that, although people do attempt to dominate nature, they are neither omnipotent in their ability to do so, nor omniscient in their ability to anticipate the consequences of their acts. Items in this domain assessed whether campers recognized these limitations and if they were hesitant to indulge in new nature-dominating activities. Domain J, Environmental Policy-Making Process, concerned institutions designed to deal with environmental problems. A major facet of this domain was knowledge of existing agencies and organizations and their purposes. Also tested was comprehension of governmental and societal processes through which laws are made and agencies formed.

Finally, Area K, the attitude domain, allowed campers to report their individual habits, activities, and beliefs concerning environmental issues by responding to statements on a four-point Likert scale (Strongly Agree to Strongly Disagree). A four-point scale was used, rather than the more typical odd-integer scale, to prevent neutral or "undecided" response choices. Illustrative items from each of the eleven domains appear in Appendix A.

Method

The general planning by national YCC staff of the 1979 assessment imposed several conditions upon the design of the survey. First, the assessment was to be nationwide. Second, procedures used needed to provide for sensitivity to rather modest changes in each of the eleven domains. Third, estimates were desired concerning the relationships among the domains. Fourth, the data needed to provide for continued psychometric evaluation of the domains as well as domain definitions. Fifth, the assessment was to be made in a way that would make clear that individual camps were not being evaluated. Finally, the design had to provide a means to confirm that observed pre-post differences, should they occur, were attributable to the YCC program's impact rather than to extraneous influences.

These requirements led to the design of a complex camper/item matrix sampling plan whereby each camper answered a questionnaire of only 40 to 50 of the 481 available items, drawn from between one to four of the domains. Different campers were observed at the beginning than at the end of the camp experience to emphasize that individual camps were not being evaluated, and to preclude the possibility that any improvement was due to prior practice on the instrument.

In order to distribute items evenly among camps and campers, 51 partially overlapping forms were designed. Eleven of these forms contained items representing a single domain. The remaining 40 forms were compiled in such a way as to provide for the co-occurrence of each pair of domains and approximately equal representation of items within domains. This design achieved an appropriate balance and breadth of representation of each domain, a balance of cross-domain information, and completeness of within-domain, cross-item information. This permitted analyses of the relationships among domains as well as estimation of psychometric properties of the domains. The reader interested in a more detailed and complete discussion of the sampling plan is referred to an earlier project report (Milbrath, et al., 1979).

The sampling of camps was accomplished by first stratifying all available YCC camps, based on 1978 camp lists, by agency (Agriculture, Interior, State), and within stratum by camp size. Each of the three resulting lists were then partitioned into sampling segments containing nine camps each, and camps within each segment were randomly ordered. With camps segmented and ordered in this manner, the first two camps from each segment were chosen for testing at the beginning of the camp experience and the next two camps were chosen for testing at the end of the camp experience. The remaining camps were set aside as spares, to be substituted if necessary, since the plan was developed based on 1978 camp lists. The sampling procedure resulted in the selection of 194 camps with 9855 campers for beginning of camp testing, and 194 camps with 9850 campers for end of camp testing. These numbers represent approximately 44 percent of the total population of YCC campers, based on 1978 camp lists.

Specific directions for test administration were distributed to camps with the forms. Completed answer sheets were mailed to the Environmental Studies Center, State University of New York at Buffalo, during the summer and fall of 1979, where an extensive screening process took place. Answer sheets were checked manually for any irregularities, such as incorrect or missing questionnaire form and camp numbers. Answer sheets that had been photocopied or done in ink were redone using a soft lead pencil, to guarantee readability by optical scanner at a later stage. Data were then transferred from answer sheets to magnetic tape via an optical scanner. The resulting data files were again scanned using a specially prepared program which examined each case for missing or unexpected pre-post camp codes, missing or multiple responses, and consistency among three form identifiers. Editing was then done manually by a staff member, who compared data records that had irregularities to the original answer sheets. Records which could not be clearly identified by form or pre-post classification were eliminated, as were cases with more than one-half of the responses missing.

The edited files were then submitted to a scoring program which recorded each item, except for the attitude domain, as correct or incorrect.

Data Analysis

Unbiased estimates of item means, variances, and covariances were computed to take into account the considerable amounts of missing data resulting from the item sampling plan. These were then synthesized into total score estimates for each domain. The estimated item parameters were also used to estimate two psychometric properties of the item sets. The reliability of tests of equal length was estimated for each domain, as was the homogeneity of the domain. A detailed account of these procedures and the resulting estimates are contained in the final report of the project (Farr, et al., 1980).

General Findings

After 165 cases were eliminated because they could not be identified, contained missing data, or were otherwise unusable, 14,796 campers were represented in the data, 7,635 who had been assessed at the start of their camp experience and 7,161 who had been tested at the end. According to the overlapping sampling plan, each domain was represented by approximately 2400 campers observed before the camp experience, and approximately 2200 observed after. Results for each domain are reported in terms of total scores based on all items included in the survey.

Estimates of before and after camp performance of the 1979 campers are shown in Table 1, arranged in order of difference between pre and post camp performance. An approximate t-test was calculated for each difference and indicated statistically significant differences for six content domains, as well as for the attitude domain.

Table 1

Estimates of Environmental Awareness Before and After 1979 Camp Experience

Environmental Awareness Area	No. of Items	Average Before	Average After	Standard Deviation Before	Standard Deviation After
Content Area Differences*					
A. Nature and Natural Systems	43	26.49	27.42	7.68	7.14
B. Relationships in Ecosystems	50	30.60	31.74	10.19	10.59
D. Carrying Capacity	40	22.53	23.27	7.24	7.24
E. Intrusive Role of Humans	45	27.89	28.60	9.38	8.93
I. Ecosystem Protection	42	29.21	29.89	8.83	8.98
F. Wastes	46	29.04	29.64	8.71	8.81
Attitude Difference					
K. Individual Interest & Concern	52**	105.83	106.94	17.44	20.37
Differences not demonstrated					
H. Renewable and Non-Renewable Resources	41	25.89	26.24	7.27	7.70
G. Human Management Limitations	42	25.17	25.49	8.44	8.89
C. Catastrophes	42	27.79	27.76	8.24	9.36
J. Environmental Policy-Making Process	38	22.25	21.96	6.29	7.19

*$p < .05$

**Scored 0-3; possible range 0-156

The gain from pre to post camp experience does not seem dramatic for any one domain, but this could hardly be expected given the diversity of camp programs. More important, from a national perspective, is the cumulative impact of YCC. Summing gains from pre to post across domains indicates that, on the average, campers improved in performance by about five points, or 2 percent of the item pool. While this improvement cannot be tested statistically, due to the nature of the research design, it seems to be a noteworthy accomplishment for a program as diverse and hurried as YCC. It is impressive that accumulating this information nationally shows a significant average impact on six cognitive areas as well as in attitudes.

The larger gains in certain domains seem to indicate that those areas which are relevant to particular work projects, and which are more often recognized as camp program objectives, also show greater effects from pre to post camp experience.

The largest gains were found in the two most general areas, Nature and Natural Systems (Domain A) and Relationships in Ecosystems (Domain B). These domains include material that is easily illustrated in almost any habitat, and which would be included as objectives in the majority of camps. The remaining four domains which showed significant gains represent more specific concepts, but those which still can be illustrated in nearly every habitat. This material, however, would less likely be included as objectives of specific camp programs.

Two of the domains which did not show differences before and after camp, Human Management Limitations (Domain G) and the Environmental Policy-Making Process (Domain J), concern people and their institutions. The material contained in these domains do not reflect the type of issues that campers would find in their everyday camp projects, nor is it likely that these are major objectives of individual camp programs. Of the remaining domains, Catastrophes (Domain C) deals with events not likely to be encountered during the camp experience, and Renewable and Nonrenewable Resources (Domain H) concerns minerals, energy, and food resources, which also may not be directly related to camp activities.

Analysis Based on Specific Items

The general finding that the YCC program had significant impacts in some environmental awareness domains but not in others suggests that YCC camps currently are better suited to instill gains in some content areas than in others. It may be that the camp experience is more closely related to some content areas than to others, or that camp personnel are better able to provide instruction and leadership in some content areas than in others.

Interestingly, many of the items which showed the greatest gains from pre to post camp represented conceptual learning. The concept clearly could not have arisen from the daily observation of natural events, but had to have been taught by an instructor. The items showing clear gains came from a variety of content domains; their common characteristic was the conceptual learning reflected in each. It would seem, on the basis of this finding that, even though the camp experience provided a setting for learning, the more dramatic gains were achieved through teaching. To illustrate, campers showed a significant increase in the content area, Carrying Capacity (Domain D). Yet carrying capacity is an abstract concept that cannot be learned by merely pointing to an object and naming it, nor through typical daily observations in the camp setting. It seems that the concept had to have been taught by an instructor who considered it an important one to learn.

These findings suggest that the YCC camps provide settings in which meaningful learning about the environment can take place, in an atmosphere similar to that of a classroom. If campers can gain significantly in areas such as carrying capacity and relationships in ecosystems, it would seem that they could also gain significantly in conceptual areas such as renewable and nonrenewable resources, human management limitations, catastrophes, and the environmental policy-making process. The fact that the campers surveyed did not show gains in any of these domains suggests that either the leaders of YCC have not emphasized strongly enough the importance of teaching these concepts to campers, or that camp staffs themselves are poorly equipped to teach in these areas. It is likely that both of these possibilities are valid.

Campers were fairly ignorant of some of the basic facts concerning energy, and had very poor knowledge of natural and human-caused catastrophes. Also, campers knew very little about population trends both in the U.S. and worldwide. The YCC camp experience did little or nothing to increase campers' knowledge in any of these areas.

Although the national environmental awareness objectives of YCC, and staff training materials, emphasize that campers should become more aware of environmental management agencies and of public policy-making processes, the results of the 1979 assessment show that campers start camp with little knowledge of government and policy processes, and that very little happens in camp to increase this knowledge.

Results regarding the attitudes of campers toward environmental issues and concerns support the notion that there is a great love of nature among today's youth. The YCC camp experience seems to build on this, as evidenced by the modest gains in the direction of greater love of nature and a desire for environmental protection. These young people have realized a personal responsibility for environmental protection, rather than assigning that responsibilitv to the socio-political system. While personal concern for the environment was high, the proportion of campers who reported having taken environmentally protective action was much smaller. Typically, no more than half of these campers reported having consciously acted to protect the environment. Gains in this direction, traceable to the camp experience, were perceptible but very modest.

Summary

From the data one can conclude that many YCC camps are suitable learning settings and that campers did learn a good deal about some content areas, as well as showing modest increases in attitudes toward the environment. In a program as diverse and limited as the YCC program, this is an impressive accomplishment. However, the data also show that there are some glaring deficiencies in the current approach to the environmental awareness component of the YCC program. Some policy decisions should be taken by national leadership concerning emphases that should be given to specific environmental awareness content areas in YCC. Following this, teaching materials and staff training should be oriented toward providing more adequate coverage, particularly to the deficient content areas selected for greater emphasis. The data further suggest that ordinary teaching methodology would probably be successful in producing substantial learning gains.

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APPENDIX A

Illustrative Items

A007 All animals need certain basic things to stay alive. In addition to water, other basic needs are:

A) people and plants
*B) food and air
C) food and fire
D) soil and minerals

B012 The process by which plants use sunlight to convert carbon dioxide and water into organic molecules is known as:

A) respiration
B) the food chain
C) evaporation
*D) photosynthesis

C002 The economic loss from floods may be reduced by all of the following except the:

A) construction of levees
B) construction of dams
*C) building of homes on floodplains
D) building of homes on mountain sides

D005 Carrying capacity is determined by:

*A) the number of organisms that an area can support over a period of several years
B) the amount of energy-producing resources in a given area that can be used
C) the depth of the water table
D) the amount of food an animal can store in its stomach

E012 Nuclear power plants located on lakes are a danger to water life because these types of power plants:

*A) raise the temperature of the water
B) reduce the oxygen content of the water
C) add dangerous chemicals to the lake
D) lower the water level of the lake

*indicates keyed response

F016 Returnable containers:

A) should be against the law
B) are a needless bother
C) increase litter
*D) reduce waste

G006 The development of chemicals to kill insects in order to prevent them from eating crops has resulted in:

A) the total destruction of many insect species
B) chemicals that only kill insects and are harmless to other wildlife
*C) harmful chemicals that are passed along in the food chain
D) "chemical saturation" of the soil

H021 A natural resource that cannot be replaced as it is being used is called a(an):

A) unlimited resource
*B) nonrenewable resource
C) renewable resource
D) recycled resource

I019 Animals listed on the endangered species list:

A) should be eliminated as soon as possible
*B) should not be hunted for whatever reason
C) are mutations and should be studied
D) are harmful to man

J013 Which agency of the United States federal government regulates both timber and land use (including wilderness areas)?

A) Bureau of Reclamation
B) Bureau of Land Management
*C) U.S. Forest Service
D) U.S. Park Service

K007 I often think about things I can do to contribute to the recycling of products we use.

A) Strongly Agree
B) Agree
C) Disagree
D) Strongly Disagree

ASSESSING ENVIRONMENTAL EDUCATION TEACHERS AND CURRICULA

Louis A. Iozzi, EVALUATION OF "PREPARING FOR TOMORROW'S WORLD"-SCIENCE/TECHNOLOGY/SOCIETY FOR GRADES 7-12.

David I. Johnson and Douglas C. Covert, A LEARNING AND COMMUNICATIONS PROFILE OF TEACHERS ENTERING AN ENVIRONMENTAL EDUCATION EXPERIENCE.

EVALUATION OF "PREPARING FOR TOMORROW'S WORLD"-SCIENCE/ TECHNOLOGY/SOCIETY FOR GRADES 7-12: METHODOLOGY AND RESULTS

Louis A. Iozzi[1]

Abstract. *The complexity of issues facing society demand an interdisciplinary curricula. Combining the theories of Piaget and Kohlberg with new research, the Socio-Scientific Reasoning model was formulated, with the goals of fostering growth in critical thinking, decision-making, problem solving and moral reasoning.* Preparing for Tomorrow's World, *a futures-focused environmental education program consisting of 14 modules that supplement existing curricula for grades 7 through 12, is based on these objectives. This program was found to be highly effective in increasing cognitive achievement and moral/ethical reasoning about issues at the interfaces of science, technology and society. Methodology and evaluation results of this intervention study are discussed.*

I. Introduction--Futures-Focused Environmental Education

Literature in the field of environmental education has, for the most part, emphasized many of the perceived contemporary environmental needs and concerns of today's world. Moreover, since the "surroundings" of individuals across our nation, and indeed the world, vary appreciably, so too do the types and orientations of environmental educators and environmental education programs. Thus, environmental education is the term employed to encompass an ever-increasing variety of notable efforts, programs and orientations.

Some environmental education programs, for example, emphasize one or a combination of two or more areas of environmental interest or concerns. While some programs focus on the natural world, others are primarily concerned with outdoor pursuits, and still others deal essentially with conservation, recreation, and, of course, energy.

Depending on the location, some programs concentrate on a particular environment such as woodlands, coastal zones, mountains, deserts, and, in recent years, the so-called "built" environment. Some restrict their area of inquiry to

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the local surroundi[illegible] while others expand their scope to include the global e[illegible]ronment. While curricula and programs of instruction in environmental education vary widely, all seem to share a common goal: to help today's youth become more aware, knowledgeable and concerned about their surroundings.

The program described in this paper, Preparing for Tomorrow's World, adds another dimension to environmental education, an emphasis on issues, problems and concerns at the interfaces of science/technology/society. This program, moreover, was designed at the Institute for Science, Technology, and Social Science Education at Rutgers--The State University, to both address issues of contemporary concern and to help prepare today's youth to deal with environmental conflicts and issues just now emerging and projected to be of significant importance in the year 2000 and beyond. Hence, the program can be described as future-focused environmental education.

That we live in a highly scientific and technological world can hardly be disputed. Few would deny that society has in recent years come to rely on the achievements of science and technology to make life more comfortable, convenient, and for many, more enjoyable. Few would deny that society is becoming increasingly more dependent upon the ingenuity and achievements of the scientific/technological world. Moreover, few would deny that the application of science and technology exerts a major impact on our total environment.

While no one can, with any degree of certainty, predict what future demands society will place on science, or for that matter, what demands science and technology will place on society, some trends seem clear. For example, Shane (1977) in a recent study interviewed and summarized the futures forecasts of a distinguished international panel of educators, world leaders and futurists. This panel identified the developments which, in their opinion, will have a significant impact on future events. According to this panel, the next quarter century and beyond will bring about:

--a continued acceleration in the rate of change

--greater complexity of life because of new technological breakthroughs

--the end of the hydrocarbon age

--a need to reassess our present concepts of growth

--continued crowding, overpopulation, and persistent food shortages

--continued pressure for human equity in all areas

--increased demand from less developed countries for a new economic order

--international disagreement and conflict

--changing concepts of work and leisure

--increased governmental debt and capital deficit

--governance problems and threats to freedom

--a post-extravagant society

Clearly, the decisionmakers being cultivated today will be required to solve environmental and social problems and resolve conflicts which are encountered only in wild dreams, or, in some cases, only in most frightening nightmares.

Although it is anticipated that our future environmental problems will to a great extent be very different from those known today, society is already beginning to see emerging the types of questions which will become common in the not very distant future.

--The question will not be "can we" utilize the power of nuclear fusion to provide an almost limitless supply of energy despite its dangers, but rather, "should we"?

--The question will not be "can we" modify weather, climate, and other aspects of our environment, but rather, "should we"?

--The question will not be "can we" colonize outer space or the ocean depths to relieve the pressures of overpopulation, but rather, "should we"?

--The question will not be "can we" produce a "Brave New World," but rather "should we"?

Simply, questions which today ask "can we" are being transformed rapidly into the more appropriate "should we."

Science and technology can respond effectively to questions of the "can we" variety, for these are decided by scientists and engineers based on technical fact. Questions of the "should we" variety require, on the other hand, the consideration of another dimension--a values dimension. Such values-based questions must be addressed by an educated and environmentally literate society, and not by scientists and engineers alone.

With the continuing complexities of issues facing society, curricula can no longer be confined to the boundaries of traditional disciplines. Just as environmental education, and indeed the environment itself, is not restricted to rigid disciplinary lines, so too must futures-focused environmental education be free to vary and to cross traditional disciplinary boundaries. As Piaget has argued in To Understand is to Invent (1973), more effective solutions to science/society problems will emerge from interdisciplinary research.

Hence, educators must develop in youth skills that are generalizable, highly flexible, and enduring; educators must emphasize the development of skills which are t least as basic as any of those proposed to date. These skills are problem solving, decision-making and a variety of analytical and critical thinking skills. Moreover, in developing these skills a moral/ethical dimension is crucial if today's students will bear the responsibility to effectively and humanely deal with tomorrow's problems.

II. Preparing for Tomorrow's World-- Description of the Program

The Institute for Science, Technology and Social Science Education at Rutgers--The State University, has attempted to "bridge the gap," both among science, technology and society and between theory and practice. These efforts have resulted in a package of curriculum materials based on the Socio-Scientific Reasoning Model (Iozzi, 1980; Iozzi and Cheu, 1978). The model is based upon and integrates the cognitive developmental theories of Jean Piaget (logical reasoning), Lawrence Kohlberg (moral reasoning), Robert Selman (social role taking development), as well as new research conducted by the author and other research dealing with adolescent problem solving. In addition to increasing students' knowledge about existing and emerging issues of importance at the interfaces of science, technology and society, the overall goal of the program--Preparing for Tomorrow's World--is to provide interesting, yet meaningful and useful experiences which will result in improved decision-making and critical thinking skills and moral/ethical reasoning ability in junior and senior high school students.

A total of 14 curriculum modules employing a variety of formats have been produced. Each curriculum module is a highly flexible, self-contained unit of instruction which includes all materials necessary for classroom use. The number of instructional periods required to teach a module ranges from a minimum of two weeks of intensive instruction to, depending on individual school needs, an entire school year. Because the modules are highly flexible, existing programs of instruction need not be altered. Modules are designed to be infused into present courses to provide needed extension or supplementary types of activities.

Each of the 14 modules focuses on a different problem area and guides students to examine numerous issues, using a variety of strategies. Specific module topics and grade levels at which they were field tested are:

<u>Beacon City--An Urban Land Use Simulation (grades 11, 12)</u>
<u>Dilemmas in Bioethics</u> (grades 11, 12)
<u>Technology and Society: A Futuristic Perspective (grades 11, 12)</u>
<u>Environmental Dilemmas: Critical Decisions for Society</u> (grades 10, 11)
<u>Of Animals, Nature and Humans: A Social Dilemma</u> (grades 10, 11)
<u>People and Environmental Changes</u> (grades 9, 10)
<u>Future New Jersey: Public Issues and the Quality of Life</u> (grades 9, 10)
<u>Perspectives on Transportation</u> (grades 8, 9)
<u>Food: A Necessary Resource</u> (grades 8, 9)
<u>Technology and Changing Lifestyles</u> (grades 7, 8)
<u>Energy: Decisions for Today and Tomorrow</u> (grades 7, 8)
<u>Space Encounters</u> (grades 7, 8)
<u>Coastal Decision: Difficult Choices</u> (grades 7, 8)
<u>Future Scenarios in Communications</u> (grades 7, 8)

The modules are essentially:

<u>Free standing</u> and can be used as a separate unit of study, mini-course, or infused into existing programs where appropriate.

<u>Interdisciplinary</u>, incorporating information and concepts from the sciences and social sciences. The issues address societal concerns which interface science, technology, and society.

<u>Future oriented</u> and aim at promoting responsible citizenry with increased abilities in critical thinking, problem solving, social/moral/ethical reasoning and decision-making; citizens who are more cognizant of the implications and consequences of their decisions.

<u>Self-contained</u> with all materials necessary for teaching the module included: background information, readings, student worksheets,

audiovisuals, evaluation instruments and other teaching/library aids.

Flexible and are designed to complement a number of subject areas.

No particular or specialized staffing is required to use any of the above modules in the classroom. The program is intended to be implemented by the regular classroom teacher in both public and nonpublic schools. Since unique teaching strategies are employed, a teacher training workshop is highly recommended if the students are to obtain the maximum benefit from the materials.

III. Purpose of the Study

The purpose of this study was to determine whether the curriculum materials comprising the Preparing for Tomorrow's World program are effective in increasing cognitive achievement and fostering growth in moral/ ethical reasoning ability in a science/technology/society context. Cognitive achievement as used here refers to the acquisition, storage, transformation, creation, evaluation and utilization of knowledge (Kagan, 1978). Growth in moral/ethical reasoning ability as used here refers to and is based upon the cognitive-developmental school of thought and relies most heavily upon the theories of Jean Piaget and Lawrence Kohlberg. Growth is based upon the stage theory advanced by Kohlberg.

Specific Objectives of the Study

1. As a result of participating in the Preparing for Tomorrow's World program, students will exhibit statistically significant ($p < .05$) growth in cognitive achievement within the context of science, technology and society.

2. As a result of participating in the Preparing for Tomorrow's World program, students will exhibit statistically significant ($p < .05$) growth in moral/ethical reasoning ability.

IV. Method

A. Evaluation Design

The evaluation design utilized was a nonequivalent comparison group design in which both treatment and comparison groups were pretested and, after intervention, posttested with instruments measuring the major dependent variables. Dependent variables included cognitive achievement, moral/ethical reasoning and aptitude/ability. Independent variables included treatment effects and sex of participants.

Since earlier studies found that cognitive achievement was significantly related to ability to succeed in academic work, the "ability" variable for both treatment and comparison groups was controlled using appropriate statistical procedures for Objective 1 (cognitive achievement). Academic ability has not been found to be significantly related to moral/ethical reasoning, and therefore, was not controlled for Objective 2 (moral/ ethical reasoning).

B. Sample Characteristics

Teachers and students from public and nonpublic schools representing 34 communities in New Jersey volunteered to participate in this program. The subjects (Ss) can be considered as representative of a cross-section of all junior and senior high school students (grades 7 through 12) in New Jersey and, indeed, the entire nation.

Academically, the students exhibited a wide range of abilities--from gifted students to those at the lower end of the academic spectrum. The differences were controlled in the statistical analyses.

Socio-economically, the Ss represented a broad spectrum--from affluent to economically disadvantaged. The major ethnic and racial groups in New Jersey were included. These include Eastern as well as Western cultures, Native Americans, and minorities. There were approximately the same number of males as there were females.

C. Sample Size

More than 6,000 New Jersey students used the Preparing for Tomorrow's World curriculum series between September 1978 and April 1980. The study utilized more than 150 New Jersey school teacher volunteers representing 34 towns/cities/communities across the state.

D. Instruments

Cognitive Achievement. A set of instruments was developed to measure cognitive achievement for the 14 modules. Test items were matched to a particular module, reviewed by subject matter specialists and teachers, revised on the basis of the expert reviews, and assembled into instruments.

All items were multiple choice with four response options. As indicated on the following table, most questions were designed to measure higher cognitive processes rather than simple recall (based on analyses by Dr. June Maul). K-R (20) Estimated Reliability Coefficients were computed by Dr. William Schabacker, Educational Testing Service (Table 1).

Content validity is essentially judgmental as to how well the test questions match some predetermined criteria. For most educational achievement tests, these criteria are the objectives of an educational program. Teachers, subject matter specialists, learning theorists and educational specialists were an integral part of this project's development process. They were utilized because of their familiarity with current issues embodied in the content of each module and/or their knowledge of educational theory and practice, and/or their knowledge of junior and senior high school age youth. While no process can guarantee that the content of a test will be valid, the steps followed in developing the project's instruments indicate a high probability that the tests have content validity.

TABLE 1

Analysis Of Test Questions

Cognitive Achievement Test	Information Recall	Synthesis	Conceptual	Total	K-R (20)
Beacon City	1	11	20	32	.79
Communications	4	10	15	29	.78
Bioethics	3	12	20	35	.71
Space Encounters	0	10	15	25	.69
Coastal Decisions	2	9	14	25	.52
Technology/Lifestyles	3	9	13	25	.75
People/Environmental Changes	3	10	13	26	.49
Technology/Society	4	7	14	25	.75
Future New Jersey	4	10	11	25	.77
Environment Dilemmas	2	14	20	36	.76
Energy	3	10	17	30	.78

School and College Ability Test--Series II--Verbal (SCAT-V). The SCAT-V was used to measure ability to succeed in future academic work. In the field test, SCAT-V served as a measure for controlling for variances in ability in both treatment and comparison groups. This test contained 50 verbal analogy items and measured a student's understanding of words. Form 3A was used for grades 7 and 8, Form 2A for grades 9 through 12. Prediction validity of SCAT-V with English grades expressed as a correlation coefficient is .52 (grades 8 through 11) and .46 (grade 12). Among the reported concurrent validity coefficients is .52 with rank in graduating class. Grade-by-grade measures with interval consistency expressed as coefficients range from .88 to .90 with grade 7 having the lowest and grade 12 the highest.

SCAT-V correlates .50 with cognitive achievement test scores.

Questionnaires. Teacher questionnaires were also utilized to determine the effectiveness of modules in meeting project objectives. These instruments employed both Likert intensity scales and open-ended variation responses. A student questionnaire was also used. This instrument was similar in format to the teacher questionnaires, but included questions directed at student concerns.

Moral/Ethical Reasoning. Two standardized and published instruments were utilized. The Environmental Issues Test (EIT) was used with modules dealing with environment related content while the Defining Issues Test (DIT) was utilized for all other modules (8 modules). Both instruments are similar in format and organized so that a student first reads a dilemma story and then indicates the importance of 12 issue statements regarding the solution to the dilemma on a Likert-type intensity scale. Each of the 12 issue statements is keyed to a moral/ethical reasoning stage as defined by Lawrence Kohlberg. After indicating the importance of such issue statements, the student then identifies and rank orders the four most important statements. Both instruments include detractor items and consistency procedures to identify any students selecting statements randomly. Those tests which do not "pass" the consistency check are discarded.

Reliability coefficient for the EIT using a test/retest technique was .84 (N = 40 ninth grade Ss). Time interval between test and retest was seven days. Judgments about content validity can be made from the EIT's parallelism to the Defining Issues Test. Concurrent reliability r = .36 with the affective subscale of the Ecology Attitude Inventory and r = .63 with the Defining Issues Test. Readability is grade 9 (Fry Scale).

For the DIT, test-retest r is .82 (N = 123 Ss, age 16-56). Time interval between test and retest was reported as "one week to five months." Among the relevant concurrent validity coefficients are .68 with the Kohlberg Moral Maturity Scale, and "in the .30s and .40s" for ninth graders on the DIT and the Iowa Test of Basic Skills. Readability is grade 9 (Fry Scale).

Both the EIT and the DIT can be scored in several ways--each method more or less sensitive to different changes. Three scoring methods were employed in the evaluation.

E. Data Collection Procedures

Treatment and comparison groups consisted of volunteers desiring to participate in the program. Although the Preparing for Tomorrow's World program consists of 14 curriculum modules, only 10 of the 14 were used in this study. For each module volunteers were limited to teachers and students in grades for which the modules were developed and who agreed to predetermined, standardized use of the project materials and evaluation instruments. For all modules and at all field test locations the following were collected:

1. Data Type. Pretest/posttest scores for cognitive achievement, moral/ethical reasoning, general academic ability, teachers' opinions, students' opinions.

2. Method of Data Collection. Standardized tests: moral/ ethical reasoning, School and College Abilities Test-Verbal (SCAT-V), questionnaires, project developed tests (cognitive achievement), and machine scorable response documents.

3. Timelines. Variable--from 2 to 8 weeks depending upon specific module, particular circumstances, existing curriculum and needs in field test school district.

4. Personnel Responsible. Regular classroom teachers, Project Director, Associate Director, Field Test Coordinator, Evaluation Consultant.

F. Sampling Technique

If all students were administered the full battery of instruments required to adequately evaluate Preparing for Tomorrow's World, each participant would have been subjected to three full class periods of pretests and three full class periods of posttests. This procedure was considered unacceptable and a matrix sampling technique was employed to both reduce the amount of testing time and to ensure the inclusion of an adequate sample size.

All students (project and comparison) were administered the SCAT-V. However, the cognitive achievement tests and the moral/ethical reasoning tests were spiraled so that each student was administered only one of the tests. This technique allowed for random assignment of a test form on the pretests. For posttest administration, each student was administered the same test form used in pretest administration.

All instruments were administered by the regular classroom teacher. All tests except the moral/ethical reasoning test were machine scored. Scanning of these documents was under the supervision of staff personnel. The moral/ ethical reasoning tests were hand scored by project personnel under the supervision of the Project Director.

Treatment groups were tested concurrently with comparison groups using the same instruments during the same time period. Since only the treatment group received instruction using the Preparing for Tomorrow's World program, any changes in pretest to posttest scores is attributable to the intervention (controlling for ability differences). The comparison group was administered only the pretests and posttests. They did not utilize any of the modules.

Since the only significant difference between the comparison group and the treatment group was exposure to the curriculum modules, any growth in cognitive achievement and in moral/ethical reasoning demonstrated by the treatment group is attributable to the effectiveness of the Preparing for Tomorrow's World program.

G. Control Group/Treatment Group--Evidence of Equivalency

Control groups consisted of classes of students and their teachers volunteering to participate in the field test. Some comparison groups were from the same school as the treatment groups while other comparison groups were from entirely different schools and communities. When comparison groups and treatment groups were from the same school, monitoring by project staff ensured that no student was inadvertently included in both treatment and control samples. When a comparison group was selected from another school or school district, the selection process included consideration of factors such as socio-economic information, school organization, learning environment, etc.

To control for any differences in ability between treatment and control groups, analysis of covariance was employed in comparing pre/posttest effectiveness. The SCAT-V scores served as the ability measure. All students were tested by their regular classroom teachers during the same time period using the same instruments.

H. Data Verification Procedures

Cognitive Achievement and SCAT-V. Responses were made on machine scannable documents. Machine scoring was conducted at Educational Testing Service, Princeton. Approximately 10-15 percent of the answer sheets were personally verified by ETS personnel.

Moral/Ethical Reasoning. Responses were made on nonmachine-scorable documents and were hand scored by project personne ter they were thoroughly instructed in the necessa: procedures. Scoring was under the direction of the Project ector. Approximately 30 percent of the instrumen were rechecked by Dr. June Maul and the Project Director--both having had extensive training and experience in scoring moral/ethical judgment tests at the Center for Moral Education, Harvard University, directed by Lawrence Kohlberg.

I. Data Analyses Procedures

Analysis of variance, analysis of covariance and t-tests were the primary statistical tools employed. ANOVA and ANOCOVA were used because the field test design required comparing in a single analysis the various cognitive factors which might be affecting the program as well as the relationship between more than two measures. T-tests were used in analyzing the data gathered for moral/ethical growth as a result of the intervention. Interpretations of significance were made at the .05 confidence level. SPSS was the computer software package and all analyses were performed by ETS, Princeton, New Jersey.

V. Results

Cognitive Achievement

Pretest and posttest means and standard deviations were computed (Table 2).

Pretest and posttest scores achieved by the treatment group and the control group were compared using Analysis of Covariance. In this analysis SCAT-V (ability) and pretest scores served as covariates (Table 3)

Pretest and posttest scores achieved by the treatment group and the control group were compared using t-tests (Table 4). Control group Ss exhibited no significant changes in pretest to posttest comparison.

TABLE 2

Pretest and Posttest Means and Standard Deviations
Achieved by Treatment Group

Module	Pretest Mean	Pretest S.D.	Posttest Mean	Posttest S.D.
Beacon City	16.75	5.37	22.13	3.63
Bioethics	16.84	5.23	19.74	4.75
Communications	14.50	4.56	16.44	4.89
Space Encounters	11.43	3.76	14.65	3.55
Coastal Decisions	9.01	2.56	11.22	4.02
Technology/Changing Lifestyles	11.55	3.93	14.50	5.30
People/Environmental Changes	8.61	3.52	11.23	3.72
Technology/Society	15.46	2.76	17.62	2.26
Future New Jersey	11.25	3.30	13.25	4.19
Environmental Dilemmas	15.45	4.53	16.45	5.04
Energy	13.76	4.97	17.02	6.29
All Modules Combined	12.55	5.10	15.18	5.75

TABLE 3

Analysis of Co-Variance Summary by Dependent Variable-
Project vs. Comparison Groups with SCAT-V and
Pretest Scores as Co-Variates

	Mean Square	d.f.	f-ratio	1-tailed probability
Beacon City	114.39	3,16	26.29	.0000
Bioethics	559.20	3,77	32.24	.0000
Environmental	243.09	3,99	11.77	.0000
Communications	74.78	3,19	7.53	.0020
Space Encounters	299.65	3,54	37.50	.0000
Coastal Decisions	187.63	3,82	18.13	.0000
Technology/Lifestyles	352.12	3,42	25.27	.0000
People and Environment	211.49	3,117	21.73	.0000
Technology/Society	130.49	3,23	25.79	.0000
Energy	1326.39	3,197	74.74	.0000

Table 4

Comparison of Pretest to Posttest
Values on Moral/Ethical Reasoning
Treatment Group

Module	Pretest Mean	Pretest S.D.	Posttest Mean	Posttest S.D.	d.f.	t values	significance
Beacon City							
"P"(1979)	11.89	4.26	12.78	4.29	17	0.72	----
"MMS"(1979)	4.14	.29	4.26	.25	17	1.64	.06
"P"(1978)	8.21	4.63	9.86	4.45	51	2.14	.025
Communications	(DOES NOT CONTAIN MORAL/ETHICAL ISSUES)						
Bioethics							
"P"(1979)	8.00	3.03	8.42	3.49	30	0.73	----
"MMS"(1979)	4.03	.30	4.05	.34	30	0.36	----
"P"(1978)	9.18	5.83	9.97	4.59	150	2.54	.01
Space Encounters							
"P"(1979)	6.90	4.59	9.33	4.64	20	2.69	.005
"MMS"(1979)	3.86	.35	4.01	.36	22	1.83	.04
Coastal Decisions							
"P"(1979)	9.00	4.05	9.22	3.26	48	.35	----
"MMS"(1979)	3.83	.55	3.94	.27	49	1.88	.03
Technology/ Life-Styles							
"P"(1979)	5.89	2.99	5.54	3.98	36	-.54	----
"MMS"(1979)	3.82	.32	3.66	.58	38	1.77	.05
People and Environmental Changes							
"P"(1979)	7.87	3.87	7.92	4.05	78	0.10	----
"MMS"(1979)	3.82	.46	3.80	.58	79	0.42	----
Technology/Society							
"P"(1979)	10.19	5.21	11.81	4.71	15	1.90	.03
"MMS"(1979)	4.16	.32	4.11	.84	15	.25	----
Future N.J.							
"P"(1979)	8.50	4.17	10.10	4.48	9	1.53	----
"MMS"(1979)	3.98	.38	4.14	.42	9	1.92	.04
Environmental Dilemmas							
"P"(1979)	9.89	3.78	10.13	3.92	62	0.40	----
"MMS"(1979)	3.83	.62	3.99	.50	62	2.18	.02
"P"(1978)	8.26	4.14	9.09	4.01	258	2.84	.005
Energy							
"P"(1979)	7.47	3.91	8.46	3.81	97	2.32	.01
"MMS"(1979)	3.61	.56	3.78	.47	102	3.24	.008
"P"(1987)	8.40	3.93	9.10	4.29	213	2.81	.005
Combined Modules							
"P"(1979)	8.21	4.07	8.78	4.17	435	2.80	.003
"MMS"(1979)	3.81	.52	3.87	.55	444	2.43	.008

An additional analysis was performed to determine the number of students whose growth exceeded one-third standard deviation of the pretest scores. This analysis was performed because a question often arises as to whether or not change, although positive, is in fact educationally significant. Contemporary thought tends to favor the opinion that if posttest scores exceed pretest scores by one-third standard deviation such growth is both statistically and educationally significant (Tallmadge, 1977). In this study more than 50 percent of the Ss in the treatment group exhibited growth in moral/ethical reasoning which was $\geq$ 1/3 standard deviation of pretest scores.

The comparison group did not exhibit any significant pretest to posttest change in moral reasoning. In fact, most Ss showed a slight but insignificant decrease in moral/ethical reasoning scores in the posttest.

VI. Discussion and Conclusions

Cognitive Achievement

The results achieved and reported above indicate rather convincingly that Preparing for Tomorrow's World is a highly effective program insofar as cognitive achievement is concerned. The treatment group achieved significantly higher ($p \leq .000$) scores on their posttests while the control groups exhibited little or no change in scores. The posttest scores for the treatment groups were, moreover, significantly higher than the posttest scores of the control group even after controlling for differences in ability.

Moral/Ethical Reasoning

Important Variables in Development of Moral/Ethical Reasoning. Development in moral/ethical reasoning as defined by cognitive-developmental theorists is dependent upon several factors. While the absence of opportunities conducive to growth will most likely result in fixation at lower stages, providing opportunities for growth, on the other hand, will not ensure that growth will in fact occur. Other variables--many of which are well beyond the control of educators--also affect both rate and degree of growth. Among the variables considered most critical for growth which must be achieved first or simultaneously, at least, are:

1. prior achievement of requisite cognitive stages as defined by Jean Piaget (e.g., one must first achieve the cognitive stage of concrete operations before achieving conventional moral reasoning. Similarly, formal cognitive reasoning precedes post conventional moral reasoning).

2. maturation of interpersonal role taking structures as defined by Robert Selman.

Moreover, while the issue is still clouded in controversy, it is broadly conceded that growth in the cognitive stages can be accelerated only within rather restricted limits.

Other factors also need to be considered. Although certain age levels are associated with each of the Piagetian cognitive stages as well as with each of the Kohlbergian moral/ethical stages, these age approximations are only crude generalizations employed to facilitate discussion. While the concrete operational level is generally associated with the ages of 9-12 years, in reality, people located at this stage span the range from 7 or 8 years on through adulthood. While formal operational reasoning is associated with adolescence and above, in reality, a large segment of the population never achieves this level. Some people function at one cognitive stage in some situations and at other--higher or lower--stages in other situations. Individual students in both cognitive and moral reasoning, then, exhibit a great degree of variation and few in fact conform to the designated "average" ages.

Hence, one cannot expect all students as a group to exhibit growth at any one particular level. Research has shown that even under the best circumstances possible using highly trained, competent, and skillful teachers, one can expect only about 30 percent of the students exposed to moral education programs to exhibit growth, and such growth is only approximately one-third of a stage--even after an 8- to 10-month intensive intervention. Such growth, moreover, occurs at a variety of points along the moral reasoning continuum which, for convenience and descriptive purposes, Kohlberg has defined as Stages 1 through 6. Hence, within any sample of students--even at the same age--one can find some children progressing from Stage 2 to Stage 3, some progressing from Stage 3 to Stage 4, and some progressing from Stage 4 to Stage 5, etc. As a general rule, older children usually exhibit growth at the higher stages while younger children exhibit growth at the lower stages.

Scoring Methods--Rationale for "Three Analysis Approach." Due to the intricacies of the still evolving cognitive developmental model of moral/ethical reasoning--some of which were described generally above--and the "state of the art" in assessing such growth, scores achieved by the participants in this study were analyzed using three methods. Each method was employed because it was particularly sensitive to detecting change at specific locations along the Stage 1 to Stage 6 developmental continuum. In view of the fact that the participants in this study were functioning at varying points along the developmental continuum, this three-analysis approach (Table 5) was considered necessary if the change that had occurred was to adequately and accurately be detected. Each method of scoring is valid and well documented in the literature (Lickona, 1976; Iozzi, 1978).

Table 5

Methods of Scoring Employed, Stage Sensitivity of Each Method, and Rationale

Method	Stages at Which Method is Most Sensitive	Rationale
"P" Score (Rest)	Sensitive to change in stages 5A, 5B, & 6 only. Does not consider scores below stage 5, e.g., $"P" = \frac{\text{stage 5A + 5B + 6}}{30} \times 100$	Considers scores only at stage 5A & above, appropriate for Ss mostly 17 years to adult. Most Ss in this evaluation were from 13-17 years, and represent stages 3 and 4.
Moral Maturity Score (MMS) (Kohlberg)	Considers changes in stages 2 through 6 but emphasizes changes at higher stages more than those at lower ones. Score achieved in each cell is weighted by the stage number, e.g., stage 2 score = 2N, stage 3 score = 3N, stage 6 score = 6N. Weighting scheme minimizes change at lower stages and enhances change at higher stages.	Weighting is greatest for higher stages (5 & 6), but vast majority of Ss in this evaluation are at stages 2,3,4. Growth from stage 2 to 3 is as important and large as growth from stage 5 to 6. MMS does not consider this. Emphasis is on higher stage change at the expense of lower stage change.
% $\geq$1/3 S.D. (Tallmadge)	Same as "P" and MMS methods above. Considers percentage of Ss whose post-test scores meet or exceed growth of 1/3 standard deviation.	Uses "P" and MMS scores and is affected by problems associated with those methods as described above. This method, however, minimizes those deficiencies.

Results of Previous Intervention Studies. Rest (1976) summarized the results of 14 previous studies which attempted to evaluate the effects of interventions designed to raise the moral reasoning levels of children and adults. In each of the 14 studies cited by Rest, the intervention was taught by an expert and/or scholar in moral/ethical reasoning as defined by Kohlberg. In contrast, Preparing for Tomorrow's World was taught by regular classroom teachers, newly familiarized with the approach utilized for a minimal (in some cases only 2 to 3 hours) amount of time.

Rest's summary revealed the following:

--Only 2 of the 14 programs cited which included junior and/or senior high school students resulted in significant growth after the intervention. Both of these programs, moreover, required an intervention of one full semester (or one-half year).

--Only 2 of the 14 studies cited included a control group for comparison purposes.

Kohlberg has addressed the issue of time vs. growth in moral/ethical reasoning as a result of intervention programs (Hersh, et al., 1979). Citing that Blatt's dissertation experiment was specifically designed to stimulate moral stage advance, Kohlberg commented, "The experiment was designed to test the cognitive-developmental theory of moral change...Blatt found that more than one-third of the students exposed to such discussions would advance during an academic year in which control students remained essentially stationary, and the change was always only to the next higher stage" (Hersh, et al., 1979, p. xiii).

In another major study conducted by Blatt and also quoted by Kohlberg: "Overall, 18 sessions were held; they were conducted twice a week for 45 minutes each. At the conclusion of the program, the students were retested. Students...showed an average increase of one-third of a stage" (Hersh, et al., 1979, p. 108).

Conclusions--Moral/Ethical Reasoning

In view of the results presented in this paper and in view of Rest's extensive analysis, it is concluded that:

--The fact that statistically significant pretest to posttest growth was achieved by the treatment group ("P" score analysis) for six individual modules (1978 and/or 1979) and all modules combined is both statistically and educationally significant. The comparison group showed no significant pretest to posttest change.

--The fact that statistically significant pretest to posttest growth was achieved by the treatment group ("MMS" score analysis) for seven modules individually (1978 and/or 1979) and all modules combined is both statistically and educationally significant. The comparison group showed no significant pretest to posttest change.

--The fact that more than 50 percent of the Ss in the treatment group exhibited growth in moral/ethical reasoning which was $\geq$ 1/3 standard deviation of pretest score is statistically and educationally significant.

--Highly significant growth was achieved using "P" score and "MMS" score analysis with an intervention of only 2 to 6 weeks maximum. No other reported programs and/or studies have achieved comparable results; few studies, despite significantly longer intervention times (up to one year), even approached the achievement level obtained using eight of the Preparing for Tomorrow's World modules.

The use of some modules with some classes did not result in significant growth even though these modules utilized similar approaches and the same curriculum model upon which the highly successful modules were based. Several possible reasons can be suggested for this phenomena. These include: too brief an intervention period, loss of large amounts of data because of teacher error, excessive student absences, failure to complete module, and limited teacher training. Each of these possibilities will be explored in future studies. Nevertheless, the total effects of utilizing the entire program resulted in statistically and educationally significant growth in moral reasoning (Tables 2, 3 and 4).

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A LEARNING AND COMMUNICATIONS PROFILE OF TEACHERS ENTERING AN ENVIRONMENTAL EDUCATION EXPERIENCE

David I. Johnson and Douglas C. Covert[1]

Abstract. *A population of teachers attending an environmental teaching workshop indicated their use and perceptions of mass media for environmental information. General interest magazines were valued more highly than electronic media or special interest magazines. This population relied heavily on knowledge already acquired or resources other than mass media to resolve conflicting environmental information.*

Introduction

The use and perceptions of mass media information sources by inservice teachers offers additional dimensions for rexamining preservice and inservice environmental education training programs.

The investigation reported here centered on teachers of first through twelfth grades entering an environmental education experience who were expected to conduct some form of environmental education in their classrooms subsequent to the experience. Mass Media use was examined to explore the significance of various media as they influence the continuing development of teachers' environmental attitudes, beliefs and behaviors.

Teachers are an especially important redistribution system because they participate in the total communication process (McNelly, 1973) and because "...teachers are important representatives of the attitudes toward which children are socialized" (Hess and Torney, 1968). If the environmental attitudes of teachers can be changed, reinforced, modified, or otherwise manipulated by mass communication, it is appropriate to identify the strength of media impingement.

Outside of the classroom, Sellers and Jones (1973) cite an instance of mass media being avoided in an environmental influence campaign, efforts to sway attitudes being directed at the interpersonal and quasi-mass communication systems. Stamm (1972) has described environmental campaigns and the communication problems which became evident during the efforts. Schoenfeld (1975) points to the successful communication record of the federal bureaus and voluntary

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associations, especially the Cooperative Extension Service. However, except for the preservice teachers of Peyton (1977), there is little in the literature to show the mass communication media use patterns of teachers for information on environmental affairs.

Methodology

The population selected for this study consisted of 123 teachers attending four, one-week, residential "Teachers' Environmental School" workshops conducted during the summer of 1978. Each workshop was staffed by faculty members from Michigan universities. All workshops were held at the Ralph A. MacMullan Conference Center, in a vacation resort area of Michigan's northern lower peninsula. Graduate and undergraduate credits were offered and were interchangeable between the four universities participating, Michigan State University, central Michigan University, Eastern Michigan University and Wayne State University.

The total population of 180 persons attending the four sessions surveyed was stratified on a single dimension, vocation, for primary analysis. Three strata were established: "teachers," "employees of the Michigan Department of Natural Resources" and "others." The analysis focused on the 123 teachers exclusive of the other strata.

Included in the analyzed population were a curriculum coordinator, an elementary school principal and an assistant superintendent in a small district. Although these three might not have been currently active in the classroom, they perceived themselves as teachers and were included in the 123 member population because of their direct influence on environmental education in their schools.

Experimental Design

Each participant was asked to complete a questionnaire as an opening activity of the week-long workshop program. The eight-page questionnaire, containing 88 numbered items, was distributed by the researcher at the conclusion of a brief introduction and collected by the researcher as it was completed by each person.

Data evaluation included descriptive statistics and both parametric and nonparametric statistical procedures available in the Statistical Package for the Social Sciences (SPSS) version 7.0 available at the Michigan State University Computer Center.

Statistical Procedures Used. Frequency distributions, central tendencies and degrees of dispersion offered the primary descriptive information. The mean was used as the preferred indicator of central tendency and the measure of variability was standard deviation. Error limits at a 95 percent confidence interval indicated the degree to which the group served as an adequate simple random sample and was a useful reliability indicator for the data summaries.

Three indices were devised to consolidate information collected about the respondents' attitudes toward environmental affairs, personal actions concerning environmental matters, and professional environmental education practices. These indices allowed convenient comparisons within the framework of the study. (For index development rationale, see Covert, 1980, pp. 91-2, 116-9, 151-6.)

The formulas for the three indices were:

Attitude Index = (Attitude Measure + Environmental Education Content Perception) 100/156

Personal Action Index = [(Public Defense of Views x 7) + (Recycling Practices x 2) + (Attempt to Influence Local Government x 28) + (Attempt to Influence Legislation x 14) + (Attempt to Influence Nongovernment Institutions x 14)] 100/77

E.E. Practices Index = [(Minutes per week in E.E./60) + (Outdoor Learning Practices) + (Out-of-school Environmental Activity Frequency) + (E.E. Workshop Attendance) + (NEEA Membership) + (E.E. Content Perception/14)] 100/35

The data offered in this report apply to the population studied. Inferences to larger populations should be approached with care.

Assumptions and Limitations. This population was made up of self-selected representatives of the teaching profession who were demonstrating through behavior an interest in their biophysical surroundings, environmental education or both. Post-data collection interviews and observations supported this assumption.

The group was expected to respond favoring perceived researcher expectations, particularly considering the nature of the survey and the physical surroundings. Questionnaire construction and cross-check items were designed to attenuate such bias. Discrepancies between responses and reality were also expected. Analysis of the complete survey data indicated minimal bias (Covert, 1980, pp. 31-32).

There is always the question of memory accuracy. Responses were assumed to accurately reflect the perceptions and recall of the respondents at the time. It was assumed, too, that variations would tend to be distributed normally throughout the population. Statistical treatments were expected to alleviate at least some of the inaccuracies resulting from faulty memories. Relationships would be stabilized by the population size and verification items in the questionnaire.

Results and Discussion

Workshop Attendance and Classroom Practices. One-third of these teachers indicated they spent 10 minutes or less per week on environmental education as they perceived it (Table 1). One-quarter of this same third attended one or more workshops or seminars on environmental education during the preceding year.

More than one-quarter of the population spent 26-50 minutes per week on environmental education while less than half of this same group attended sessions for skill improvement.

There was little apparent relationship between workshop attendance and school time committed to environmental education (Table 1). These teachers seemed to attend workshops without a particularly high time commitment to environmental education in their classrooms, although the exposure may have improved the quality of the instructional time. Advocates of holism in environmental education will probably be disappointed to see such a modest proportion of the school week perceived as a part of environmental education activity.

Simplified interpretation of the data in Table 1 should be approached carefully. For instance, the 26-50 minute category may represent a reported 5 to 10 minutes per day or one "class period" per week, implying quite different approaches to the study of environmental matters.

Professional Membership. Less than one-quarter of the teachers surveyed belonged to the Michigan Environmental Education Association, the professional association created and maintained to assist teachers in the conduct of environmental education. On the other hand, these same teachers belonged to an average of two other professional organizations (mean 2.065; SD 1.08; 95 percent C.I. 9.3 percent; N = 123).

TABLE 1

WORKSHOP ATTENDANCE--CONTINGENCY TABLE ANALYSIS,
MINUTES IN SCHOOL PROGRAM BY WORKSHOP ATTENDANCE

Minutes per week	Number of Workshops Attended						row total
	0	1	2	3	4	5	
	percent of total respondents						
0	21.3	3.3	2.5	.8			27.9
1-10	4.1	.8		.8			5.7
11-25	9.0	2.5					11.5
26-50	14.8	9.0	1.6	.8			26.2
51-75	5.7	1.6	.8	.8		.8	9.8
76-100	2.5	1.6	.8				4.9
101-125	2.5						2.5
126-150		.8	.8	.8			2.5
151-250	2.5						2.5
251-HI	.8	3.3	1.6	.8			6.6
total	63.1	23.0	8.2	4.9		.8	N=122

Chi square = 43.21; df = 36; significance = 0.19
Cramer's V = 0.298
Kendall's tau c = 0.186; significance = 0.002
Gamma = 0.327
Pearson's r = 0.248; significance = 0.003; r^2 = 0.061

Continuing Information Source Use

Exposure Quantity Per Day. The population was asked to report the total time per day spent with each of the four mass media listed (Table 2). The data are not a measure of time quality. The radio or television may be "on" without much attention directed to the content. Magazines may be perused for their pictures rather than their verbiage. Newspapers may be selectively read for other than general news content.

The first point of interest is the high incidence of use, noted in the column labeled "Users Percent" (Table 2). The figures in this column represent the percentages of those teachers reporting the use of each medium on a daily basis.

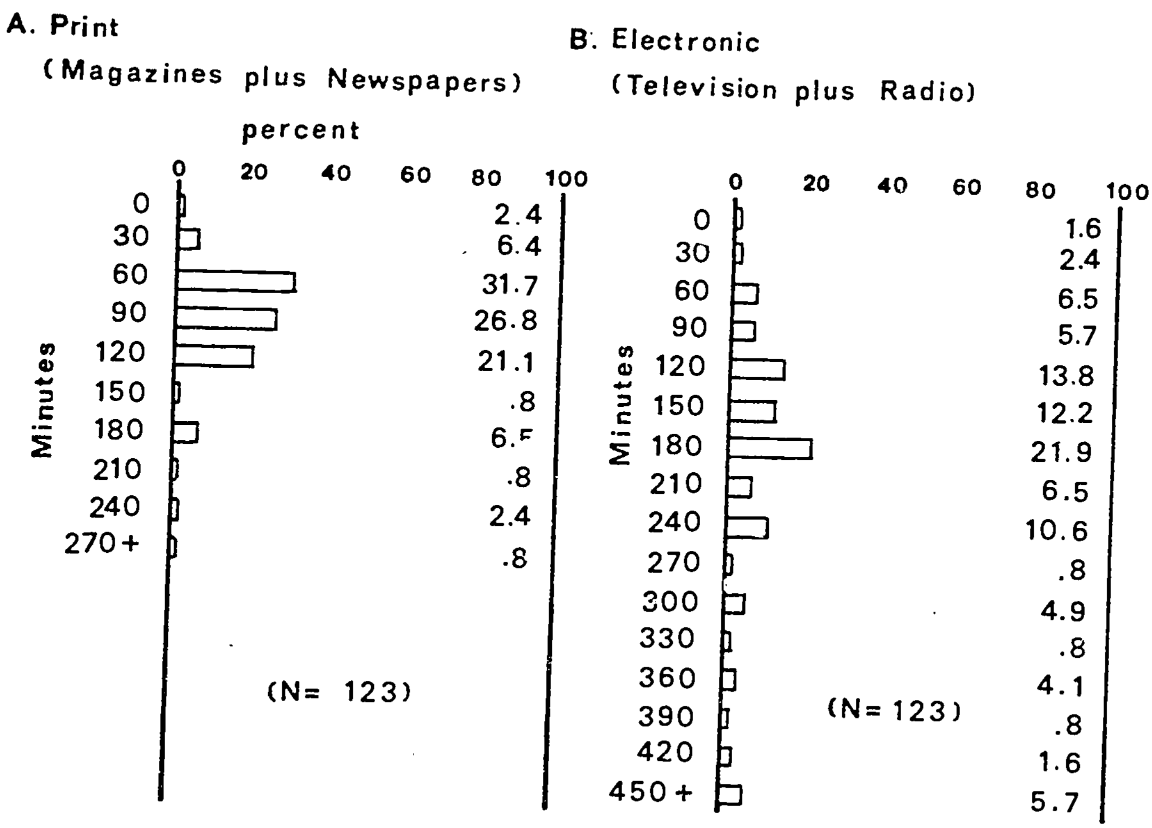
Less than 5 percent of these teachers spent more than three hours per day with the print media but over 35 percent spent more than three hours per day with radio and television combined (Figure 1). Considerable discretionary time was recalled as spent in the company of electronic media, slightly more than twice as much as with print media.

TABLE 2

CONTINUING INFORMATION SOURCE PROFILE--
MINUTES PER DAY WITH MEDIUM

	N	Mean	SD	95% C.I.		Mean hours	Users %
				+ or -	%		
Magazines	122	42.484	35.254	6.319	14.9	0.708	95.9
Newspapers	123	47.846	27.803	4.963	10.4	0.797	94.3
Television	123	93.049	56.943	10.164	10.9	1.55	93.5
Radio	122	112.992	138.358	24.799	21.9	1.88	87.7

Inquiry was made as to the number of times per day each respondent watched television news or listened to radio news (Figure 2).



MEAN = 88.25
S.D. = 48.55
95% C.I.= ± 8.74, 9.9%

180 min. (3 hrs.) = 95.7%

MEAN = 187.88
S.D. = 105.96
95% C.I.= ± 19.32, 10.3%

180 min. (3 hrs.) = 64.1%
8 hrs. or more = 5.7%

Figure 1. Combined Electronic Media and Print Media Exposure Minutes Per Day

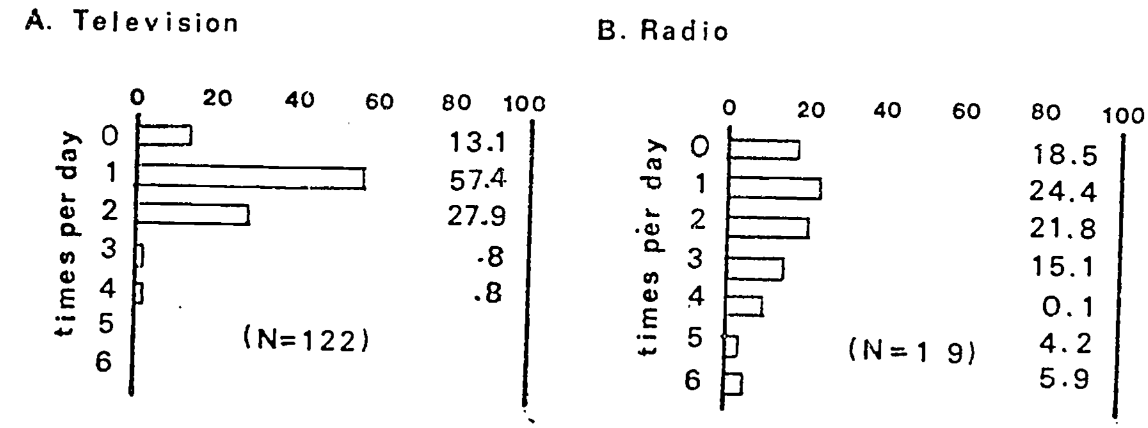
It seems that news broadcasts were not an especially important part of broadcast programming to these teachers. Whereas 12.3 percent of the respondents did not listen to radio at all, an additional 6.2 percent of the listeners did not listen to radio news broadcasts, presumably confining their listening to entertainment programming, for a total of 18.5 percent. With 6.5 percent of these teachers not watching television, an added 6.6 percent did not watch television news for a total of 13.1 percent.

Attention to Content. Magazines were read by more than 95 percent of the teacher population surveyed (N = 122), a higher use-percentage than the other three media, although mean exposure time per day was less for magazines than for the other media (Table 2). But magazines often provide greater depth of coverage of their content, have important value as reference material and require more commitment to consumption. As Schramm (1977) notes in "The Nature of an Audience," magazine readers tend to be seeking more depth of information than the electronic media supply when they read; children turn to magazines and books when they seek information rather than entertainment.

The respondents were asked to name the periodicals, journals and magazines they read regularly. Eight categories and their popularity were subsequently defined (Figure 3). Popularity was determined simply by finding the percentage of respondents indicating that they regularly read in the particular category. While unsophisticated, the simple frequency of regular exposure to the content offers a fairly well defined picture of reading tastes.

The magazines specializing in natural history and environmental information ranked higher than all other categories for this self-selected group. Less than 40 percent of these teachers read professional journals regularly, a category which included those periodicals aimed directly at teachers and designed to assist them in improving their professional performance.

The workshop setting and purpose and the questionnaire structure may have affected accuracy of recall and stimulated memory for natural history and environmental information titles. Time reports and conversion of the data into "intensity of use" (Table 3) suggest reasonable correspondence between response and reality.



MEAN = 1.19
S D = 0.70
95 % C.I. = ± 0.125 (10.5%)

MEAN = 2.10
SD = 1.69
95% C.I. = ± 0.308 (14.7%)

Figure 2. News Exposure Times Per Day, Electronic Media

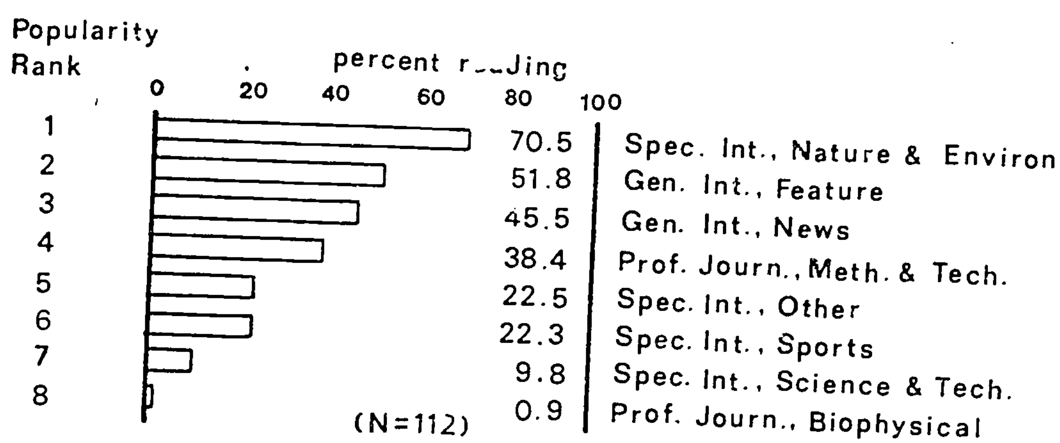


Figure 3. Periodical Reading by Category

TABLE 3

INTENSITY OF PERIODICAL USE BY CATEGORY

Category by Intensity Rank	Mean hours per month	Mean minutes per month	Mean number of titles	Mean hrs. per title per month
Gen. Int. News	2.355	141.3	0.57	4.12
Combined Gen. Int.	5.198	311.9	1.54	3.38
Prof. Journ. Biophysical	0.027	1.6	0.01	3.00
Spec. Int. Other	0.768	46.1	0.29	2.67
Spec. Int. Sports	1.000	60.0	0.38	2.60
Gen. Int. Feature	2.482	148.9	0.96	2.57
Spec. Int. Science & Tech.	0.357	21.4	0.16	2.22
Prof. Journ. Meth. & Tech.	1.411	84.7	0.72	1.95
Spec. Int. Nature, Environ.	2.784	167.0	1.48	1.88
Factored Gen. Int. News	0.589	35.3	0.14	0.95

Cosmopolitan interests were suggested in the high frequency of exposure to the two categories of general interest magazines, News and Features. When these two categories were combined, 69.6 percent regularly read in one or both categories. Attention to General Interest magazines and to Nature and Environment magazines then became essentially equal.

Numbers of contacts are only the beginnings of quantity evaluation. The time spent with each periodical category expands this evaluation potential and offers some indication of the "quality" of the contacts. Combining the number of titles read per month and the hours spent each month with each title provided an approximate measure of magazine use intensity in each category, or the thoroughness with which these magazines were read (Table 3).

The categories were ranked (Table 3) according to mean hours per title per month--the intensity of use per title. This also suggested the attention-to-content ranking and intensity. General Interest News magazines received the most intensive use. Although probably a function of their weekly frequency, this intense use indicates that a large amount of information may be acquired, or encountered, with potential for considerable reinforcement from this source. The reduction to last place of Special Interest Nature, Environment magazines indicated that consumption in this category was comparatively superficial.

Information Source Evaluation

Credibility. Although the quantity of exposure to mass media information sources has important relevance to a determination of communication effects, the audience perceptions of quality in the exposure must not be overlooked. Respondents were asked to indicate their credibility rating of several subdivisions of the electronic mass media on a seven-segment scale (Figure 4).

These ratings suggest that electronic media may be divided into two major credibility groupings for these teachers. Television documentaries, special television programs and public television make up the more credible group, whereas news programs from any source make up the less credible group. Radio "specials" may have suffered due to perception as expanded news programs rather than distinctly special programs.

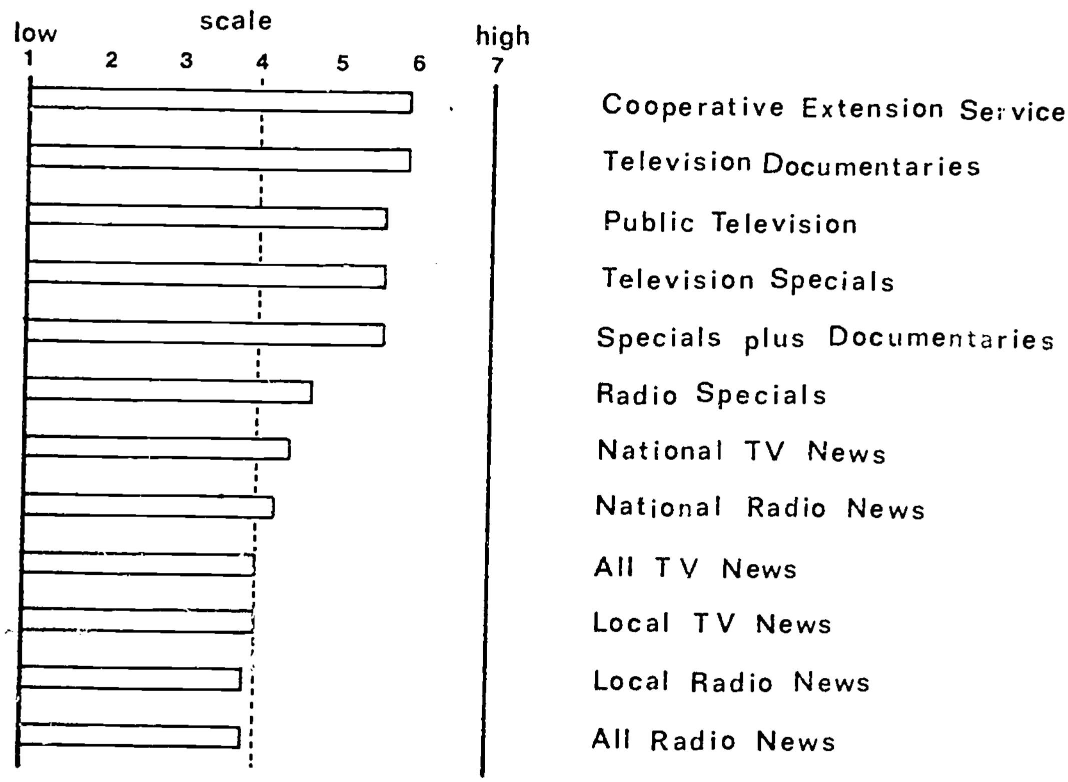


Figure 4. Credibility Rating

The combined visual and aural impact of television would be anticipated. However, it might be expected that dramatized versions of information as presented in the documentaries and specials would be viewed by this audience with more skepticism than the brief but "straighter" news broadcasts. Either the more thorough coverage or the dramatic entertainment style, or both, of the longer programs seemed to add to credibility. Perhaps the pseudo-dramatic style of news broadcasters detracted from credibility or it may be the immediateness of the reporting and the content itself which influenced the confidence.

Objectivity. With the strong differences in physical form, sensory impact, commitment to consumption and scale of treatment among the four mass media in this study, a common denominator was used for comparison. By emphasizing the reporter as a basis for comparison, the influence of visual materials and other aspects of physical form might be reduced. The visual presence and dramatized style of the television reporter would dominate, but by changing the response system to a rank-ordering by objectivity the effect on teacher perception might diminish.

The magazine writer ranked first by a considerable margin in the evaluation of relative objectivity (Figure 5). There may be two particular factors at work in this. First, the length of a magazine article allows inclusion of a considerable number of facts and thorough exploration of relationships, but the other three media are more abbreviated in their content.

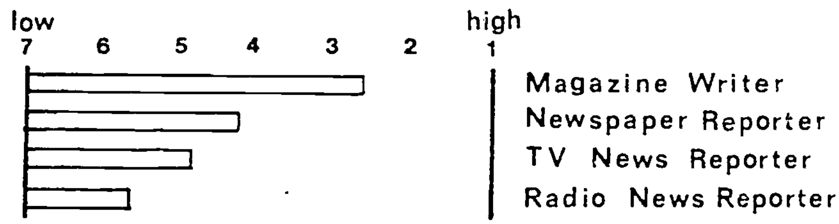


Figure 5. Objectivity Rank

Secondly, selectivity, in the seeking of information and in perception, is a factor. It is likely these teachers selected magazines for purposeful reading with a predisposition to believe and value the content of their selections. As a result, they would be expected to cast a strong vote of confidence in magazines.

Intellectual commitment to valuing the printed word probably plays an important role here while the facelessness and low listener involvement of radio undoubtedly contributed to its relegation to last place.

Reliability. A variety of information sources was selected for a broad evaluation by these teachers to measure perceptions of currency, accuracy and thoroughness of coverage. The terms up-to-date, accurate and thorough were used in the study instrument but were then abbreviated for reporting convenience into a single term--reliability.

An essential purpose was to test the relative position of "colleagues" as a representative of interpersonal information sources and "formal classes" as representative of quasi-mass media. Although workshops and seminars would have been preferable in the latter instance, the inherent bias of the immediate environment would have been prohibitively high and would have jeopardized the rankings of the entire list.

While the variations in response patterns were quite broad, as evidenced by the standard deviation, three distinct divisions emerged (Figure 6, Table 4).

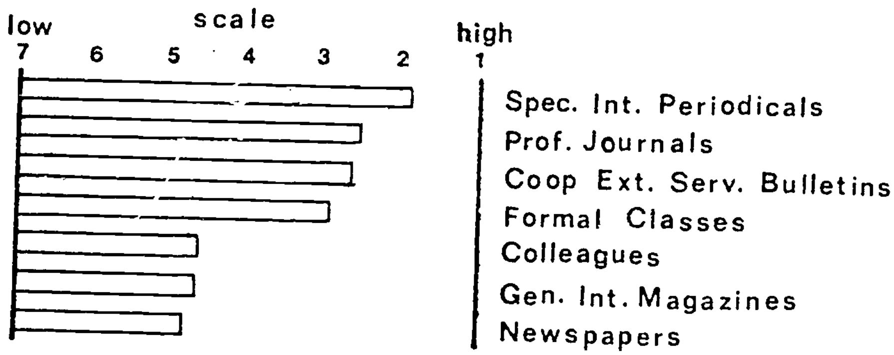


Figure 6. Reliability Rank

Special interest periodicals led the way with professional journals, bulletins of the Cooperative Extension Service and formal classes grouped together not far behind. Colleagues, general interest magazines and newspapers were apparently not held in high regard when compared with the other sources. Thoroughness, followed or accompanied by accuracy, seemed to play an essential role in evaluation of a medium when transmitting environmental information. Perceptions of timeliness did not appear to play a prominent role in this evaluation.

Source value rank. Source value rank is an evaluation of a variety of media based on objectivity and reliability measurements. Although the numerical accuracy of the intervals is questionable, it does indicate the rank positioning, the relative descriptive intervals, and the inductive and intuitive consistency of the findings of this survey.

TABLE 4

RELIABILITY RANK

	Rank	N	Mean	SD	95% C.I.	
					+ or -	%
Special interest periodicals	1	118	1.915	1.202	0.22	11.4
Professional journals	2	105	2.552	1.461	0.28	11.1
Cooperative Extension Service bulletins	3	75	2.640	1.248	0.29	10.9
Formal classes	4	91	2.945	1.501	0.31	10.6
Colleagues	5	69	4.681	1.622	0.39	8.3
General interest magazines	6	83	4.711	1.729	0.38	8.0
Newspapers	7	79	4.835	1.605	0.36	7.4

The print media which serve the special and professional interests of these teachers are their most valued sources of information (Table 5). This is not surprising nor is the low rating of radio which apparently serves more as background sound than information source. The near quality of colleagues, newspapers and general interest magazines, close to mid-scale, is enlightening in that the interpersonal exchange with colleagues, assumed to be a knowledgeable peer group, would be expected to rank higher than the mediated information from generalized sources.

TABLE 5

SOURCE VALUE RANK

Information Source	Value Rank Range: 1-7	
Special Interest Periodicals	High	1.80
Professional Journals		2.40
All Magazines		2.87
Colleagues		4.40
General Interest Magazines		4.42
Newspapers		4.54
Television		5.17
Radio	Low	6.09

Information Conflict Resolution

This study attempted to identify a generally available information source of perceived value used or engaged by the respondents for resolving conflicts in information received. Sources assumed to be available for "consultation" and used on a daily or near-daily basis for other purposes were offered. Radio, television and newspapers were the mass media selected to meet these criteria. Colleagues was the interpersonal source selected.

While other interpersonal sources could have been included, colleagues was assumed to be the only interpersonal source other than household members available to all teachers any and every working day, and colleagues would be considered a knowledgeable peer group which could be used to help sort out conflicting information received from other sources. It is true, of course, that the colleagues could generate conflicting information but it would then be expected that another source would be selected for resolution.

No particular mass medium was chosen as having any special value in resolving conflicts in information received (Figure 7). Colleagues were valued no more than the mass media. The pattern of responses here was supported by the value ranking shown in Table 5. Several statistical procedures were applied seeking correlations between media usage patterns and the conflict resolution choices but no correlations were apparent.

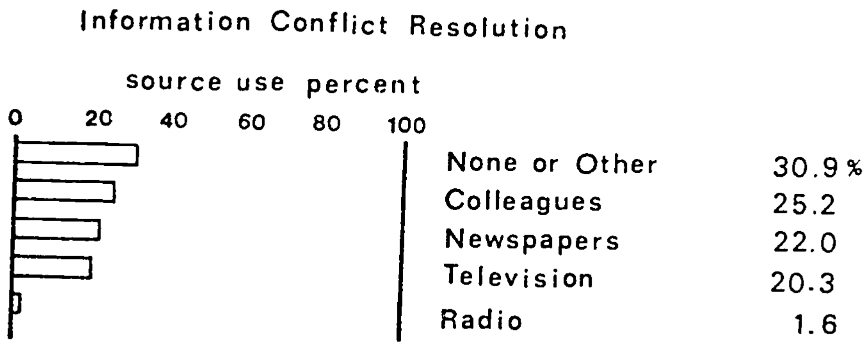


Figure 7. Continuing Information Source Profile

Apparently, these teachers rely heavily on knowledge already acquired, or less immediate and ubiquitous sources than mass media or interpersonal sources, when confronted with conflicting environmental information. Perhaps newly encountered dissonant information is ignored or judged irrelevant to themselves. Perhaps the continuing flux in environmental information is sufficiently confusing that only the information which reinforces existing attitudes and beliefs, or serves a self-centered special interest, is selected for acquisition.

Nor were these teachers particularly dependent on interpersonal sources such as friends, family and colleagues for development of their attitudes about environmental matters.

Further correlations were sought, using several statistical procedures, in attempts to find relationships between conflict resolution choices, media use patterns, environmental attitudes, personal environmental actions, and environmental education behaviors. The results were of negligible value.

Simple summary figures were compiled to create a pictorial profile of each conflict resolution response category (Figure 8).

The television choosers had the most total exposure to mass media and were the most environmentally active. Newspaper choosers appeared to "avoid" television, while maintaining exposure to the other media, and were the least

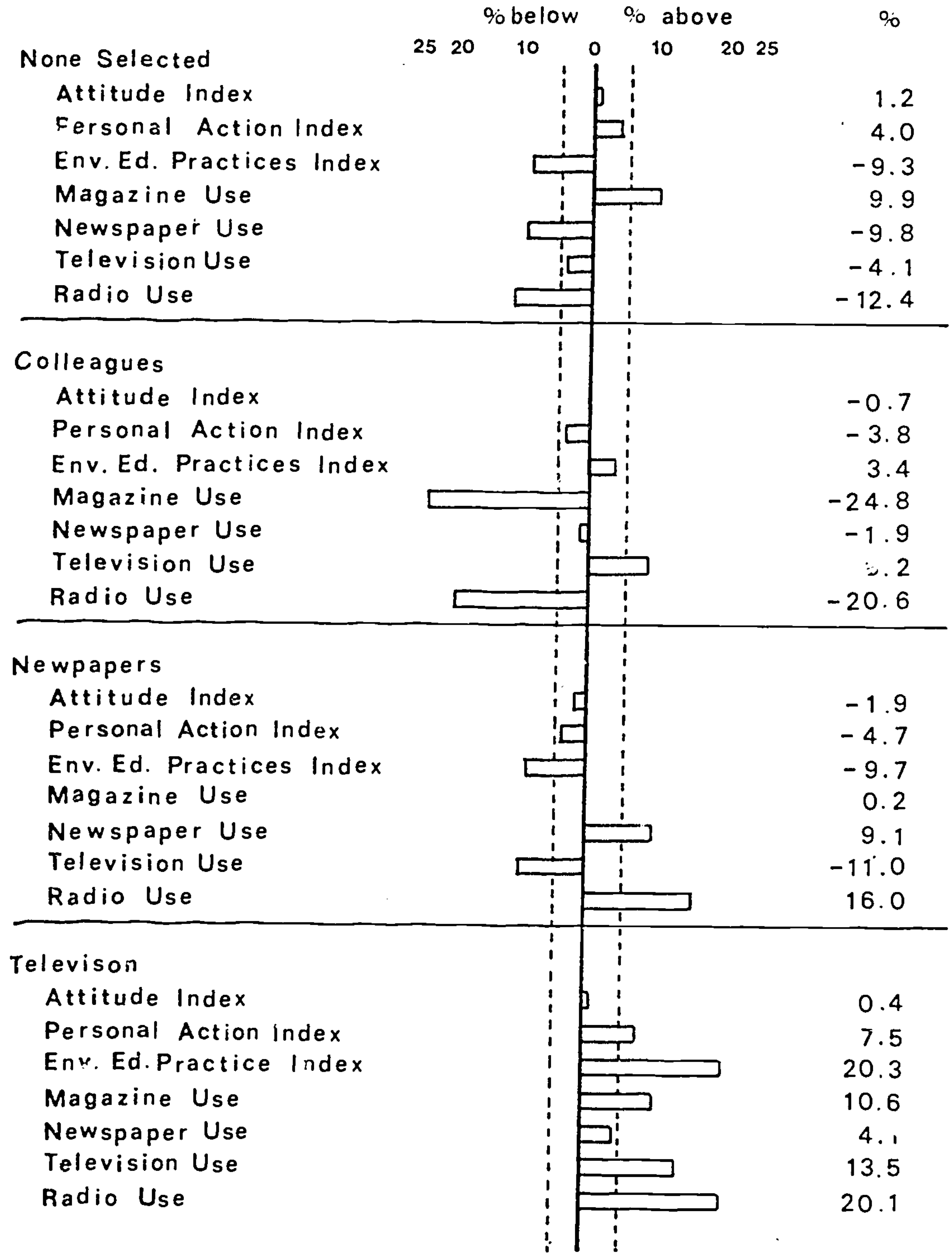


Figure 8. Information Conflict Resolution Profile -- Percent Below or Above Mean, Each Category

environmentally active. Colleagues choosers made more than average use of television while spending notably less time with the other media and were average in environmental activity. Although it is an oversimplification from the data available, no-response choosers appear to consist of self-contained isolates.

Analysis and interpretation of the data in this portion of the survey indicated that those teachers with a high quantity and wide-ranging media consumption pattern were also inclined toward active personal and professional roles in environmental affairs. High total media consumption rather than consumption from specific sources showed the strongest positive relationship with environmental education practices, although inferential statistics remained weak. Those who sought no resolution of information conflict and those who sought answers only from newspapers and radio were below average in their conduct of environmental education.

Conclusions

Most of the teachers surveyed in this study used all four of the mass media offered: radio, television, newspapers and magazines. Although these teachers were fairly heavy consumers of electronic media, news broadcasts were not considered an especially important part of broadcast programming. Perhaps this was due, in part, to a low comparative-credibility rating of electronic media reporters. Television specials and documentary programs on environmental matters were, however, highly regarded. Extensive and dramatic coverage appeared to have strong influence on quality perceptions.

Magazines showed a higher use-percent than the other media and reading patterns provided especially convenient subject matter breakdowns. As might have been expected for this group, magazines directed toward natural history and generalized environmental interests were over 50 percent more popular than any other single category. But, this category received the lowest intensity of use. It may be concluded that these magazines are perused rather superficially, perhaps for their visual imagery rather than their verbal content, and have little but aesthetic impact on attitude formation and reinforcement impact on attitude development.

When intensity of use was determined, professional journals, which were directed toward teachers and intended to assist them in improving their performance, ranked next to last, only slightly ahead of the "environmental interest" publications.

In evaluating media, magazine writers were perceived as being the most objective and special interest periodicals were seen as especially up to date, accurate and thorough in their coverage of environmental affairs. For these teachers, "thoroughness" appeared to be the essential element in evaluation of media transmitting environmental information.

The media information sources achieving the highest value ranking in this survey were magazines and journals. The data indicated that these teachers were rather dedicated readers, especially of the general interest magazines and those catering to special interests. Although no category of publication should be considered unimportant, environmental communicators would do well to note the strong influence of general interest periodicals, especially those emphasizing news and news-type feature coverage.

This survey suggested that any correlation between mass media consumption patterns and environmentally favorable activity lay in total rather than specific consumption. Of the teachers surveyed, those with high quantity and wide-ranging media usage were more active, personally and professionally, than those employing smaller quantities or a narrower range. An inference which might be drawn is that those with a broad and active information base are more widely interested in the total world around them.

The data accumulated here leads one to conclude that these teachers used mass media to gain a general perspective on the course of society, to reinforce their personal interests and for entertainment, but did not use mass media directly to support their professional growth or to add to environmental knowledge.

Recommendations and Implications

Implications for the academic community emerged from this study of mass media use by inservice teachers.

Constructive evaluation and criticism of the mass media as they provide environmental information need to come from well-informed intellectual leaders. It is of little value to confine critiques to exchanges within a community of scholars. Rather, sound evaluations must be provided to those who teach whether or not those teachers acknowledge that all education is environmental education. And such evaluations must be extended and made available to the broader public through a wide-ranging distribution system.

Teachers and prospective teachers need guidance in developing their own critical thinking and in their own evaluations of media presentations. Moreover, students must be trained in the use of mass media, particularly the electronic media, as information sources. This is especially true for those students who will become environmental educators. The mass media are teaching resources, out of school as well as in school, but students need guidance in critical evaluation of the direct content and the implied messages. The constant media exposure requires that the receiver be both selective and critical of the messages received.

In the school setting, learning aids applied before, during and after guided media exposure offer valuable assistance in learning from and evaluating mediated information. Such experience will be of continuing benefit to students.

It is becoming increasingly evident that the college educational experience and the training of teachers is far more important than many have previously thought when it comes to the environmental arena. The teachers in this study show a strong tendency to fall back on their own prior knowledge, experiences and opinions rather than to seek out other sources when faced with new information.

Purposeful information gathering, in-depth conceptualization and even learning in general are severely limited after leaving the college setting. This argues strongly for expansion of environmental education teacher-training and for environmental education specialists. Such specialists would need not only a major or at least a minor in their college program, but training in the conduct of teacher inservice training programs.

The environmental educator is a communication regulator, gatekeeper and agenda-setter. The continuous impingement of a variety of mass media demands that the practitioner be well-trained in critical evaluation and use of media and in guiding students to become critical consumers of mediated messages.

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