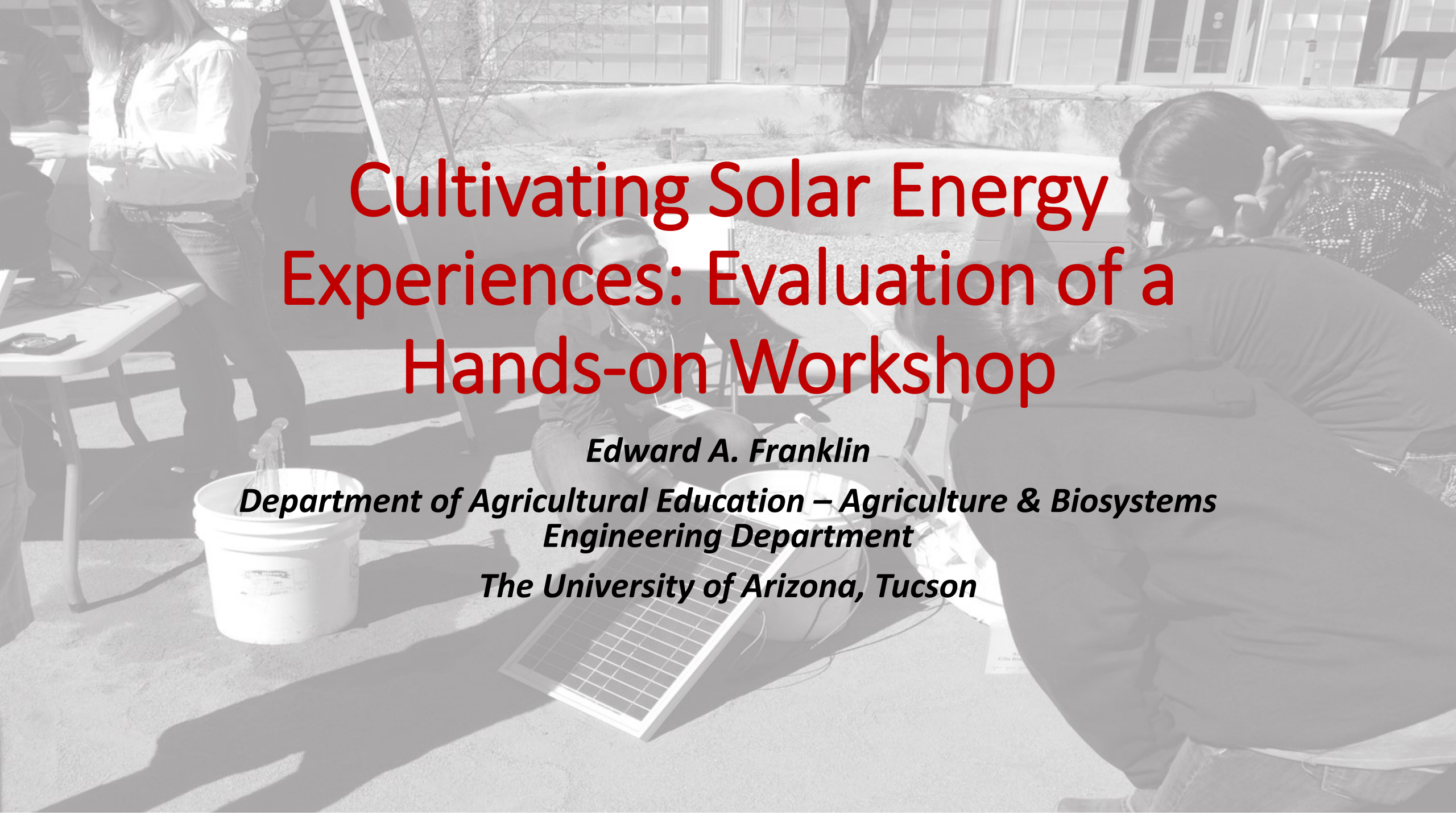


Cultivating Solar Energy Experiences: Evaluation of a Hands-on Workshop

Edward A. Franklin

Department of Agricultural Education – Agriculture & Biosystems Engineering Department

The University of Arizona, Tucson

Introduction

- Adopting a technology for teaching or personal use requires:
  - familiarity,
  - understanding of use,
  - a degree of self confidence,
  - ability to use before acceptance.
- Weighing benefits to use versus alternatives to not using the technology.

Rationale

- Getting to people to change or adopt requires:
  - effort,
  - change in knowledge,
  - ability to relate,
  - a demonstration of concepts,
  - opportunity to experiment
  - ability to try it for themselves
  - have something to take away and reflect on it

Investigation to Determine Use

- What motivates individuals to attend workshops?
- What are their expectations?
- Providing opportunities for workshop attendees to gain hands-on experiences.
- View and discover materials and tools before in-depth lecture.
- Checking the weather for timing.

Purpose of Presentation

- Share effectiveness of a particular workshop to educate about solar photovoltaic (PV) energy.
- Using a combination of power point lecture, realia, and hands-on activities to create understanding.

Methods

- Conducted Needs Assessment
- Cooperative Extension professionals in Arizona
- Determine perceived importance of learning about renewable energy systems, particularly solar photovoltaic (PV) energy

Methods

- Determine optimum:
  - Time of year
  - Location of workshops
  - Length of time for workshop
  - Cost of attending
  - What to take away
- Determine possible barriers:
  - Location
  - Travel
  - Cost

Setting up the Classroom or Meeting Room

- Attendees appreciate:
  - Printed materials to follow along with powerpoint presentation
  - Links to websites
  - Bound worksheets
  - Safety glasses
  - Flash drive with handouts, recommended teaching materials
  - Solar book
  - Refreshments available

Solar Photovoltaic Fountain – Simple Example

Examples of Demonstration Systems

- Stand-alone
- Battery-based system
- Solar PV module, charge controller, 12 volt battery, & 12 volt DC load (pump in a bucket)

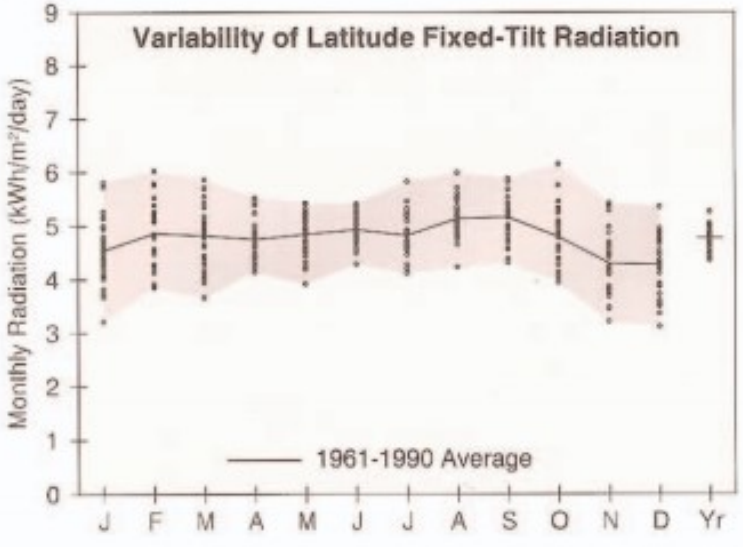
Using Industry-related Hand Tools

- Measuring solar irradiance with a Pyranometer.
- What is the expected energy output of the PV module?
- What effect does solar irradiance have on water pump performance?
- How does tilt angle & orientation of the module toward the sun effect water pump performance?

Teaching Safe Use of Digital Multimeter

- Understanding how the meter functions.
- Selecting the proper settings.
- Identifying what to expect.
- Taking readings.
- Interpreting the results.
- Reinforcing safety when taking readings on energized equipment.

Knowledge of Effect of Tilt on Performance



Hilo, HI

WBAN NO. 21504

LATITUDE: 19.72° N
LONGITUDE: 155.07° W
ELEVATION: 11 meters
MEAN PRESSURE: 1015 millibars

STATION TYPE: Secondary

Solar Radiation for Flat-Plate Collectors Facing South at a Fixed Tilt (kWh/m²/day), Uncertainty ±9%

Tilt (°)		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
0	Average	3.8	4.3	4.6	4.8	5.2	5.4	5.2	5.3	5.0	4.3	3.7	3.5	4.6
	Min/Max	2.8/4.6	3.5/5.1	3.5/5.5	4.2/5.6	4.2/5.8	4.6/5.9	4.4/6.4	4.4/6.2	4.2/5.7	3.7/5.4	2.9/4.5	2.8/4.2	4.2/5.0
Latitude -15	Average	4.0	4.4	4.7	4.8	5.1	5.3	5.1	5.3	5.1	4.5	3.9	3.7	4.7
	Min/Max	2.9/4.9	3.6/5.4	3.6/5.6	4.2/5.6	4.1/5.8	4.6/5.8	4.4/6.3	4.4/6.2	4.3/5.8	3.8/5.6	3.0/4.7	2.9/4.5	4.3/5.1
Latitude	Average	4.5	4.9	4.8	4.7	4.8	4.9	4.8	5.1	5.2	4.8	4.3	4.3	4.8
	Min/Max	3.2/5.8	3.8/6.0	3.7/5.9	4.1/5.5	3.9/5.4	4.3/5.4	4.1/5.8	4.2/6.0	4.3/5.9	4.0/6.2	3.2/5.4	3.1/5.3	4.4/5.3
Latitude +15	Average	4.9	5.0	4.7	4.4	4.3	4.3	4.3	4.7	5.0	4.8	4.5	4.6	4.6
	Min/Max	3.3/6.3	3.9/6.3	3.6/5.8	3.9/5.2	3.5/4.8	3.8/4.7	3.7/5.1	3.9/5.4	4.1/5.7	4.0/6.3	3.3/5.8	3.2/5.9	4.2/5.1
90	Average	3.8	3.4	2.6	1.8	1.4	1.4	1.4	1.6	2.3	3.0	3.3	3.7	2.5
	Min/Max	2.5/5.1	2.6/4.3	2.0/3.1	1.7/2.0	1.4/1.5	1.3/1.5	1.3/1.5	1.5/1.7	2.0/2.5	2.5/3.9	2.3/4.4	2.4/4.8	2.1/2.7

Attendee Feedback from Evaluations

- Combination of Scaled-questions, and open-end responses:
  - Appreciation for hands-on activities
  - Working with tools, modules, meters, and pumps
  - Small group work is effective
  - Balance of lecture and hands-on activities
  - Mixture of methods during workshop

Results

- Materials are age-appropriate.
- Engagement leads to experimentation and discovery.
- Middle schoolers and high schoolers find tools and equipment are easy to use.
- Intrigued in operation of solar PV module and effects of shading on module and what it does to water pump performance.

Conclusions/Implications

- Keeping it relevant.
- Understanding level of knowledge of workshop attendees.
- Making adjustments to each workshop presentation.
- Use of pre-workshop knowledge/attitude survey to determine where your audience is.
- Follow it up with contact.
- Developing solar-related factsheets for Cooperative Extension

Thank you for your time!