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Energy Literacy in K-12 Education: Evaluating Energy Learning Potential and Gaps through a Survey of Idaho Teachers

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Executive Summary

A driving force in education is innovating everyday curriculum to prepare students for the real world. A pervasive issue in education policy is finding ways to teach students the breadth and depth of knowledge expected by a variety of standards with limited resources, while balancing classroom needs. This brief reviews research that surveyed Idaho teachers to examine the incorporation of energy information into K-12 education curriculum, as both a scientific concept and among everyday topics. The survey focused on energy topics taught, what resources and teaching materials were used by teachers, a wish list for resources and support to improve energy education, and perceived challenges. Teachers throughout the state reported using a myriad of resources to teach about energy in science, math, history, health, and special education classes. The predominant challenge identified by teachers was lack of time to teach energy in addition to all the other goals that need to be met for pacing guides and standardized tests. This technical and policy brief poses unique solutions to maximize government spending on science education in schools, build a coalition of teachers and experts to create energy curriculum that will benefit all schools in Idaho, and identify energy experts and projects in communities to leverage unique teaching opportunities.

Background

Energy and environmental literacy represent key competencies that empower students to make political, technical, and socially-informed decisions about their homes and communities. Early education in these fields is seen as necessary to develop critical thinking and technical

skills required for the modern workforce. The rationale suggests that knowledge on energy topics helps create better global citizens, regardless of career path. The energy education literature is rich with studies analyzing critical junctures in training for students in order to understand energy concepts and begin organizing information systematically as well as to build connections across topic areas (Fortus et al, 2018; Opitz et al, 2019; Chen et al, 2013; Kohn et al, 2018). However, the abundance of literature on instructional challenges in science could itself reflect a barrier to establishing a singular approach to teaching the subject in a way that is "acceptable to physicists and meaningful to students" of all ages (Constantinou & Papadouris, 2012).

Research exists on educator perceptions related to teaching science in addition to perceived barriers to communicating science in the classroom. These studies indicate that professional development of teachers is a solution (Robertson & Daane, 2017; Van Aalderen-Smeets et al, 2012). Van Aalderen-Smeets (2012), however, in their more extensive literature review highlight that focusing additional time on science education is not the answer. Rather, sustainable improvements will only come if teachers develop more positive attitudes toward science—and as scientific knowledge and attitudes improve, so will confidence and teaching innovation in this area. Research also underscores how teacher's knowledge and attitudes matter to the instruction of science at all age levels.

Specific to energy education, a different treatment is deemed to be necessary (National Research Council, 2012; Blatt, 2015), since energy is not only a core concept in the physical and life sciences, but also a crosscutting concept in multiple disciplines. According to the *Framework for K-12 Science Education*, a real value of teaching energy is in the way that students will learn about the subject from varying foci and diverse terms that will be used to explain similar concepts, thus linking science in multiple contexts and facilitating cumulative learning experiences during students' K-12 experience (Opitz et al, 2019). Hence, the focus of the following research was to explore what the current resources, teaching materials, and challenges of teachers in Idaho schools are perceived to be as a baseline. Then, to gather teachers' ideas regarding how to improve the system in new ways.

Brief Analysis

This research surveyed Idaho teachers to examine the existing incorporation of energy information into K-12 education curriculum as well as the potential for more. Investigators sought to understand opportunities for innovation and to identify what programs are already underway in a variety of Idaho communities. The survey was sent in several waves via email to around 2,500 teachers in Idaho between March and May of 2020 and received a response rate of roughly 24 percent. Of the surveyed teachers, the most commonly taught subjects were

science, math, reading and social studies, although art, health, special education and other subjects were also included in the sample.

The research sample was stratified by grade level, teacher's subject expertise, and a rural school indicator to shed light on nuances in the data. The most taught energy topics across all grades were energy science basics, environmental aspects of energy, practices or behaviors in energy use, and renewable energy. The survey provided a list of resources teachers might use. Teachers across rural-urban school districts reported using information from a utility company, iStem, and Khan Academy to teach students about energy, but teachers at non-rural schools also often identified PhET. Additionally, in an open-ended category for the same question, we discovered teachers use Mystery Science, Foss Science Kits, Teachers Pay Teachers and many other online sources to instruct on energy topics in the classroom. Over half of the surveyed teachers identified time as a challenge to teaching energy topics. These concerns were followed closely by knowledge in the subject area, difficulty finding age appropriate relevant resources, lack of linkages to curriculum, and insufficient funding to create meaningful experiences. Interestingly, few teachers identified a lack of personal interest as a barrier to teaching energy in the classroom and only about five percent of respondents reported experiencing no challenges.

A binary logistic regression, using the subject of science as the dependent variable showed strong associations between many of the independent variables and the subject of science. The regression and additional correlations demonstrated strong relationships between both math and science as topics and resources such as Khan Academy, PhET, Stem Rising, and KidWind—as one would expect science resources to be utilized in STEM classrooms. While the outlined study provides a good basis for further investigation, the following represents interim options and recommendations.

Proposed Policy Options

1. Build an informal network connecting teachers across the state and available energy professionals to share lessons, reference material, and success stories, as well as to ask questions.
2. Create a state-wide consortium to design grade-specific resources on energy that incorporate age-appropriate information on scientific concepts as well as on everyday topics as a crosscutting concept. Such resources could include books, podcasts, online resources, and tactile activities.
3. Identify regional specialists willing to teach and provide demonstrations in classrooms or in video presentations. Pinpoint region-specific opportunities for educational fieldtrips

to locations such as wind farms, solar arrays, geothermal plants, hydroelectric dams, or historical sites.

Recommendation

The proposed policy options take a new approach to addressing several common policy failures in education, such as deficits in government funding, emphasis on standardized testing, and community involvement in education. The focus of these recommendations is to maximize available financial resources, human capital, and community partnerships to provide the best energy and science education in Idaho schools.

The feedback from teachers demonstrated a common interest in building more collaborative relationships within schools, districts, communities, and across the state to lower barriers for teachers to introduce energy topics into curriculum across subjects and at all levels of education. By building a coalition of experts, educators, and administrators to identify teaching resources, create curriculum, and supply community resources, individual teachers will decrease the amount of time they have to spend searching for resources, planning lessons and looking for ways to incorporate lessons or set up field trips. Additionally, building a statewide network would provide up-to-date information on a rapidly changing subject area and supply a venue for teachers to ask questions directly to experts on complicated topics outside of their training. The coalition also gives those with subject expertise a platform to teach and find pathways to share information in meaningful ways to multiple age groups.

Developing a substantive energy curriculum beginning with kindergarten and carrying through high school provides many benefits to individuals, communities, and Idaho as a whole. Energy has been identified as a crosscutting concept in science, which comes up in physics, biology, chemistry, earth science, engineering, health, and many other topic areas. Studying these subjects is essential for students to learn critical thinking, problem solving skills, and map connections between systems. These skills are key to careers in STEM and provide a foundation to evaluate their own knowledge and critically evaluate the claims of others. Not only will students with a strong foundation in energy education become good global citizens, they have the potential to benefit their communities and the economy of Idaho by filling important engineering and tech jobs at Micron, Simplot, Hewlett-Packard, and Idaho National Laboratory.

Endnotes

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