They don’t really teach about it. They would like to tell us what it is, but they’d say, “Okay, who saw the spinny thingy out there?” And then the people who knew would raise their hand and they’d tell what it was. And that’s — not all teachers do that, but they don’t teach about that.

(Harper, 7th Grade)
Stanley Hall
the haworth center

Perkins+Will renovation, 2007
How can green buildings **TEACH** us about environmental issues?

my overarching question
the teaching green building

“My point is that academic architecture is a kind of crystallized pedagogy and that buildings have their own hidden curriculum that teaches as effectively as any course taught in them” (David Orr, “Earth in Mind,” 2004)
## The Teaching Green Building: 5 Theoretical Perspectives

<table>
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<tr>
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Cole (in press)
Framework based on the stated goals of Environmental Education Tbilisi Declaration (1977)
understanding green building knowledge

Factual Knowledge (elements)
- What does a wind turbine do?
- What are recycled content materials?

Conceptual Knowledge (relationships)
- How does daylight impact building energy conservation?
- How do activities in the building impact air and water quality?

Procedural Knowledge (process)
- When can I open windows without negatively impacting building energy efficiency?
- How do I compost my lunch scraps?

From Bloom’s Taxonomy Table (Krathwohl, 2002)
Located in Northern California
K-8 Public Charter School
Emphasis on language and the arts, sustainability not part of founding mission
New building funded by local foundation
arts school: a new construction teaching green building
arts school
arts school longitudinal study [with grades 6-8]

1. Old school building (2011)
3. Three years later (2015)

Local Comparison Non-Green School
Overarching Research Question

What environmental education outcomes do students experience over time in a Teaching Green Building?
data collection: a mixed-method approach

Student Photovoice Project

Green Building Literacy Survey

n = 267

Plus... Interviews with administrators, facility managers, and architects, focus groups with teachers, and spatial analysis of buildings with teaching green features located

n = 39 in data presented here
Where do you learn about environmental sustainability around your school building?

*(students were asked to take photos that answer this question)*

Student photovoice project
photovoice: photos before and after

Pre-move

Post-move
photo categories: pre and post move

Pre

- Recycling/Reuse: 36%
- Plants / Animals: 25%
- Litter / Trash: 14%
- Water: 12%
- Socio-Cultural: 5%
- Electronics/Energy Efficiency: 3%
- Transit: 3%
- Signage General: 2%

Post

- Plants / Animals: 22%
- Daylight/Air: 15%
- Alternative Energy: 7%
- Building Artwork: 3%
- Building Materials: 3%
- Litter / Trash: 2%
- Water: 3%
- Socio-Cultural: 11%
- Electronics/Energy Efficiency: 8%
- Transit: 8%
- Signage General: 5%

n = 27
n = 34
photovoice interview analysis

“The amphitheater has no roof... it saves electrical, like lighting... It saves electrical, heating and cooling costs.” (Madelyn)

“Because the walls are special. They either – I think they keep heat in or something like that. I didn’t really learn much about it, but I know they’re special.” (Ava)

Cole & Altenburger (in review)
But there is a lot of uncertainty about how things work...

Additional Quotations from interviews with 7th graders...

- Well, it was just, kind of, like, using reused — our school’s pretty much a whole architecture made out of reused items. Like, pretty much almost everything in our school is reused. It’s made out of reused items. (Sophia).

- I heard something about how they would filter it. I think they used the water [inaudible] filter it. I don’t remember. But I heard about that so I took a picture of it that kind of meant that reason (Brooklyn).

- And then I took a picture of the lights from the science lab, and the lights, I don’t know how they do this, but when it gets brighter they like dim. (Jayla)
photovoice interview analysis

Overview of what we found:

• Sustainability integrated into mission after building was built
• Green Facilities
• Uncertain Teachers
• Very little formal environmental education
• No Green Culture

Students aware of building but not deeply knowledgeable

Minimal mention of teachers, classroom learning or school cultural events.

Cole & Altenburger (in review)
data collection: a mixed-method approach

Student Photovoice Project

Green Building Literacy Survey

Plus...
Interviews with administrators, facility managers, and architects, focus groups with teachers, and spatial documentation of buildings with teaching green features located

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<th></th>
<th>Pre-Move</th>
<th>Year 1</th>
<th>Year 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green School</td>
<td>50</td>
<td>92</td>
<td>90</td>
</tr>
<tr>
<td>Non-Green School</td>
<td>0</td>
<td>32</td>
<td>43</td>
</tr>
</tbody>
</table>

n = 267
What changed when the arts school moved into a new green building?

- Environmental conditions assessment increased and stayed high.
- Environmentally friendly behaviors at school increased and then dipped.
- Assessment of Supportive environment also peaked at Year 1 and then declined.

* Significant difference found between pre-move and year 1.
How does the arts school compare to a local non-green school?

Metrics where green school is (or was) significantly higher
Green Building Knowledge Test Scores

- Pre-Move
- Year 1
- Year 3

Test Score (49 points possible)

- Green School
- Non-Green School

* Statistically significant differences (p < 0.05)
What green building features do you know about?

<table>
<thead>
<tr>
<th>Category</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Alternative Energy Systems</strong></td>
<td>Wind, Solar, Geothermal</td>
</tr>
<tr>
<td><strong>Energy Conservation</strong></td>
<td>Thermostat, Appliances, Efficient heating and cooling systems</td>
</tr>
<tr>
<td><strong>Food-related</strong></td>
<td>Gardens, compost, chickens, greenhouses</td>
</tr>
<tr>
<td><strong>Sustainable Sites</strong></td>
<td>Green roof, Trees, Plantings, Stormwater management</td>
</tr>
<tr>
<td><strong>Recycling &amp; Waste</strong></td>
<td>Recycling bins, Litter reduction, Technologies that save resources (like smartboards to save paper or hand dryers to save towels)</td>
</tr>
<tr>
<td><strong>Transit</strong></td>
<td>Bike racks or electric car plug-ins</td>
</tr>
<tr>
<td><strong>Light</strong></td>
<td>Energy-efficient lightbulbs, daylight, motion sensor lights</td>
</tr>
<tr>
<td><strong>Building Materials</strong></td>
<td>Recycled, reused, natural, and local building materials</td>
</tr>
<tr>
<td><strong>Water Conservation</strong></td>
<td>Rain catchment, greywater use, water-saving toilets and faucets</td>
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</tbody>
</table>
Composite of all students in green and non-green school across all years of study. Includes 823 valid, categorized responses from 307 student responses.
What green building features do you know about?

This graphic shows the percent of responses in each category, by school.

- Green School Pre-Move (n=50)
- Green School Year 1 (n=92)
- Green School Year 3 (n=90)
- Non-Green School Year 1 (n=32)
- Non-Green School Year 3 (n=43)

n = 267
What green building features do you know about?

- Energy Conservation
- Food-related
- Sustainable Sites
- Recycling & Waste
- Building Materials
- Light
- Water Conservation

This is the same data as the previous slide with outliers removed.

Potent themes for students without a green building: alternative energy, food, sustainable sites, and recycling.

Themes more common with students in green building: building materials, light, and water conservation.
What green building features do you know about?

Differences in both **quantity** and **quality** of responses...

- “A special nature-made wall soaks up heat in the summer time making the building cooler”
- “Solar panels help reduce the use of fossil fuels”
- “Recycled materials making up walls, floors, etc reduces the amount of new products being made”

Green School

- “Solar panels help us use less electricity”
- “bike stand encourage riding bikes, so we pollute the air less”
- “all the trees around our school make it more environmental.”
Emergent Findings [Across Methods]

• Green building knowledge is
  – higher for green school students compared to non-green school students
  – shallow not deep, and might be increased with formal curriculum

• No other environmental education outcomes detected at this time
Research Agenda: Next Steps

PUBLIC GREEN BUILDING EDUCATION

Theorizing Green Building Literacy [GBL]

TEACHING GREEN BUILDINGS
For Youth + General Public

Green Schools

School Building Design

Continuation of Dissertation Research Agenda
Research Agenda: Green Buildings + Science Education

Curriculum Development
Green Buildings and Science Education in the Elementary School Classroom

Science Museums
Do science museums with green buildings use the buildings to enhance their educational missions?

Photo: Don Shrubshell / Columbia Tribune

http://www.vernerjohnson.com/portfolio/flinthills/
laura b cole
the teaching green school building
“It's not about the ‘it.’ Building is not a noun, it's a verb. And it's really important that we are sustaining life, not an object. So when we focus on objects, that is actually what has gotten LEED into trouble with checklist approach. It is killing life when you do that, breaking it into pieces. The building is a catalyst, a germ, a seed, for building relationships.”

Bill Reed, Interview, Fall 2011
The willow school – exemplar teaching green school building
the willow school: grounds
The glass boarders on the walls of this bathroom are made from discarded glass bottles from curbside recycling programs and contain 85% recycled content.
the willow school: building materials
Call to Action: **Design for Sustainable Behaviors**

**POWER IN DECISION MAKING**

- **USER**
  - Informing
- **Informative signs**
- **Persuading**
- **Persuasive signs**
- **Determining**
- **Change Bin Design**

photo categories: pre and post move

**Pre**
- Recycling/Reuse: 36%
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Pre and Post move comparisons include categories such as Recycling/Reuse, Plants / Animals, Litter / Trash, Water, Socio-Cultural, Electronics/Energy Efficiency, Transit, and Signage General.
photo categories: pre and post move

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Top four categories go from 87% to 35% of content
photo categories: pre and post move

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photo categories: pre and post move

Pre

Post

33% of content is new
The Green Building Literacy Survey

Green Building Literacy Measurements

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## Changes over 1 year

### Green Building Literacy Measurements

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<th>Non-green School (Y1)**</th>
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* Paired sample T-tests (n=38), p < 0.05  
** Independent Sample T-Tests (n=124), p < 0.05
## Changes over 3 years

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*Independent Sample T-Tests (n=263) , p < 0.05*
Building as Symbol: Differing Logics for Green Buildings

Arts School

Willow

Eco-technic
Eco-medical

Eco-cultural
Eco-centric
Eco-social

SCIENCE MUSEUM

CALL TO ACTION

3-D TEXTBOOK

SYMBOL

PLACE

The glass boarders on the walls of this bathroom are made from discarded glass bottles from curbside recycling programs and contain 85% recycled content.