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DEMONSTRATION CLASSROOM A THEMATIC APPROACH TO SCIENCE/MATHEMATICS INTEGRATION

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A fundamental principle of ecology is that "everything is interconnected." This observation holds true in the academic as well as the natural world; if we study an environmental issue in depth, we find that it cannot be resolved by means of any single discipline. Environmental studies transcend all disciplines so as to include the sciences, mathematics, technology, social studies, language arts and the practical and fine arts.

The science component, ecology, is itself an integrating rather than a splintering science. It draws together the traditionally separate disciplines of biology, chemistry, physics and earth science. Mathematics provides a tool for quantifying and interpreting the data obtained through experimentation and observation.

The integration of mathematics and science is effectively demonstrated by the Environmental Issues Instruction (**eii**) approach (Bollwinkel 1991). Students focus on an environmental issue such as "Tropical Rain Forest," "Feeding the World" or "Biodiversity." Focusing on a single theme, or case study (Ramsey & Hungerford 1989) permits thorough exploration of the issue using the tools of many disciplines, including science and mathematics. This integrated approach stimulated the inclusion of **eii** in the Demonstrating Excellence in Mathematics and Science Teaching (DEMAST) grant proposal. The University of Northern Iowa DEMAST proposal has been funded by a Regents Eisenhower grant. It includes elementary, middle school and high school classrooms which demonstrate several approaches to mathematics and science integration. Dr. Larry Leitzinger of the UNI Mathematics Department is the project director.

To gain a better understanding of an **eii** demonstration classroom, one must examine the **eii** instructional model, the approaches or strategies used in this model and the inservice program used to disseminate **eii**.

The eii Instructional Model

The **eii** instructional model is essentially the model developed by Harold R. Hungerford, associates and graduate students (1985). It has been modified in delivery, particularly in the use of the thematic approach. The ultimate goal of **eii** is to inspire students to take **responsible environmental action**. In order to achieve this, students must become convinced that they can *make a difference*. The instructional model developed to attain this may be described in four goal levels:

I. Issue Analysis: development of understanding of what makes an environmental problem an issue. A problem becomes an issue when people take different positions relative to the issue because of differing beliefs.

II. Ecological Foundations: development of understanding of ecological principles. A general understanding of ecology is important to the study of environmental issues. Some ecological principles are more directly related to an issue than others, and these must be comprehended before an issue can be successfully investigated.

III. Issue Investigation: development of the skills and the gathering of data from primary and secondary sources for investigation of a chosen issue.

IV. Environmental Action: development of skills and taking action to help resolve the issue. Appropriate responsible student actions usually fall into four areas: persuasion, political action, consumerism or ecomanagement.

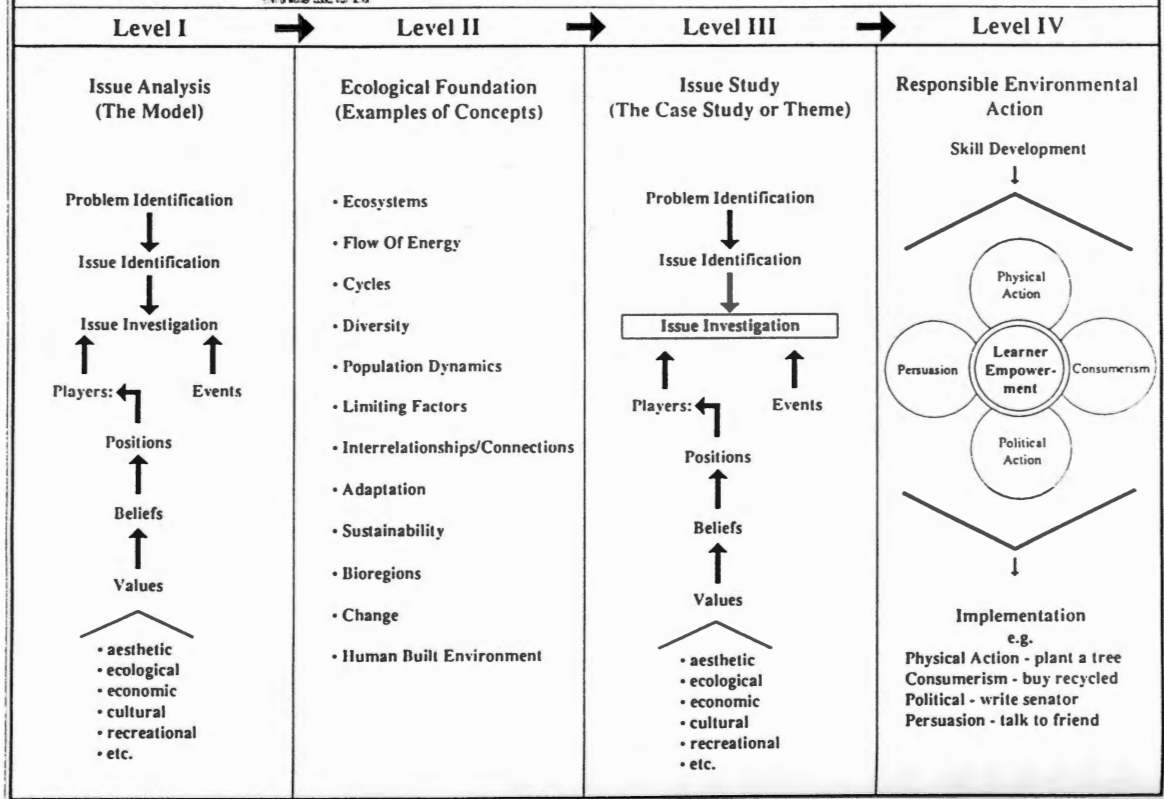
A diagram presenting these levels (Fig. 1) was prepared for inclusion of this model in the environmental education framework recently developed for the State of Iowa. The publication of this document has not yet been completed.

eii Strategies

By virtue of the transdisciplinary nature of environmental issues, **eii** has been found to be an appropriate vehicle for developing various cooperative or team teaching approaches. Teachers find that their students benefit when they work with teachers of other disciplines in the development of issue themes.



MODEL. Issue Investigation



Much data is obtained through process related, hands-on activities and the questionnaire and opinionnaire techniques often characterized as typical of social studies investigations. The use of opinionnaires and questionnaires brings focus to the importance of issues studies having local student significance as well as global implications.

One of the primary functions of the **eii** teacher network is to facilitate resource sharing among teachers. Some activities which integrate science and mathematics into particular issue topics were developed last summer, and more continue to be created through the experience of the demonstration classrooms. The network is especially important, however, since the **eii** program will not produce its own rewritten curriculum but emphasizes a framework for instruction using any and all appropriate materials available. Some of the more appropriate curricular materials have been described as problem solving, hands on, minds on, learning cycle based, experiential and/or process orientated.

The directors of **eii** agree with the many environmental educators who believe our great need today is implementation of those materials already developed.



Teachers interact with eii program directors during an in-service workshop.

The eii Inservice Model

The eii inservice, or implementation, model has several components including the demonstration classrooms. Weekend workshops experientially inservice teachers in the instructional model at various locations across the state. After the introductory weekend, teachers modify and apply the model to best fit their own teaching situation, K-12, self-contained or departmentalized, team or individually taught. Teachers are encouraged to seek and provide collegial support. eii staff are available for consultation by phone or classroom visits. Classroom implementation is followed by a weekend update session at which teachers compare notes on the success of their modification and application of the model. The update session also allows teachers to share curriculum materials and resources which they have discovered and found useful. A newsletter continues this networking process.

eii Demonstration Classrooms

Demonstration classrooms provide the opportunity for teachers to observe integrated science and mathematics being taught via the eii model. A middle-school team, Rosalie Cochran (science) and Carol Harrington (mathematics), at Fairfield Middle School currently hosts teachers from middle schools in Toledo, Marshalltown and Tama. Other teachers are welcome to visit. Visitations to the demonstration classrooms are preceded and followed by conferences with the demonstration teachers. Visiting teachers find it helpful to participate in related eii workshop programs which present training in the entire instructional model.

In Fairfield, mathematics and science teachers plan together to integrate science and mathematics. For example, a modified AIMS activity using M&Ms® is being taught in the mathematics classroom. This activity helps students gain a better understanding of population diversity as it relates to the environmental issue of preserving biodiversity. Science class activities are designed to stress the use and application of mathematics skills in the measurement and analysis of biodiversity in plant communities. On occasion, Cochran teaches in the mathematics room and Harrington teaches in the science room. Both have been trained in the eii instructional model. They design activities which help students understand and plan action to resolve the environmental issue currently under study.

Barbara Bonnett (fifth grade) and Scott Wood (fourth grade) will begin hosting teachers in their elementary classrooms at North Hill School in Burlington, Iowa, during the next academic year.

In both schools, the lead teachers are developing team relationships, and other teachers in their school are participating in components of

eii instruction. These cooperative activities have included not only math and science specialists but also music, home economics and special education teachers. Although not officially included in the DEMAST grant, these teachers have shared their **eii** expertise with other teachers at workshops and in consultation.

Over 500 other Iowa teachers have received training in the **eii** model and have been sharing their expertise with other teachers to form instructional teams.



Rosalie Cochran interacts with students in her demonstration classroom.

Conclusion

Environmental issues naturally lend themselves to study from the perspectives of a number of different fields. The **eii** approach has proven to be an effective method of presenting these issues. It integrates many of the areas currently being emphasized in science education: demonstration classrooms, long-term inservices, and development of collegial support. Through the thematic approach, students find that they need to investigate across the disciplinary lines of mathematics and science in order to resolve environmental problems. The proof of the program's effectiveness lies in the fact that students not only gain a thorough understanding of the issues, but are prepared to decide upon appropriate environmental action.

If you wish to visit an **eii** science/mathematics demonstration classroom or participate in **eii** workshops, call the University of Northern Iowa Office of Continuing Education at 1-800-772-1746 and ask to be placed on the **eii** mailing list or request information about demonstration classrooms and **eii** workshop registration.

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