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Engaging Teachers and Students in STEM Instruction through Service-Learning

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Abstract
GreenSTEM at VCU integrates science, technology, engineering and math (STEM) education with a focus on energy and the environment using service-learning techniques for middle school science, mathematics and technology teachers.

Keywords
STEM, STEAM-H, STEAM, service-learning, GreenStem, Teaching, Middle School

Disciplines
Higher Education

Comments
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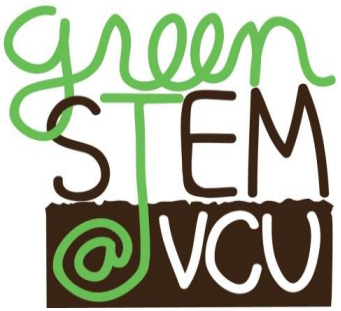


What is GreenSTEM@VCU?

- An innovative in-service program for middle school science, math, and technology teachers
- Funded by Learn and Serve America
- In-person and online instruction
- Assists teachers with integrating STEM instruction into high-quality service-learning
- Service-learning projects address local issues with a focus on energy and the environment

Program Focus

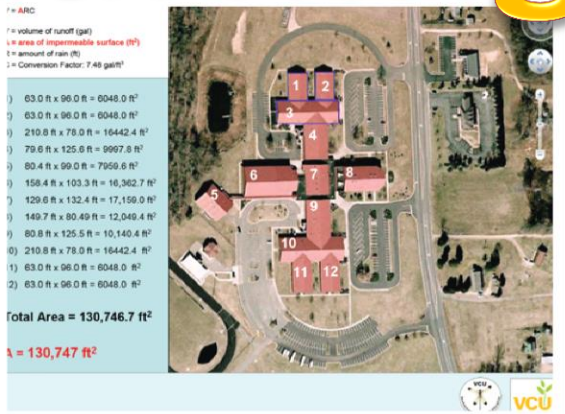
SCIENCE

TECHNOLOGY

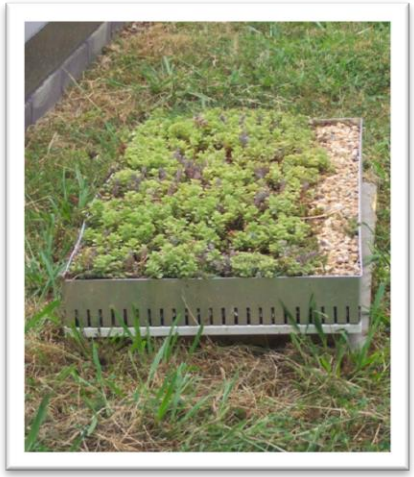
Service-Learning

ENGINEERING

MATHEMATICS



Program Highlights



- Investigate green buildings and environmental science at VCU's LEED platinum Rice Center education building
- Experiment with alternative energy strategies in VCU's state-of-the-art Engineering lab facilities

Program Objectives

- Identify a problem or concern in your community.
- Use STEM concepts to help find a solution.
- Work with other students, teachers, and community partners to implement the solution.

SAMPLE LESSON
"Down Came the Rain: Roofs and Runoff"
http://sites.google.com/site/vcurunoff/home

- Integrative STEM
- High quality service-learning
- Alternative energy resources
- Green building techniques
- Green jobs

Purpose of Study:

To evaluate the program's impact on teachers

Variables:

- Knowledge in the areas of integrative STEM education, service-learning, and green jobs
- Self-efficacy about teaching these concepts
- Attitudes and behavior related to teaching these concepts

Proximal vs. Distal Outcomes:

- Short-term impact on knowledge
  Following participation in a one-week on-site summer academy
- Sustained impact on all three variables
  Following implementation of service-learning projects with their students

Participants

2010 GreenSTEM@VCU teacher cohort

- 16 teachers
- From 11 schools
- Teaching more than 600 middle school students

"The students have been fantastic. At every step they've been in charge of the project. They have really learned how STEM subjects and environmental issues relate to their everyday lives and, that by working and planning together, they can make a difference."

~2010 Teacher Participant

Measures

1. Knowledge Test

   - 38-question paper and pencil assessment
   - Administered as a repeated measure:
     - Pretest: on first morning of the one-week (5-day) summer academy
     - Posttest 1: on the final day of the summer academy
     - Posttest 2: at the end of the 2010-11 academic year
   - Content areas:
     - knowledge of service-learning quality standards
     - knowledge in the integrated STEM disciplines
     - understanding of green-economy jobs.

Measures

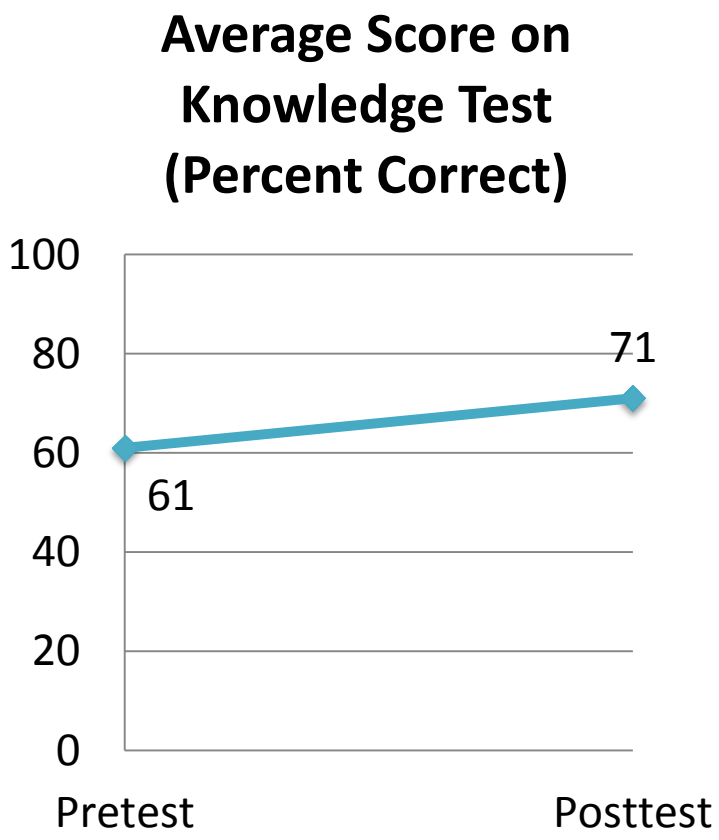
2. Self-Efficacy, Attitudes, and Behaviors Survey

- 17-item online questionnaire
- Administered as a pretest/posttest measure:
  - Pretest: prior to arrival at the summer academy
  - Posttest: at the end of the 2010-11 academic year
- Content areas:
  - Use of service-learning pedagogy
  - Teaching of integrated STEM content
  - Partnering with community organizations
  - Working with media representatives
  - Career intentions

Short-Term Outcomes

Following the One-week Summer Academy

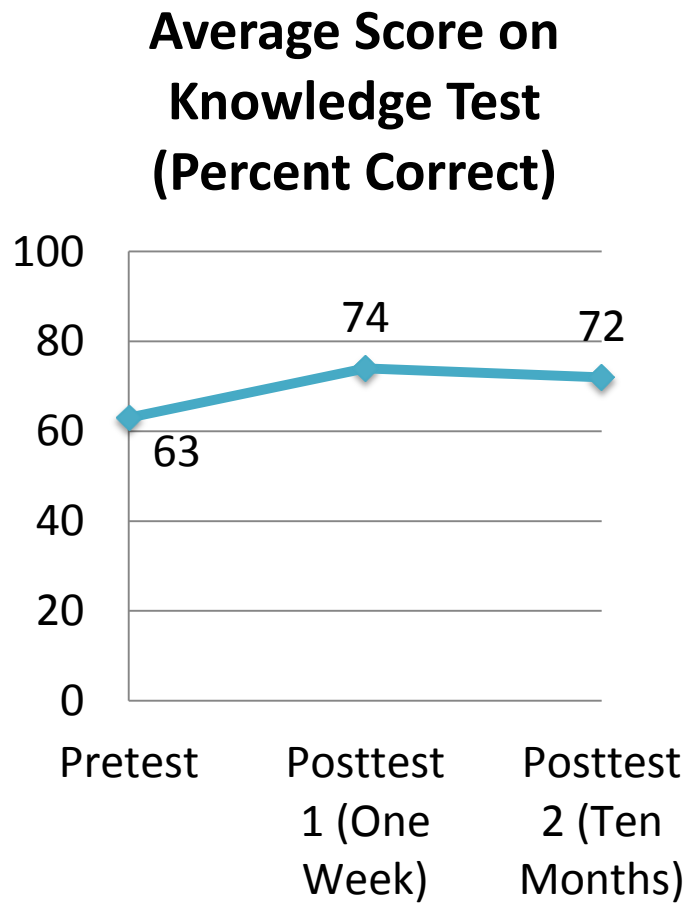
- **Knowledge Gain**
  - Paired samples *t*-test
  - $n = 16$
  - Average score increased from 61 to 71
  - Increase is significant ($p < .001$)
  - Effect size for change is large (Cohen's $d = 1.06$)



Long-Term Outcomes

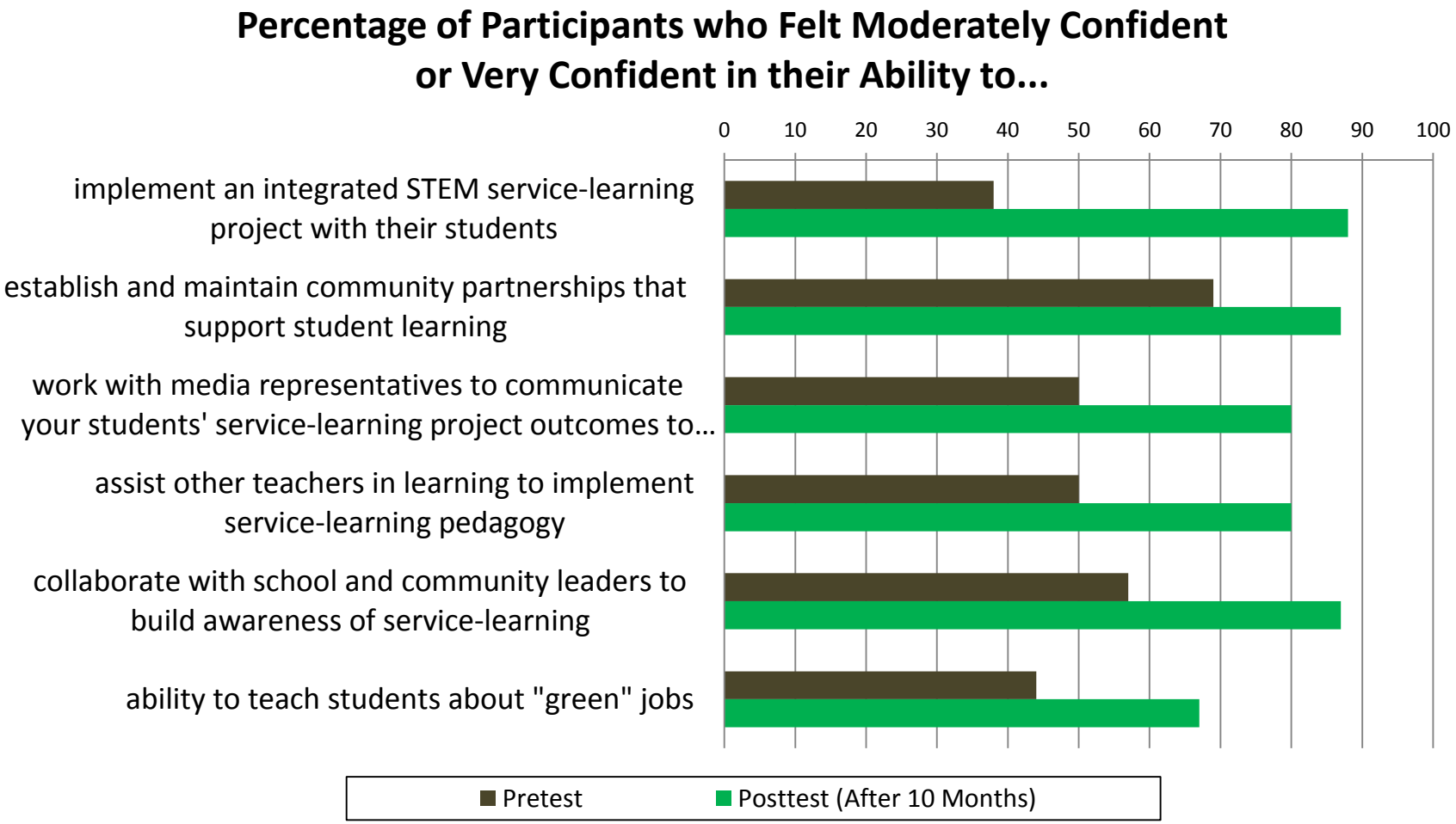
Knowledge Changes After Ten Months

- **Knowledge Gain**
  - Repeated measures ANOVA and paired samples *t*-tests
  - $n = 11$
  - Average final test score represents a significant increase in teacher knowledge ($p < .05$).
  - Scores dropped slightly between summer academy and end of program, but decrease is not significant.



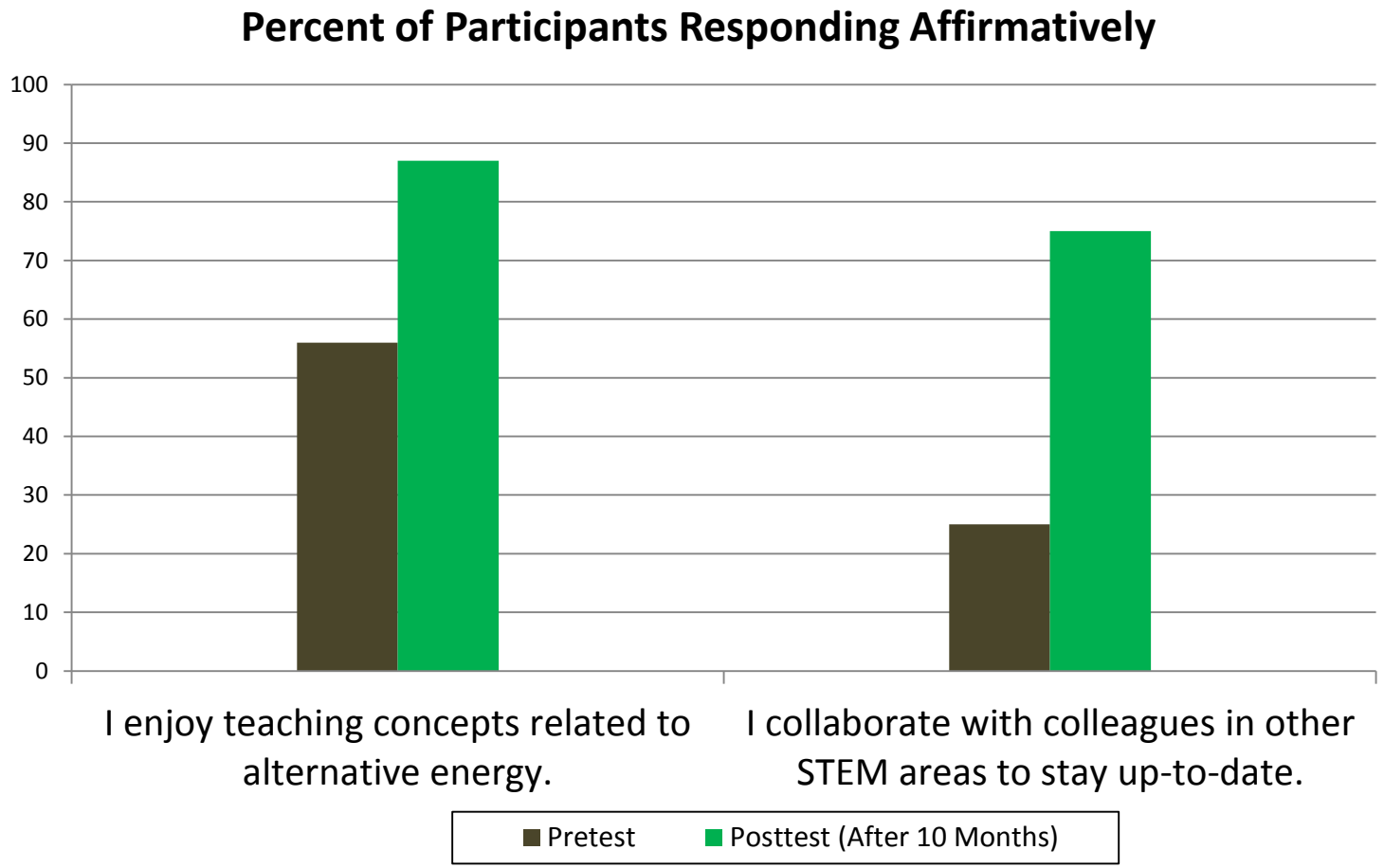
Long-Term Outcomes

Self-Efficacy Changes After Ten Months



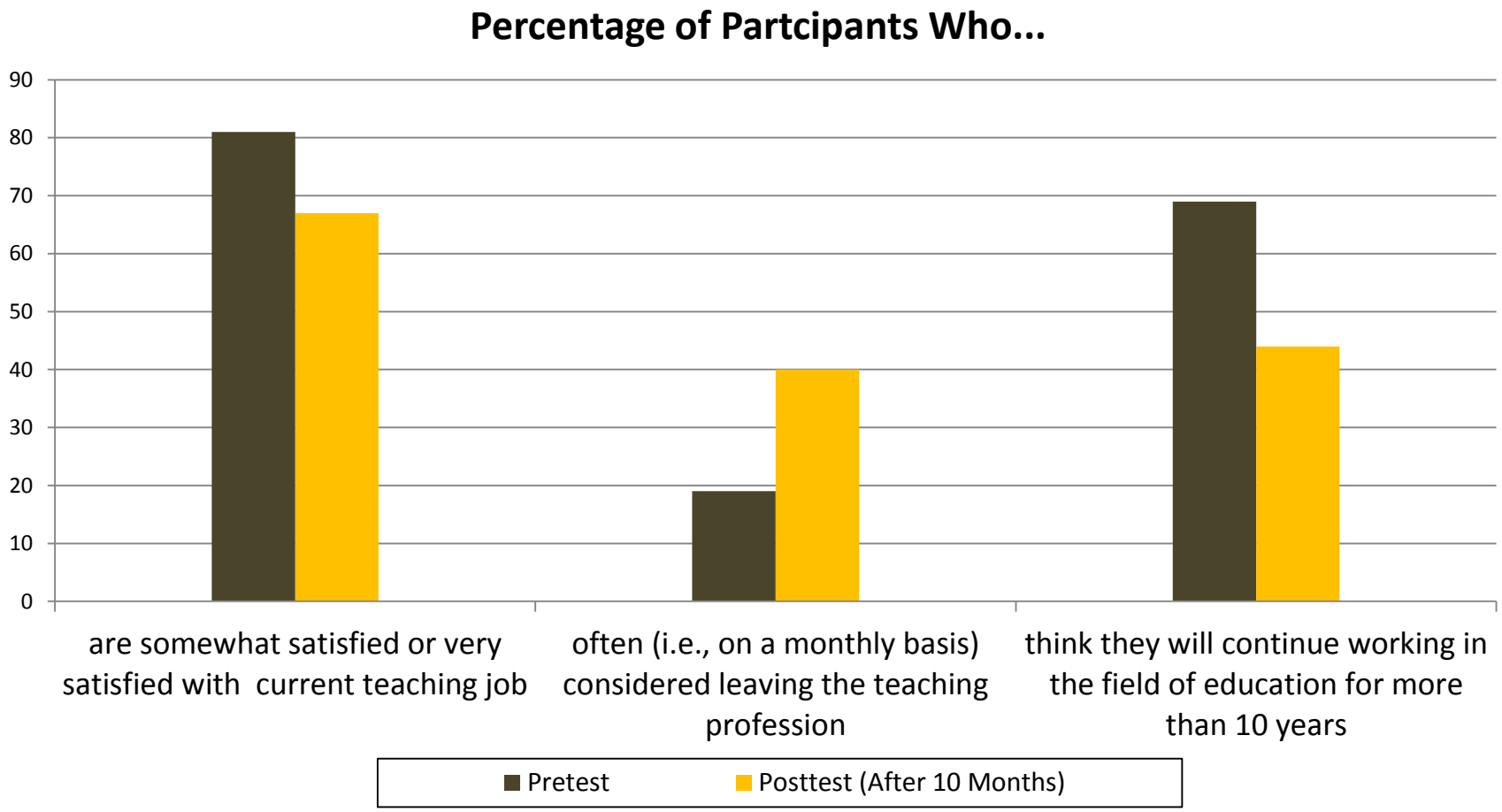
Long-Term Outcomes

Attitude and Behavioral Changes Related to Teaching Practices



Long-Term Outcomes

Attitude Changes Related to Career Intentions



Conclusions

- The summer academy is effective at increasing teacher knowledge.
- Program activities help to sustain knowledge during the subsequent academic year.
- The program is effective at increasing self-efficacy about teaching STEM concepts and green jobs, and using service-learning pedagogies.
- The program is effective at promoting positive attitudes and behaviors about teaching STEM concepts.
- Administrative support is critical to success.

GreenSTEM@VCU 2012

- June 25 – 27, 2012
- For more information:
  - https://sites.google.com/site/greenstemvcu2012/
  - Sue Kirk at svkirk@vcu.edu