Lighting Up Students with Technology and Progressive 21st Learning Strategies

The D Team

Our Story

Our Team Presenting Today

• Dr. Ronda Frueauff, Superintendent (Educational Leader)
• Tony Wall, 3W Management (PM/Owner’s Rep)
• Michael Hall, Fanning Howey Architects (Educational Consultant)
• Ron Essley, Emc2 Architects (Architect of Record)
• Jim Benya, Benya Lighting Design (Daylighting)
The Fort Huachuca Accommodation School District:
- 1300 Students
- Grades K-8
- Students are primarily from military families
- Located 45 minutes southeast of Tucson, AZ
- Located on the U.S. Army’s leading intelligence training installation
- Educational Leadership from the Superintendent

The New Colonel Smith Middle School
- The NEW CSMS is a replacement school
- For Grades 6, 7 and 8
- This is a public school
- Built on federal land, with federal funds
- Inspected for fire by the State and the Post
- Within the building jurisdiction of the City of Sierra Vista, Arizona
Our Site

- 26 acres with 41 feet of fall
- Located in the center of the U.S. Army Post
- Strong storm water entering the site
- Existing road through site to abandon
- Existing underground utilities to relocate
- Expansive soils
- Water conservation requirement on the Post

The Educational Program

**Our Vision:**
- Real world, authentic Project Based Learning
- STEM Driven, integrated, group instruction
- Supported by integrated technology
- Student Center, Teacher Facilitated
- All based on Dr. Frueauff’s research and experience
- Electric, Solar, Water and Wind are all monitored for student study purposes
Our Team

• Embraced the **Vision**
• Worked under the ‘**Project Umbrella**’ supporting and **respecting** each other’s **expertise**
• We **learned** from each other!
• **All disciplines** at the table from Day 1 (CMAR)
• Commitment led us to a **dynamic design** that **delivers** the **Vision** and **Educational Program**

Design Criteria

• A ‘**future proof**’ school......... **flexibility**
• **Support** Project Based Learning model
• **Learning must start** immediately when student steps on to the site
• Every square foot **indoor and outdoor** must provide a learning opportunity
• **Support the community environmentally** (Not LEED)
• A **sense of ‘Place’** for students
Instructional Design & Delivery

- Focus on Science, Technology, Engineering and Mathematics
- Teacher as the facilitator
- Student mobility for group instruction

Schooling Conceptual Frame Revisited

<table>
<thead>
<tr>
<th>What Learning Has Become</th>
<th>Linking Actions</th>
<th>What We Need</th>
</tr>
</thead>
<tbody>
<tr>
<td>JOYLESS</td>
<td>Learning goals need to address both applied and basic skills</td>
<td>MISSION AND VISION OF SCHOOL AS 21ST CENTURY LEARNING ORGANIZATION</td>
</tr>
<tr>
<td>RIGID</td>
<td>Students need to employ creative and innovative thinking</td>
<td>AUTHENTIC TASKS</td>
</tr>
<tr>
<td>RELENTLESS</td>
<td>Students need to work at meaningful tasks</td>
<td>ACTION BASED ON CURRENT KNOWLEDGE OF HOW PEOPLE LEARN</td>
</tr>
<tr>
<td>EXTRINSICALLY MOTIVATED</td>
<td>Students need to become lifelong learners</td>
<td></td>
</tr>
<tr>
<td>CONTENT COVERAGE AND TEST PREP-ORIENTED</td>
<td>Students need to maximize their personal health and wellness</td>
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<td></td>
<td>Parents need to hold schools accountable</td>
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<tr>
<td></td>
<td>Students and teachers need to promote quality of thinking</td>
<td></td>
</tr>
</tbody>
</table>

Allison Zmuda, *Breaking Free*, 2010 (Modified)
Committed to Integrated Technology

- Research-based, technologically enhanced education
- Technology Integration Specialists
  - Coach, coax and model implementation
  - Individual student technology devices

Technology Integration

- 21st Century Learning Environment
- Cloud Computing
- Hand Held Devices
- Indoor/Outdoor Connectivity

- Professional Development
- T I Specialists
- Intel Courses
  - Arizona Teach 21
  - Project Based Approaches
  - Assessment in the 21st Century Classroom
21st Century Learning Concepts

- Learning opportunities enhanced through technology
- Inquiry based activities using synthesis and analysis
- Collaborative instructional space supports active student engagement
- Interactions model meta-cognition
- Communities of global inquiry
- Learning experiences are embedded in authenticity
- Instruction is interdisciplinary and projects-based
- Relevance prevails
- Students at the center of the learning process

Research Commons

Student Research Center

Student Commons

TOI Lab
How to go from zero to *Final* Schematic Design in 29 days!
First – Assemble the Dream Team

- **Fort Huachuca Accommodation Schools** - Owner  
  - Dr. Ronda Frueauff, Superintendent  
  - Karen Norte, Business Manager  
  - Bob Henderson, Col. Smith MS Principal
- **3W Management - Program Management**  
  - Tony Wall
- **Emc2 - Lead Architects**  
  - Ron Exley  
  - Richard Elcius  
  - Dominick Monachio  
  - Michael Hudson
- **Fanning Howey - Educational Planners**  
  - Michael Hall  
  - Chuck Tyler  
  - Gail Hennesschneider  
  - Laura Reesmeyer  
  - Ian Riddles
- **Meeks Educational Technologies**  
  - Glenn Meeks
- **Benya Lighting Design**  
  - Jim Benya
- **Monrad Engineering - Electrical Engineering**  
  - Chris Monrad
- **Turner Construction – Construction Managers**  
  - Scott Elbers  
  - Scott Eaton  
  - Scott Gaten  
  - Valorie Schruchwasser  
  - Jim Wellenauer
- **City of Sierra Vista**  
  - Bob Camps, Building Admin.  
  - Don Brush, Planning Admin.
- **PSOMAS - Site/Civil Engineering**  
  - Jerry Edwards  
  - Regina Beem
- **Speedie and Associates - Geotechnical Engineering**  
  - Greg Creaser
- **Broderick Engineering – Structural Engineering**  
  - Greg Broderick
- **PH Mechanical - Mechanical Engineering**  
  - Eric Hein
- **Ryan & Associates – Landscape Architecture**  
  - Phil Ryan
- **William Caruso & Associates – Food Service**  
  - Bill Mash
- **Chevron Energy Solutions**  
  - Dan Musgrove
- **Fort Huachuca Directorate of Public Works**  
  - Christina Hansen

Second – Lock them in a room for 3 days
Third – Change the Language

**word**

- a unit of language, consisting of one or more spoken sounds or their written representation, *that functions as a principal carrier of meaning.*

### Changing the Language

<table>
<thead>
<tr>
<th><strong>Old</strong></th>
<th><strong>New</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Classroom</td>
<td>Flexible Learning Station</td>
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<tr>
<td>Extended Learning</td>
<td>Student Collaboration</td>
</tr>
<tr>
<td>Media Center</td>
<td>Research Commons</td>
</tr>
<tr>
<td>Music Room</td>
<td>Music Integration Lab</td>
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<tr>
<td>Art Room</td>
<td>Art Integration Lab</td>
</tr>
<tr>
<td>Science Room</td>
<td>STEM Lab</td>
</tr>
<tr>
<td>Computer Lab</td>
<td>TOI Lab</td>
</tr>
</tbody>
</table>
Fourth - Change the Picture

Form follows... form?

Changing the Picture

Changing the Picture

A video projector the size of a sugar cube could be used to project images from mobile phones, PDAs or laptops.

A device for every student?

Cloud computing?

What is a great learning environment in the Wikipedia age?
The Entire Ed Spec

First Explorations

ACADEMIC CONCEPTS 2

ACADEMIC CONCEPTS 3
Middle School House
Middle School Neighborhood

Specialized High School House (Future)
Specialized High School House (Future)

Design Charrette Work
Final Schematic Plan

Student Collaboration Area
Inside
- Flexible furniture allows every SF to be used for Learning Opportunities
- Cloud computing with hand-held tablet devices allows students to learn in any area.

Outside
- Adjacent with Student Collaboration Area
- Small, medium and large group instruction
- Astronomy & Optics, Environmental Science and Indigenous Plant Study.
Energy Conservation & NZEB

“Our school should reflect environmental awareness and student learning opportunities through building operation.”

Ronda’s Vision

• The definition of a Net Zero Energy Building (NZEB) is a building that - “generates more energy than it consumes on an annual basis”
• The goal of NZEB is to minimize energy use.

What makes NZEB possible?

First - Through Integrated Building Design
Integrated Design Process

1. Orientation & shape
2. Site design
3. Lighting, daylighting & electricity
4. Ventilation
5. Heating & cooling
6. Material selection
7. Envelope design
8. Quality assurance

What makes NZEB possible?

First - Through Integrated Building Design

- Efficient North/South building orientation
- High-efficiency window glazing
- Layered day lighting (50% energy reduction)
What makes NZEB possible?

First - Through Integrated Building Design
• Efficient North/South building orientation
• High-efficiency window glazing
• Layered day lighting (50% energy reduction)
• Increased roof insulation
• Highly efficient HVAC system and controls
• Energy Efficient lighting with digital controls
• Solar photovoltaic potable water heating
• Low water flow or waterless plumbing fixtures
• Rainwater harvesting / on-site storage (50K gal)

What makes NZEB possible?

Second - Meet remaining energy requirements:

*Develop on-site renewable energy sources*

– Site produced electrical energy with solar photovoltaic - 250 kW system
– Solar potable water heating
– 5 wind machines – part of the educational delivery system
NZEB Benefits

- Stabilize future building energy costs
- Reduce overall school energy consumption
- Building and systems designed as an integral part of the educational delivery process
- Students monitor energy use and generation, wind dynamics and water harvesting

Daylighting Impact on Design, Education and Energy Modeling
Objectives

• Design principles of NZEB if/when solar is funded

• NZEB primary principles
  – Carefully designed daylighting, turn electric lights off, solar gain less than electric lighting internal heat gain
  – Optimized HVAC designed to daylighted building
  – Control over all other loads, especially computers
  – Minimum quiescent base load

Procedures

• Fully daylight all high-occupancy-hour spaces
  – Don’t waste cooling energy on low-occupancy-hour spaces

• Primary source: north sky clerestories
  – More lumens per watt than other daylight orientations

• Secondary sources
  – Shaded south daylight
  – Diffusing skylights
  – Windows
Climate and Site

- Favorable latitude 31.5° N
- High sunshine availability
- Moderate temperatures
- Low humidity
- Unobstructed sky dome

Siting and Massing

- Single story structure
- Minimum rotation off north axis
- Minimum east and west facing fenestration
Strategy

• Classrooms
  – North and south clerestories and windows
  – Skylights
• Gym
  – North clerestory
  – Skylights
• Core
  – Skylights, perimeter windows

Typical Classroom Section

• Peek-a-boo clerestory
• South wall shaded window and clerestory
  – Cutoff angle for winter passive heating
• Skylights in side classrooms (min E and W windows)
Notes

• Designed to operate without electric lighting by day in highly occupied spaces
• Very efficient dimmable electric lighting is provided with daylighting controls
• Spaces not fully daylighted have low hours of general use or useful low light levels
  – Café/Student Union
  – Entry Commons

Notes (Continued)

• Design target <15,000 BTU/SF/YR
• Minimal electric lighting day and night
• NZEB operation at lowest possible cost for renewable resource
• HVAC system size smaller than a conventional design
• Total energy use reduced by about one-half
Guiding Principles

• It takes *educational leadership* to design responsive educational environments
• Success is determined by a well-defined *Vision* and quality *pre-construction work*
• The basis for facility-related decisions should *always be the instructional program* and what’s best for *students*

Outcomes

• Great / Flexible Learning Spaces
• *Indoor* and *Outdoor* Learning Areas
• *Water Harvesting* supports Post water usage requirements
• Arizona’s FIRST *NET ZERO* school building....
• 12<sup>th</sup> *NET ZERO* School in the United States
• *Team* continues to work *together*....
• Leaving a legacy for *staff* and *community* to work together
Take Aways....

*Points to Remember:*

It takes *educational leadership* to create a great school........

Decisions should be based on *what’s best for students*........

Make your buildings *sustainable* and *renewable* in every way......

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