Artifact based energy literacy assessment utilizing rubric scoring

Quinn Langfitt, Liv Haselbach, R. Justin Hougham

Issue

This research focuses on development of an energy literacy rubric for scoring course or project-type deliverables, an approach that has not been taken with respect to energy literacy assessment. To examine if the rubric approach may be applicable, the rubric was applied to the Imagine Tomorrow competition, a high school energy competition, and trends in the results were examined to support rubric effectiveness. Competition deliverables include an abstract and a poster.

Background

Energy Literacy

Energy literacy is understanding how energy is generated and used, what role it plays in our lives, and how we can utilize that knowledge to solve problems

- Adults in the U.S. tend to score poorly on energy literacy tests
- Higher energy literacy important to national:
  - Policy decisions
  - Personal choices
- Energy literacy should be emphasized more at a young age
- Project-based learning can be a valuable addition to classroom style learning

Imagine Tomorrow Competition

- Annual high school energy competition started in 2007
- Teams from Pacific Northwest compete at WSU
- Students engage a self-chosen energy issue with a group
- Submit an abstract and present a poster at an academic-style poster session
- Compete in one of these categories:
  - Behavior
  - Design
  - Technical
  - Biofuels
  - Interdisciplinary
- Some teams also build displays or prototypes

Study Objectives

Applicability of rubric use for examining energy literacy in artifacts as an alternative to testing

Energy literacy levels and trends displayed in Imagine Tomorrow competition deliverables

Rubric Approach

Why Use a Rubric?

These differences between tests and rubrics make it important for a rubric based approach to be developed:

- Rubrics may measure more applied type knowledge than tests do
- Rubrics can be applied to past works
- Rubric assessments do not require any effort by the assessed
- No non-responses in rubric assessment

Our Rubric Development

- **Framework**: Based on WSU Civil Engineering senior design project rubric
- **Content**: Adapted from science writing literacy rubric
- **Review**: Reviewed by energy education and assessment experts

The Rubric

Energy Literacy						
Absent 1	Pre-Emerging 1.5	Emerging 2	Developing 3	Competent 4	Effective 5	Mastering 6
Students: - Do not identify issue - Do not summarize the issue - Do not consider stakeholders - Focus on their own perspective - Do not consider impact or context -Do not consider current information available on the issue			Students: - Begin to frame the issue, but gloss over key details - Discuss approaches to resolve issue - Discuss the impact in one or two contexts - May consider perspectives of some stakeholders -Mention available information		Students: -Frame professional challenge -Develop appropriate approaches to resolve the issue -Deeply examine impact -Seek and evaluate outside sources -Examine current information as it relates to their research -Understands various stakeholder views	

Rubric Interpretation:

- Absent: Did not address energy in any way
- Pre-emerging: Briefly addressed one rubric topic, but with very little detail
- Emerging: Briefly addressed 2 rubric topics or did 1 from second group well
- Developing: Did ~2 from the second group well
- Competent: Did ~2 plus from the second group well
- Effective: Did ~2 from third group and most from second group well
- Mastering: Did ~2 plus from third group and all from second group well

Reliability

The ability for scores to be reproduced if works rated again

- Two types of reliability are consensus and consistency
  - *Consensus*: Raters agree on scoring
    - Measured by Cohen's Kappa
  - *Consistency*: Raters agree on ranking order of works, but not the actual scores assigned
    - Measured by Spearman's Rho

Validity

Degree to which the rubric is measuring the intended entity

- In this study supported by:
  - Proven framework
  - Adaptation from published content
  - Expert review

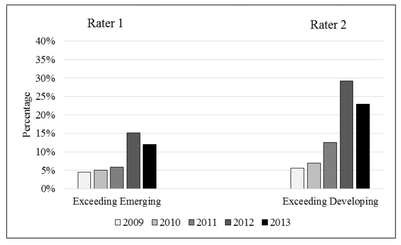
Application

- Rubric applied to Imagine Tomorrow deliverables:
  - Abstracts from 2009-2013 by two raters
  - Posters from 2013 by one rater

Assessment Results

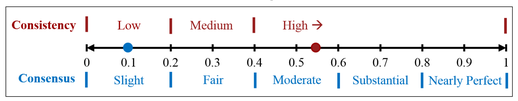
Abstracts

Abstract Energy Literacy Scores by Year



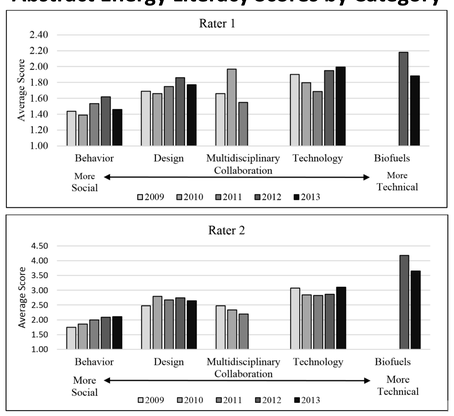
- Energy literacy is higher in last two years
- Additional outreach these years likely a driving factor
- Similar trend between raters on yearly basis

Rubric Reliability on Abstracts



- High consistency
- Slight consensus

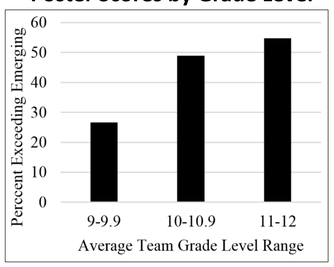
Abstract Energy Literacy Scores by Category



- Energy literacy higher in more technical categories
- Consistent with what testing has shown
- Similar trends between raters on category basis

Posters

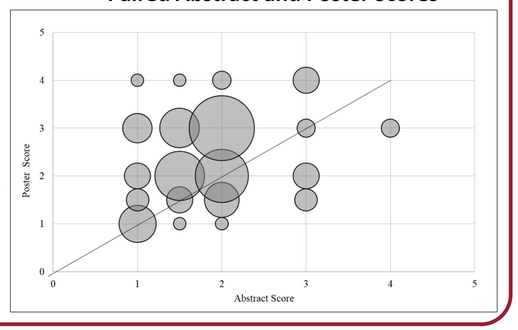
Poster Scores by Grade Level



←Energy literacy positively correlated to average student grade level

Abstract energy literacy moderately good predictor of poster energy literacy→

Paired Abstract and Poster Scores



Conclusions

Outcome

Rubric approach appears to be working effectively

- Energy literacy follows expected trends
  - Increased literacy after increased outreach
  - Higher literacy in more technical categories
  - Higher literacy among older students
- Raters exhibited moderate to high reliability

- Rubrics haven't been used for energy literacy assessment and contribute to the available set of tools
- Could be expanded to other related applications
- Could be used to assess/improve energy education techniques

Future Work

- Apply to 2014 competition with the following changes:
  - Refine the rubric for more clarity
  - Improve scoring database for better analyses
  - Hold calibration session
  - Add more raters
- Determine if changes improve assessment results

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