Abstract – An energy education program that embeds energy topics within a societal context that is meaningful to students may improve energy literacy and effectively prepare students to interpret energy issues and make sound actions and choices as voters, consumers, and professionals. High school environmental science students participate in a project-based energy module where they explore technical, environmental, societal, and economic concerns related to the production, delivery, and use of hydrogen fuel and fuel cells for transportation. In-depth assessment evaluates the course’s impact on students’ energy-related knowledge, attitudes, and behaviors, as well as their feelings of general self-efficacy. The analysis uses a triangulated mixed-methods design, including pre/post written questionnaires, classroom observations, post-program focus group interviews, and post-program opinion surveys.

Index Terms – Energy education, Energy literacy, Hydrogen fuel cell, Project-based learning, Societal context.

INTRODUCTION AND BACKGROUND

Environmental issues, and energy-related issues in particular, play a prominent role in the lives of today’s students. As we move into a future with limited fossil fuel resources and worsening environmental conditions, our society is becoming increasingly entrenched in a struggle to define new directions with respect to energy consumption and energy independence.

Energy literacy enables people to embrace appropriate decisions and behaviors with respect to energy in everyday life. An informed public will be better equipped to make responsible energy choices. Unfortunately, recent evidence suggests that U.S. students – in fact, the U.S. public in general – are lacking in their awareness of energy-related issues [1]-[4]. The National Environmental Education & Training Foundation (NEETF) found in a 2001 survey that, while many Americans tended to overestimate their energy knowledge, just 12% could pass a basic quiz on energy knowledge [2].

Energy education typically falls within the realm of science instruction in the traditional K-12 curriculum. Curricular-based topics generally include scientific principles associated with energy concepts – energy conversion, work, and power. A variety of alternative materials have been developed that address energy issues from a broader perspective, but many of these are still primarily concerned with the scientifically based energy concepts that are embedded in the requirements of State and National education standards. Few address students’ attitudes or behaviors related to energy issues, and the implications of those attitudes and behaviors within a societal or global context. Moreover, most are available as supplemental science activities. Experts generally agree that the best way to promote energy literacy is to include energy education within the existing curricula and, where possible, to use an interdisciplinary approach [5]. A project-based approach that provides opportunities for learning within an overarching problem assignment, with reference to societal themes, makes the material more relevant to the students’ own lives and helps them understand how the science impacts them and the communities in which they live.

PROPOSED STUDY

This descriptive study evaluates the impact of a special topics energy module on students’ energy-related knowledge and attitudes. “The Hydrogen Economy” is an 18-day module created and taught in conjunction with an NSF GK-12-funded educational outreach program at Clarkson University. Throughout the interdisciplinary module (Table I) students explore technical, environmental, societal, and economic concerns related to the production, delivery, and use of hydrogen fuel and fuel cells for transportation. The module is framed within a societal/global context and is project based: students are first introduced to their problem assignment, and all subsequent activities and investigations are designed to provide them opportunities for gaining knowledge and skills needed to complete the assignment. An element of formalized decision making instruction has been included [6].

The study is piloted in a high school environmental science class (18 students), with plans to expand the program into additional high school science classrooms in the future. Through the pilot study we hope to evaluate the effectiveness of the learning module (e.g., classroom delivery) and the study design (evaluation and analysis). The evaluation will assess the module’s impact on students’ general knowledge and awareness of energy issues, their energy-related attitudes and behaviors, and their general feelings of self-efficacy and locus of control (LOC). We will also correlate energy knowledge,
changes pre/post. Aggregated class data will be used to investigate changes in group response to particular questions or groups of questions, while individual student responses to the aggregated questions will provide information regarding general knowledge, attitude, behavior and self-efficacy changes among the students as individuals.

Interview transcripts and post-program free-response survey data will be analyzed using inferential statistics. Materials will be reviewed for the presence of patterns revealed by the narratives that may expose inconsistencies or further explain the quantitative results. Patterns will be identified and tabulated, and subsequently quantified according to the frequency, extensiveness, and intensity of response.

**PROJECT STATUS AND SUMMARY**

This pilot study is scheduled to occur in late May/early June of 2006. Preliminary analysis of student pre-survey questionnaires, completed in April 2006, reveals that student performance on the attitude portion of the survey was generally better than the knowledge and behavior sections. Students scored a mean of 59% on both the knowledge and behavior portions of the test, while the mean attitude score was 72%. Perhaps this indicates that, while students have the desire to make appropriate energy choices, they lack the knowledge to do so. An initial round of pre vs. post data analysis will be complete for presentation at the conference.

**ACKNOWLEDGMENT**

This work was sponsored by the National Science Foundation, grant nos. DUE-0428127 and DGE-0338216. The findings and opinions presented here do not necessarily reflect the opinions of the funding agency.

**REFERENCES**


