

Energy Literacy among Middle and High School Youth

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Abstract - An energy literacy survey for middle and high school students has been developed according to established psychometric principles and methodologies. The survey measures energy-related knowledge, attitudes and behaviors and is correlated to established benchmarks that define energy literacy as determined by a panel of energy- and energy-education specialists. Results from a pilot of the survey among 955 New York State students indicate low levels of energy-related knowledge, with fewer than 1% of the students scoring above 80%. Attitude and behavior scores are slightly better, suggesting that while students may recognize the existence of an energy problem, they generally lack the knowledge and capabilities to effectively contribute toward a solution. Results support the need for development and implementation of energy education programs as part of the regular school curriculum.

Index Terms – Energy, Energy literacy, Education.

INTRODUCTION AND BACKGROUND

Energy is the “underlying currency that governs everything humans do with each other and with the natural environment that supports them.”[1]. Our reliance on energy-rich sources of fossil fuels has created the underpinnings of modern society, enabling mobility, industrial growth, domestic comfort, unprecedented lavish food supply, and economic prosperity. Inarguably, energy is one of the most important issues of the 21st century. As we move into a future with limited fossil fuel resources and worsening environmental conditions, our society is faced with defining new directions with respect to energy consumption, resources, and independence. An informed, energy-literate public is more likely to be engaged in the decision making process, and will be better equipped to make thoughtful, responsible energy-related decisions, choices, and actions.

Unfortunately, a number of studies have shown that Americans are generally ill-prepared to actively contribute to solving our energy problems, largely because they lack energy-related knowledge and awareness (e.g., [2-4]). For example, the National Environmental Education & Training Foundation (NEETF) found in a 2001 survey among young adults over the age of 18 that, while many Americans tended to overestimate their energy knowledge, just 12% could pass a basic energy quiz [3]. More recent findings from an internet-based public opinion survey on climate change and

the environment developed at the Massachusetts Institute of Technology (MIT) revealed that most of the 1200 respondents had not heard or read about hydrogen cars, wind energy, or nuclear energy. In fact, 17% of those surveyed had not heard of any of the listed items [4].

One avenue for change is through effective energy education programs. The children sitting in our classrooms today are the voters and consumers of tomorrow, and effective energy education will help them understand the relevance and implications of their own actions within their community and the wider world as they become adults. Effective energy education will improve energy literacy by improving students’ broad, citizenship-based understanding of energy that includes content knowledge as well as energy-related attitudes and behaviors.

Adequate energy-literacy assessment is needed to ensure that quality education programs are available. Except for a few general studies that address energy-related knowledge and attitudes (e.g., [2, 5]), assessment directed toward middle and high school students has most commonly been in the form of a written test or survey following student participation in an energy curriculum or unit. This type of assessment is typically limited to conceptual knowledge, somewhat narrowly focused on specific curricular objectives (e.g., [6]). Thus, the assessment results do not necessarily reflect energy literacy levels but, rather, student achievement with respect to pre-determined, specific energy-related content, which may or may not be representative of a holistic approach to energy literacy. Alternatively, energy surveys have been administered to more broadly assess energy-related knowledge, attitudes, and/or behavior among consumers [3, 4], yet while many of these are more general in scope, many are designed for verbal or telephone administration, many of the questions are inappropriate for school-aged students, and most are too lengthy and mature for practical classroom application.

There is a need for effective assessment tools that will help measure energy literacy in terms of valid conceptual benchmarks that comprehensively define energy literacy with respect to students’ content knowledge as well as energy-related attitudes and behavior. A broad, efficient measure of energy literacy for middle and high school students may prove useful for determining baseline energy literacy levels among groups of students, as well as to assess the effectiveness of energy education programs for improving energy literacy. Such assessment would provide

valuable program feedback, enabling greater strides toward better educational programs, wider implementation of these programs in our classrooms, and improved energy literacy.

RESEARCH OBJECTIVES

The overall objective of this research is to develop a valid and reliable measure of energy literacy that meets the following criteria:

- is appropriate for students at the middle and high school level, in terms of language, level of conceptual understanding, and appropriateness of topics;
- is convenient for use in a classroom setting;
- can be completed within a 30-minute period;
- is easily scored; and
- is comprehensive in nature, closely correlated to critical benchmarks that define energy literacy in terms of students' energy-related knowledge, attitudes, and intentions/behaviors.

The written survey will be useful for investigating the status of energy literacy in a variety of classroom settings, and will also serve as a useful quantitative component in a mixed-methods approach to analyze and evaluate energy education programs and their potential for improving students' energy literacy. This paper presents an overview of the survey development process and describes some initial results obtained from a pilot administration of the written survey in New York State. The initial stages of survey development, including the establishment of characteristics and criteria for energy literacy, are described more thoroughly elsewhere [7].

SURVEY DEVELOPMENT

Overall Approach

The Energy Literacy Survey has been developed according to established psychometric principles and methodologies in the sociological and educational sciences (e.g., [8-12]). The approach is based largely on earlier work done by the Wisconsin Center for Environmental Education and the Wisconsin Environmental Education Board as part of the Wisconsin Environmental Literacy Assessment Project [13, 14]. Early stages of construct development were guided in part by studies that define characteristics and measurable benchmarks in environmental literacy [15] and technological literacy [16].

Survey development is a stepwise endeavor that relies on the efforts of the primary researchers, an ad hoc panel of energy and education experts, and a host of volunteer educators and students. The basic steps for creating the instrument (adapted from [11]) include:

- (1) define the objectives/criteria to be measured;
- (2) review related surveys, quizzes and tests to develop a pool of potential survey questions that match the defined objectives;
- (3) prepare and administer a pilot instrument; and finally,
- (4) evaluate the pilot and revise the final survey instrument.

Instrument validity has been established through a variety of measures: by applying the construct definition (e.g., definition of energy literacy) and reviewing/applying prior energy education and knowledge/attitude/behavior research; by using items drawn from existing energy and environment surveys; and through a survey review process involving a panel of experts in energy and energy education (the "validity panel"). Additional validation has been established by administering the pilot survey to a "known group" of subjects who are literate about energy.

Role of the expert validity panel

The assistance of an ad hoc panel of energy-experts, educators, and energy-education specialists has been essential for creating the pilot instrument. The six-member panel includes a middle/high school science teacher, the executive director of an energy efficiency advocacy and technical services non-profit organization, two energy education specialists, a professor from St Lawrence University's Department of Environmental Studies who teaches courses on energy and energy issues, and a mechanical engineering professor from Clarkson University whose research focuses on wind energy and energy efficiency. This diversity of backgrounds provided a range of perspectives for evaluating criteria against which energy literacy is measured, thereby providing construct validity. The diversity was also instrumental for designing a non-biased survey that includes appropriate questions to meet these criteria, thereby providing content and face validity.

Using methods drawn from the work of Peri and Quale, in developing environmental literacy surveys [13, 14], the validity panel reviewed initial drafts of the objectives and criteria for energy literacy and ultimately approved an Instrument Development Framework, described below, to establish construct validation – that is, to ensure that the concepts addressed by the survey are comprehensively representative of *energy literacy*. Likewise, the validity panel reviewed each potential survey item and approved the final set of survey questions for use in the pilot instrument, helping to establish content and face validity of the instrument (ensuring that the questions adequately match the concepts and are appropriate for the particular age group).

The validity panel's review process was carried out using a modified Delphi Survey Technique, which is a method that allows the sharing of ideas and consensus building among a group of experts who are not necessarily in close geographical connection with each other. In this study, group members were able to review materials independently and share their ideas by means of electronic communication. A limited number of physical meetings were held to facilitate further discussion and reach consensus among the group.

Instrument Criteria

Establishing a set of measurable criteria for energy literacy follows directly from the groundwork laid by the development of a comprehensive definition of energy

literacy. Described in further detail elsewhere [7], the set of criteria broadly encompasses the three dimensions of energy literacy: content knowledge (cognitive); sensitivity and attitude (affective); and intentions/behaviors. This allows the resulting survey instrument to be categorized into three convenient subscales, each subscale encompassing a group of questions that addresses a singular dimension. Specific characteristics described in the definition give rise to specific criteria or objectives within each dimension, enabling the instrument to measure energy literacy in terms of benchmarks that align with cognitive, affective, and behavioral attributes. Figure I demonstrates this general approach and provides a subset of the characteristics and criteria identified.

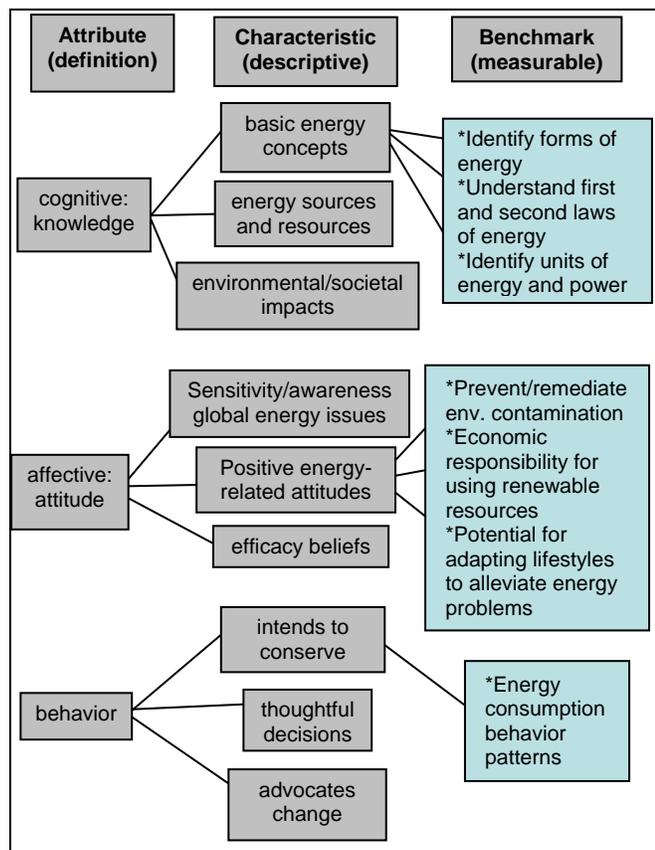


FIGURE I. CRITERIA FOR ENERGY LITERACY: EXAMPLE ATTRIBUTES, CHARACTERISTICS, AND MEASURABLE BENCHMARKS

For example, within the cognitive domain (energy knowledge) one of the characteristics defined is an understanding of basic energy concepts. A few example benchmarks associated with this characteristic are that students should demonstrate an understanding of the forms of energy, first and second laws of thermodynamics, and be able to identify units of energy and power. Within the affective domain, an energy literate person is expected to have a “positive” energy-related attitude, respecting the need to reduce consumption of finite energy resources as well as the need for the prevention/remediation of

environmental contamination, willingness to assume economic responsibility for using renewable energy resources, and appreciating one’s potential to influenced energy problems – positively and negatively - with lifestyle choices. Finally, within the behavior domain, an energy literate person is expected to show an “intention to conserve” as demonstrated by their energy consumption behavior patterns.

The resulting criteria that define energy literacy establish the basis for the Instrument Development Framework, which organizes the criteria into an outline of content that is to be included in the final literacy assessment instrument [13, 14]. The Framework, which has been reviewed and approved by the Validity Panel, contains a comprehensive list of components that validate the construct of the assessment, broadly identifying topics rather than specifically indicating the required depth of mastery at any particular grade level. A small excerpt from the Instrument Development Framework is included in Table I; for a more thorough description see [7].

TABLE I. INSTRUMENT DEVELOPMENT FRAMEWORK (AN EXCERPT)

Cognitive Outcomes
Knowledge of Basic Scientific Facts <ul style="list-style-type: none"> • Definition of energy • First and second laws of energy (concepts of energy conservation and entropy) • Relationship between energy and power
Knowledge of Issues Related to Energy Sources and Resources <ul style="list-style-type: none"> • Sun as primary energy source, other sources of energy used by humans • Renewable and nonrenewable energy resources • Advantages and disadvantages of developing and using different energy resources (technical, environmental, economic, societal)
Affective Outcomes
Sensitivity/Awareness with Respect to Global Energy Issues <ul style="list-style-type: none"> • Energy education • Seriousness of energy problem
Strong Efficacy Beliefs <ul style="list-style-type: none"> • Internal locus of control • Assumption of personal responsibility in contributing toward development of sustainable energy resource development and use
Behavioral Outcomes
Thoughtful, Effective Decision-Making

Item Pool and Pilot Survey Development

The Instrument Development Framework serves as the guidepost for developing the actual survey instrument. The framework forms the basis for selecting items, or questions, used in an item pilot of the instrument. Potential survey items were identified by reviewing existing consumer- and student-oriented surveys related to energy and the environment, as well as science textbooks, curricular materials, and educational standards (e.g., [3, 6, 17-19]), resulting in a pool of 184 potential survey items in three subscales (111 knowledge, 45 attitude, and 28 behavior/intention).

Potential survey items were aligned to the Instrument Development Framework using a matrix that matched each question to the area of the framework that it addressed. Using the correlation matrix along with a set of review criteria (age appropriateness, conceptual relevance, readability, accuracy), validity panel members reviewed each potential survey item to ensure content validity of the instrument. Through the review process many questions were revised or eliminated, but the correlation matrix provided a mechanism for maintaining a set of questions that comprehensively addresses the objectives and criteria of the survey, as defined by the Instrument Development Framework.

Eighty seven questions, encompassing three subscales (51 knowledge, 24 attitude, 12 behavior) were retained for the pilot survey. Each knowledge question uses a 5-option multiple choice format with one correct answer. Multiple choice items are attractive because they can be objectively scored, and are maintained by many as best suited to test gains in cognitive knowledge domains [8]. Although a number of attitude and opinion scales are available, the Likert-type is reportedly the most common scale used in survey questionnaire research, particularly for measuring opinions, beliefs, and attitudes [11, 12]. Attitude and behavior questions use a five-part Likert-type scale, with choices including strongly agree, agree, neither agree nor disagree, disagree, and strongly disagree.

The retained questions were formulated into two separate Item Pilot Survey Forms, with each pilot form aligned to the Instrument Development Framework to ensure that each covers the entire spectrum of measurement criteria. Four self efficacy questions were embedded within the attitude portion of each test form.

Item Pilot Administration, Item Evaluation

The pilot surveys were administered to 955 middle and high school students in 13 science and technology classrooms throughout New York State, with random distribution of the two test forms within each classroom and an approximately equal male/female split for both forms. Our objective was to obtain a sufficiently large sample size for statistically-based item analyses (conservative guidelines recommend a sample size at least ten times as large as the number of items on each subscale [10]), and also to administer the pilot to a student population that would roughly mimic the target audience for the final survey, as well as reducing the risk of biasing survey results in any one direction. To that end, more than half of the students were in grade 8 (56%), with the remaining students distributed among grades 6 (10%), 7 (27%), and high school (7%). The students attended a variety of school types (urban, rural, suburban) that reported a broad cross-section of socioeconomic and ethnic backgrounds. According to reports by participating teachers, the students had been exposed to a wide range of energy education, with more than half (55%) receiving less than 5 hours of classroom-based energy instruction throughout the year.

Responses to each of the three subscales have been analyzed separately to determine which items should be selected for inclusion in the final instrument. The assessment, which involves a combination of statistically-based item analysis in conjunction with qualitative evaluation of each item's contribution to the overall objectives of the survey, has been guided by recommendations from sociological and educational researchers [8-14]. The item analysis differs somewhat between cognitive and affective/behavior subscales, but generally involves the following battery of tests:

- **Item difficulty** (cognitive subscale only; percentage of students who scored correctly on the item). The difficulty of test items in the subscale should be spread across the continuum from 0 to 100, with a higher concentration of items that have difficulties close to 50% [12]. An item was considered too difficult if fewer than 20% (equivalent to one standard deviation below the average item difficulty for the subscale) of the students chose the correct answer.
- **Response frequency** (percent of students who select each answer choice). For cognitive subscales, each distracter, or incorrect answer choice, should be chosen by at least one person, and moreover, should be chosen by some of the lower ability respondents. Distracters that are not chosen by anyone, or distracters that are chosen by a larger portion of higher-ability respondents than by lower-ability respondents, may not be acceptable [8]. The distribution of scores across the five answer choices in the attitude and behavior scales should show an acceptable range of emotional intensity in both positive and negative directions, while a high undecided response rate ("neither agree nor disagree," choice C, greater than 25%) signals that an item is marginally useful and may not be discriminating well [9].
- **Discrimination index** (the degree to which a student's responses on the item correlate with the student's responses on the subscale as a whole). According to Koballa [9], this correlation provides the best judgment of an item's appropriateness for the subscale. If an individual's overall score on the subscale is considered to provide the best estimate of his/her energy-related knowledge, attitude, or behavior, than a high correlation between the score on an individual item and the overall subscale implies that the item itself is a good predictor. Values for the discrimination index should be above 0.20 [11].
- **Average score** (cognitive subscale only; raw test score for students who chose a particular answer choice). Students who answer an item correctly should have a higher raw score than students who answer an item incorrectly.
- **Change in subscale reliability** (Cronbach's alpha, α) when item is removed. Removing an acceptable item from the subscale should lower the subscale reliability.

The above criteria have been used primarily as a guide for selecting items to retain in the final instrument. Of primary importance were the discrimination index and the influence of each item on subscale reliability (Cronbach's α), although all criteria were considered for any one question, and results from any one test did not determine whether an item was retained or omitted. After considering results from the statistical item analysis, individual questions were evaluated according to their consistency with the overall objectives of the research. The culminating test for the group of questions as a whole was to ensure that all major components of the Instrument Development Framework are represented by the final survey.

RESULTS: ENERGY LITERACY ASSESSMENT SURVEY

The final literacy assessment survey has been created based on evaluation of the pilot survey data. Age- or grade-specific differences in the pilot results led to the development of two separate survey forms, one for middle school and a slightly longer version for high school that includes some questions that were too complicated for the younger students. Both forms contain a section of questions that request some personal information as well as some self-assessment of energy-related knowledge, followed by an attitude subscale (17 questions), behavior/intention subscale (10 questions) and knowledge subscale (28 and 37 questions for middle and high school, respectively). The three subscales have internal consistencies (as measured by Cronbach's alpha, α) of 0.62 (knowledge), 0.70 (attitude), and 0.71 (behavior).

Additional survey validation has been established by administering the survey to a known group of subjects, consisting of 35 college honors students enrolled in a renewable energy course and eight adult community members attending a renewable energy fair. The known group, who are expected to be more energy literate than the pilot test subjects, performed significantly better on all three subsections of the pilot ($p < 0.001$ for knowledge and attitude; $p = 0.02$ for behavior). Scores for the known group were 74%, 75%, and 66% on the knowledge, attitude, and behavior subscales, respectively. The lower behavior-related score relative to energy-related knowledge and attitude is consistent with other research (e.g., [20]).

A GLIMPSE AT THE STATUS OF ENERGY LITERACY

Results from the pilot questions that have been retained for the final survey provide an interesting look at the status of energy literacy in our classrooms today. In general, energy literacy levels are quite low, particularly on the knowledge subscale. Although 40% of the students strongly agreed or agreed that they "know a lot about energy," mean scores on the knowledge subscale are just 40%, 39%, and 46% for students in grades 6-7, 8, and high school, respectively (Figure II). As expected, the knowledge scores improve as the grade level increases (differences are significant between grades 6-7 and 8 [$p = 0.03$] and between grade 8 and

high school [$p = 0.005$]). Sixty five percent of the students responded that they learn most about energy in school.

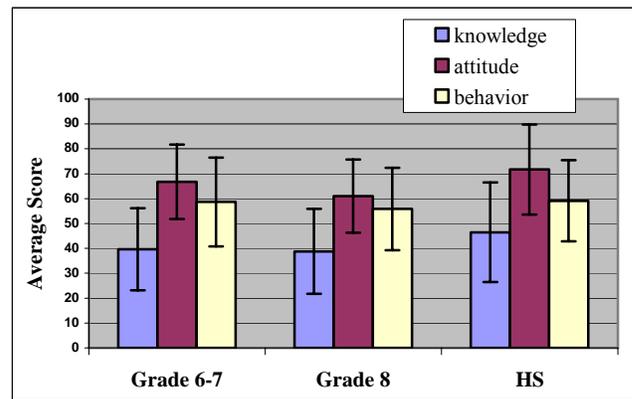


FIGURE II. PILOT STUDY RESULTS – ENERGY KNOWLEDGE, ATTITUDE, BEHAVIOR (ERROR BARS REPRESENT MEAN +/- 1 STANDARD DEVIATION)

Similar to findings from the NEETF study among young adults [3], students included in this pilot study scored well in a few key areas (for example, 68% knew that light bulbs convert electrical energy into heat as well as light; 58% correctly identified renewable energy resources), yet scores were low in most areas and few exhibited a high degree of broad energy knowledge. Less than 1% of all students scored above 80% on the knowledge subscale, and the 75th percentile score was only 53%. Students lacked knowledge of some key energy concepts – for example, only 13% knew that our electric meters measure the amount of electricity in units of kilowatt hours (40% selected “volts” as an answer), only 21% correctly identified space heating and cooling as the major energy consumer in the average American home (32% selected “lighting the home”), and only 33% realized we cannot build a machine that produces more energy than it consumes.

Attitude and behavior scores are somewhat better, although students in grade 8 scored lower than both other groups of students on both subscales. Eighth graders scored significantly lower than both other groups on the attitude subscale ($p < 0.001$), and significantly lower than students in grades 6-7 on the behavior subscale ($p = 0.03$). Scores for the three groups (grade 6-7, grade 8, high school, respectively), are 67%, 61%, and 72% for attitude; and 59%, 56%, and 59% for behavior. Among all students surveyed, 53% recognize there is an energy problem where they live, 72% feel that Americans should conserve more energy, and 64% feel we should make more electricity from renewable energy resources, yet that number drops to 43% if an increase in cost is involved. Sixty percent feel that energy education should be an important part of every school's curriculum, 58% said they would do more to save energy if they knew how, and a full 65% of the students say they realize that the way they personally use energy makes a difference to the overall energy problem. However, fewer students actually report energy saving behaviors: 52% try to conserve water; 65% turn lights off when they leave a room;

39% turn off their computer when it's not being used; and 40% use compact fluorescent light bulbs. Only 24% of the students report that they think about energy as they make decisions throughout the day.

CONCLUSION AND RECOMMENDATIONS

This research has successfully developed an energy literacy survey that comprehensively addresses critical benchmarks that define energy literacy in terms of knowledge, attitudes, and behaviors. Students can complete the survey within the confines of the classroom in one class period, and it is easily and objectively scored using computerized scanning techniques. The survey is appropriate for the specified age group in terms of language, topic areas, and concepts, although the level of proficiency exhibited by students who have taken the survey thus far has been below what was expected in terms of content knowledge.

Nevertheless, and unfortunately, the low scores we observed in this study are in line with previous research that has looked at energy-related knowledge, attitudes and behaviors among young adults and consumers. Like these other studies, our findings indicate that students recognize that we are facing an energy problem and feel the need or desire to do something about it, but lack the knowledge and capabilities to do so. Moreover, results from administering the pilot survey to a known group of energy literate individuals have shown that, although these individuals demonstrate significantly greater knowledge and more positive energy-related attitudes, these differences are not reflected to the same degree in actual energy-related behavior. These preliminary results support the need for improved energy literacy in our public school classrooms, and emphasize the potential value of research and development geared toward creating and implementing effective energy education programs that seek not only to improve students' knowledge but their attitudes and, perhaps most importantly, their energy-related behaviors as well.

ACKNOWLEDGMENT

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REFERENCES

[1] KEEP, "K-12 Energy Education Program: A Conceptual Guide to K-12 Energy Education in Wisconsin", 2003, University of Stevens Point, Stevens Point, Wisconsin: Wisconsin K-12 Energy Education Program and the Wisconsin Center for Environmental Education.

[2] Barrow, L.H. and J.T. Morrissey, "Energy Literacy of Ninth-Grade Students: A Comparison Between Maine and New Brunswick", *Journal of Environmental Education*, Vol. 20, 1989, pp. 22-25.

[3] NEETF, "Americans' Low "Energy IQ:" A Risk to Our Energy Future/Why America Needs a Refresher Course on Energy." 2002, National Environmental Education & Training Foundation: Washington, DC.

[4] NOWCAST, "U.S. Public in the Dark on Climate Change Issues", *American Meteorological Society*, June 2005, pp. 775.

[5] Barrow, L.H. and J.T. Morrissey, "Ninth-Grade Students' Attitudes toward Energy: A Comparison between Maine and New Brunswick", *Journal of Environmental Education*, Vol. 18, 1987, pp. 15-21.

[6] NEED (National Energy Education Development Project), "Secondary Energy Poll, Page 39-41, Blueprint for Success", 2006, The NEED Project: Manassas, VA (<http://www.need.org/needpdf/SecondaryPoll.pdf>).

[7] DeWaters, J.E., S.E. Powers, and M. Graham, "Developing an Energy Literacy Scale", in *Proceedings: 2007 ASEE Annual Conference and Exposition*, 2007, Honolulu, HI.

[8] Qaqish, B., "Developing Multiple Choice Tests for Social Work Trainings", *Training and Development in Human Services*, Vol. 3, 1, 2006, pp. 45-57.

[9] Koballa, T.R., Jr., "Designing a likert-type scale to assess attitude toward energy conservation", *Journal of Research in Science Teaching*, Vol. 21, 7, 1984, pp. 709-723.

[10] Abdel-Gaid, S., C.R. Trueblood, and R.L. Shrigley, "A Systematic Procedure for Constructing a Valid Microcomputer Attitude Scale", *Journal of Research in Science Teaching*, Vol. 23, 9, 1986, pp. 823-839.

[11] Benson, J. and Clark, "A guide for instrument development and validation", *The American Journal of Occupational Therapy*, Vol. 36, 12, 1982, pp. 789-800.

[12] DeVellis, R.F., "Scale Development: Theory and Applications", 1991, Newbury Park, CA: Sage.

[13] Peri, P., "The Development of an Instrument to Assess Environmental Literacy of Eleventh Grade Students in Wisconsin", Unpublished Masters Thesis, 1996, *College of Natural Resources*, University of Wisconsin: Stevens Point, WI.

[14] Quale, A.M., "The Development of an Instrument to Assess the Environmental Literacy of Fifth Grade Students in Wisconsin", Unpublished Masters Thesis, 1993, *College of Natural Resources*, University of Wisconsin: Stevens Point, WI.

[15] Roth, C.E., "Benchmarks on the Way to Environmental Literacy K-12", 1996, Developed by the Benchmarks for Environmental Literacy Project of the Massachusetts Secretaries Advisory Group of Environmental Education.

[16] Pearson, G. and A.T. Young, eds, "Technically Speaking: Why all Americans need to know more about technology", ed. G. Pearson and A.T. Young, 2002, National Academy Press: Washington, DC.

[17] Holden, C.C. and L.H. Barrow, "Validation of the Test of Energy Concepts and Values for High School", *Journal of Research in Science Teaching*, Vol. 21, 2, 1984, pp. 187-196.

[18] Jackson, E.L., "Environmental Attitudes and Preferences for Energy Resource Options", *Journal of Environmental Education*, Vol. 17, 1, 1985, pp. 23-30.

[19] NAEP, "Energy knowledge and attitudes: A national assessment of energy awareness among young adults", National Association of Educational Progress, 1978, Denver, Colorado: Education Commission of the States.

[20] Costanzo, M., et al., "Energy Conservation Behavior", *American Psychologist*, Vol. 41, 5, 1986, pp. 521-528.