Effective Traditional and Virtual Education Outreach

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http://lsop.colostate.edu

COLLEGE OF
NATURAL SCIENCES
COLORADO STATE UNIVERSITY

LITTLE SHOp OF PHYSICS
http://lsop.colostate.edu
It’s been really great to interact with other adults.

(And with other physics educators, of course.)
Little Shop in action at a school
Annual Open House
Experiment Stations Built By Undergraduate Students
International Efforts
Why do we do outreach?
Who are the beneficiaries?

Breakout Rooms
Not intelligent design. Evolution.
“Building the Brand”

Wonder
Science Is Social
Student-Centered
Undergraduate Engagement
Community
Questions

1) Is informal education effective?
2) How can we make our efforts inclusive and equitable?
3) Who are the beneficiaries?
4) What is the difference between outreach and engagement?
Target Audience #1: K-12 Students
Early Efforts.

Can we show any effect, at all?

*Draw a picture of air pressure in action.*
How do you measure engagement?

Observation study of about 1000 kids.
Does the student read the sign?  

How long does the student spend trying to figure out the purpose of the exhibit?  
(in seconds)

Does the student use the exhibit in the correct manner (as implied by directions)?  Y =1/N=0

How long does the student stay at the exhibit after figuring out the purpose?  
(in seconds)

Does the student use the exhibit at all as though it were a physical object?  Y=1/N=0

On balance, characterize student’s use of the exhibit:

0 – Completely (or nearly so) as physical object
1 – Clearly more as physical object than for inquiry
2 – About equally as physical object and for inquiry
3 – Clearly more for inquiry than as a physical object
4 – Completely (or nearly so) for inquiry

Which of the following statements best describes how the student interacts with the exhibit?

0– The student cannot immediately see how the exhibit works, so the student moves on to the next exhibit
1– The student seems interested by the exhibit, but doesn’t understand how it is supposed to work, so student moves on to next exhibit
2– The student plays with the object in their own way, not trying to figure out the purpose of the exhibit/how it should work.
3—Student works at figuring out how the exhibit should be used, but neve figures it out and moves on to next exhibit
4– The student works at figuring out how the exhibit should be used and then once discovering this moves on to the next exhibit
5– The student figures out how exhibit should be used and then becomes more intrigued and continues to play with it in this manner

If the student played with the object in their own way was it:  

Does the student describe to another how the exhibit works?  
Y=1/N=0

How does the student mostly use the exhibit?  

Does the student ask for assistance about how to do something?  
Y=1/N=0

Inter-rater reliability was very high.
Time at a station.

Median Time: 15 seconds
Seconds per station, by grade level.

<table>
<thead>
<tr>
<th>Grade Range</th>
<th>Time (s)</th>
<th>± (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 - 5 grades</td>
<td>15</td>
<td>±5</td>
</tr>
<tr>
<td>6 - 7 grades</td>
<td>18</td>
<td>±2</td>
</tr>
<tr>
<td>8 - 9 grades</td>
<td>13</td>
<td>±2</td>
</tr>
<tr>
<td>Reads Sign?</td>
<td>3&lt;sup&gt;rd&lt;/sup&gt;-5&lt;sup&gt;th&lt;/sup&gt;</td>
<td>6&lt;sup&gt;th&lt;/sup&gt;-7&lt;sup&gt;th&lt;/sup&gt;</td>
</tr>
<tr>
<td>------------------</td>
<td>-------------------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>Completely Reads</td>
<td>17.5%</td>
<td>26.1%</td>
</tr>
<tr>
<td>Briefly Reads</td>
<td>16.9%</td>
<td>23.2%</td>
</tr>
<tr>
<td>Doesn't Read</td>
<td>65.6%</td>
<td>50.7%</td>
</tr>
<tr>
<td>Used the equipment correctly?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-----</td>
<td>----</td>
</tr>
<tr>
<td></td>
<td>88.4%</td>
<td>11.6%</td>
</tr>
</tbody>
</table>
Became more interested, explored more. | 50.7%
---|---
Moved on. | 49.3%

Of the students who used the equipment correctly...
Inquiry

Student used the equipment:

<table>
<thead>
<tr>
<th>Description</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completely for inquiry</td>
<td>36.3%</td>
</tr>
<tr>
<td>More for inquiry</td>
<td>58.2%</td>
</tr>
<tr>
<td>About equally</td>
<td>5%</td>
</tr>
<tr>
<td>More as physical object</td>
<td>0.5%</td>
</tr>
<tr>
<td>Gender Effects?</td>
<td>Male</td>
</tr>
<tr>
<td>----------------</td>
<td>------</td>
</tr>
<tr>
<td>Becomes more interested, explores more.</td>
<td>42</td>
</tr>
<tr>
<td>Moves on.</td>
<td>44.7</td>
</tr>
<tr>
<td>Doesn’t use equipment correctly.</td>
<td>13.3</td>
</tr>
<tr>
<td></td>
<td>Anglo</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>Becomes more interested, explores more.</td>
<td>44.3</td>
</tr>
<tr>
<td>Moves on.</td>
<td>45.5</td>
</tr>
<tr>
<td>Doesn’t use equipment correctly.</td>
<td>10.2</td>
</tr>
</tbody>
</table>

Ethnicity differences?
There does not seem to be a significant difference in engagement between different kinds of students.
Normalized learning gain

\[ g = \frac{\text{post} - \text{pre}}{100 - \text{pre}} \]
Pre-test vs. post-test

Before visit / after visit
Time varies, but results do not seem to
The Way the Wind Blows

In Colorado, sometimes the wind blows from high elevations and low pressures in the mountains to low elevations and high pressures on the plains.

As the air does this, it:

A. cools down.
B. warms up.
Comparing pre-test / post-test data

Data from Columbia Middle School
17 Feb 2011
Changes in self-efficacy
Target audience #2: Undergraduate students
Intern interviews

• All surveyed students noted lessons and specific skills that they had learned, regardless of their eventual career path.

  I learned to imagine more and instruct less. The kids always had interesting ideas with the projects I had never even considered.

• All surveyed students reported gains in communication skills.

  I found that learning science is a very individualistic thing. Something that made one person understand might not work on another. The important thing was always to just keep trying.

• Nearly all students reported clarification of career goals.

  LSOP was the first step for me to change from a research focus to an education focus. The knowledge that I enjoy teaching has impacted many of my career decisions since.

• Interns reported gains in interpersonal skills.

  Great team relationship and depending on other people to hold high expectations as well.
Target audience #3: Fellow educators
### Responses from summer workshop attendees

<table>
<thead>
<tr>
<th>Item</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>I used what I learned in the workshop in my teaching.</td>
<td>93%</td>
</tr>
<tr>
<td>I used hands-on activities from the workshop in my teaching.</td>
<td>93%</td>
</tr>
<tr>
<td>I shared what I learned with other science teachers at my school.</td>
<td>86%</td>
</tr>
<tr>
<td>I became more confident in my ability to communicate science.</td>
<td>79%</td>
</tr>
<tr>
<td>I learned from the pedagogical approaches of the workshop.</td>
<td>57%</td>
</tr>
<tr>
<td>I used slides from the workshop in my teaching.</td>
<td>36%</td>
</tr>
</tbody>
</table>
Lessons for my teaching
Science and education are social enterprises.
We learn best when we are active.
Our job as educators is to design an environment in which students can learn.
Engagement vs. Outreach
It’s not the having. It’s the doing.
How do we stay connected in a physically-distanced world?
Virtual Connections

http://lsop.colostate.edu

Not intelligent design.
Evolution.
LSOP LIVE: FOOLED YOUR BRAIN, FRIDAY, APRIL 9
You know about optical illusions, where your eyes see something that isn’t really there—but do you know that there are hearing illusions, touch illusions, and even taste illusions? It turns out that it’s not that hard to trick your brain, and doing so teaches us a lot about how your brain works. Video Shorts Read More

LSOP LIVE: INVISIBLE FORCES, MARCH 5, 2021
By request from a local school: Invisible Force! Do you can’t see gravity—but you can certainly feel its effects. And it works at a distance—you don’t need to be in contact with the earth to feel its pull. We say that the earth has a gravitational field around it—and if you are in the field, you feel it. [Read More]

LSOP LIVE: SCIENCE IT UP!, FEBRUARY 28, 2021
Last week, we asked students to share their questions with us—and they did! We got questions from: “Why do we see clouds, since they are made of air?” “Why do snowflakes have different designs?” This week, we take new question after another and Science It Up! We take each question and use it to make something new. [Read More]

LSOP LIVE: THE MUSIC SHOW, FEBRUARY 5, 2021
Talking about music gives us a chance to talk about forces, frequency, energy, vibrations, and states of matter. It’s a rich topic, and we’ve had a lot of fun exploring. How many ways can you play Hot Cross Buns? We play it on glasses, bottles, reed pipes, electrical conduit, and, of course, actually [Read More]

LSOP LIVE: DO THE LOCOMOTION, APRIL 2, 2021
By student request: A show about how you walk, how fish swim, how birds fly! If you want to move forward, you need to push backward—on the ground, on the water, or on the air. You want to do this efficiently, using as little energy as possible. In this show, we answer a bunch of [Read More]

LSOP LIVE: ROCK ON! MARCH 19, 2021
What’s so cool about rocks? Ah, it all turns out. In this episode, we show you rocks that pop like popcorn, rocks that you can use to make electrical circuits, rocks that split light in two. We also show you how to read history in rocks that you find, and even how to find [Read More]

LSOP LIVE: BOUNCING, BENDING, AND TWISTING LIGHT, FEBRUARY 19, 2021
Mirrors, lenses, and prisms, oh my! In this episode we show you some amazing effects that light can do. We also show you how to read history in rocks that you find, and even how to find [Read More]

LSOP LIVE: THE HEART OF THE MATTER, JANUARY 22, 2021
This week, we are trying something new: the heart topics that are part of the state science standards, to better connect with what students are learning in school. This week, we consider the following fact: Matter is made of atoms. Understanding this helps understand matter’s appearance and behavior. Why is steel bouncy? Is—very [Read More]

LSOP LIVE: THE WATER SHOW, JANUARY 15, 2021
Water is very special about water? Quite a bit, as it turns out! In this episode, we show you bunchs of simple experiments you can do that illustrate the special properties of water. We make water freeze on command, make a stream of water follow a string, use water to lift writing off glass, and [Read More]

LSOP LIVE: FORCE AND MOTION, MARCH 12, 2021
By request from a local school: Force and Motion! When you jump in the air, it’s not your legs that push you upward—it’s actually the ground! And you know you have to push something to get it moving. You have to push to make it, we make things float and [Read More]

LSOP LIVE: SINKING AND FLOATING, FEBRUARY 12, 2021
A bouncing ball—does it use energy to float? The answer might surprise you, as will dozens of the experiments we share. We float bubbles and steel balls, and make a ketchup packet go back and forth between sinking and floating. We answer the question: How do you make things float and make them sink? [Read More]

LSOP LIVE: IT’S ABOUT TIME, JANUARY 29, 2021
This episode is about time! We use aides to slow time down, speed time up, to make time go backwards—and we see how this changes our view of the world. We also do some cool tabletop experiments with watermen, with hot cross, and with hand sanitizer. What do these things have to do with [Read More]

LSOP Live Live

https://www.lsop.colostate.edu/lsop-live/
Workshops & courses
Science Outreach Scholars & Boys & Girls Club
Transition to in person learning
Classroom Connections
What ideas do you have?

Breakout Rooms
Questions?

http://littleshop.physics.colostate.edu