You can have STEM too!

Case studies in STEM Upgrades to Existing Schools

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In an ever-changing, increasingly complex world, it's more important than ever that our nation's youth are prepared to bring knowledge and skills to solve problems, make sense of information, and know how to gather and evaluate evidence to make decisions.

These are the kinds of skills that students develop in science, technology, engineering and math—disciplines collectively known as STEM.

~ United States Department of Education
Office of Innovation & Improvement
Science
- Atmospheric Scientist; Biochemist; Chemist; Conservation Scientist; Geneticist; Hydrologist; Life Scientist; Microbiologist; Physicist

Technology
- Business Intelligence Developer; Cyber Security Analyst; Computer Game Designer; Network Administrator; User Interface Developer

Engineering
- Aerospace Engineer; Architectural Engineer; Chemical Engineer; Electrical Engineer; Industrial Engineer; Nanosystems Engineers; Robotics Engineer

Mathematics
- Biostatistician; Cartographer; Economist; Mathematician; Statistician; Survey Researcher; Transportation Planner
SUCCESSFUL STEM PROGRAMS

Employ multiple teaching strategies – guided & independent – active & passive

Encourage students to think critically, produce results and communicate their process

Associate both subject matter and learning strategy with their career analogs
What core elements facilitate STEM program implementation?
Core Learning Activity Formats

- Instruction & demonstration for large class & multi-class groups
- Instruction & demonstration for small groups or individuals
- Independent learning with monitoring & supervision
- Student project collaboration & group team development
- Student presentation & rhetoric in varied formats such as discussion panels or debates
- Display of student work for ongoing critique and inspiration
- One-to-one device use
- Research, concentrated study & testing
Core Learning Activity Formats

- Specialized instructional space appropriate to programs
- Specialized laboratory & workshop space appropriate for interactive projects
- Flexible space for small or medium-sized group assemblies
- Community/collaborative workspaces (with passive supervision and monitoring)
  - For individual and small group project teams
  - For presentations and open discussions
  - For research, study & testing
- Community display and gallery space
Shared across disciplines, a presentation area gives students both an outlet for constructive feedback and a way to showcase their work.

Presentation Area

Visual Art

Graphics, Coding, Robotics & Technology

The "Computer" lab as it developed in the early 2000s has been reimagined to serve a broader set of STEAM goals from coding and gaming design to digital imaging and web design.

Makerspace “Clean”

Makerspaces provide an arena for students to get hands-on. Here they have the space and the tools to experiment, invent, create, and tinker.

Workshop & “Dirty” Prototype

Can utilize and improve existing facilities, providing integrations with new technologies such as CNC and 3D Printing.

Physics & Applied Sciences

Commons
Identify Available Resources / Advantages

- How can STEM integration impact the holistic modernization of a facility?
  - Access to multi-use areas (cafeterias, LGIs)
  - Expanded use of underutilized areas (cafeterias, libraries)
  - Extended use of all areas more accessible after traditional school hours with blended social functions (like a donut shop)
Identify Available Resources / Advantages

- How can shared building resources allow staff to function more efficiently?
- How can staff already present and engaged augment passive security & supervision?
  - Knowledge concierge (librarian & IT support)
  - Guidance suites
  - Faculty work rooms & break rooms
Supporting the Evolution of Staff & Learning Resources

Staff Resources

- Knowledge concierge: IT Support + Library & Research Assistance
- Traditional staff in expanded roles: Guidance & administrative staff as passive supervisors with on-demand assistance
- Traditional shop or vocational technical staff augmenting programs or immersed within STEM
**Equipment Support**

- Specialized workshop and lab equipment to directly support programs
- Scanners, 2D & 3D printers or other prototyping equipment
- One-to-one devices including charging, storage & maintenance
- BYOD support tools
- Appropriate work surfaces to reduce static and withstand wear from maker tools
- Open area and safe rigging for motion capture activities and virtual reality interaction
- Furnishings that foster flexible use
Supporting the Evolution of Staff & Learning Resources

Infrastructure

- Additional power and charging requirements including redundancy to maintain projects through service interruptions
- Network demand for internal servers and internet access
- Supply of water, chemicals & safe hazardous material disposal
- Safety support stations for labs
- Dust and fume protection
- Secure display and presentation systems for projects
- Appropriate heights to facilitate use or testing of automated flight technologies
How does planning for STEM in renovated space differ from new construction?
# Don’t Underestimate the Value of What You Have

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<th>Common Elements</th>
<th>New Demands...</th>
<th>Current Value...</th>
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| Student Transportation| • more busses, student parking  
                         • separation from staff & deliveries                                           | • grading and road networks already in place                                     |
| Staff Transportation  | • after dark safety                                                            | • site lighting utilities in place                                               |
| Community Use         | • before & after school + year round                                           | • large volume interior spaces (gym, multipurpose, auditorium)                   |
| Restrooms             | • accessibility & privacy                                                      | • water utilities in place with building plumbing and basic infrastructure       |
| Basic Classrooms      | • power & data                                                                 | • power utilities in place with some conduit and wiring in building             |
| Roof, Walls, Windows  | • insulation for comfort & sound                                               | • bricks & mortar envelope under cover                                           |
| Furnishings           | • collaboration                                                                | • reusable in traditional areas?  
                         • reusable in other buildings?                                                  |
Holistic Approach to Renovations

Build on what you have while bringing aging facilities up to the rigorous standards of a 21st century education.

- Maximize shared resources
  - increase utilization
  - provide passive supervision
- Improve delivery of services
  - teacher communication & collaboration
  - accommodate new technologies
  - elevate standards of comfort
- Reduce Expenses
  - maintenance
  - utility operations
  - optimize staffing
Don’t Overestimate the Value of “New”

- If current needs are addressed, remaining differences are cosmetic (and also upgradeable).
- Appearance of renovated spaces are often indistinguishable from new.
- Quality of renovated space is often better with conserved resources from envelope allowing for repair of superior finishes (tile & terrazzo) or replacement materials of higher quality (rubber or solid vinyl tile vs. VCT)
- Significant investment in infrastructure (roads, utilities, land, building envelope) is retained. Replacement of these reduces available construction budget for all-new building scenario.
Don’t Overestimate the Value of “New”

- More area can be retained, renewed or restored in a renovation for the same dollars than can be created as a new facility.
- Existing resources like auditoriums and gymnasiums may be cost-prohibitive to recreate within a new-build budget, especially for middle or junior high level programs.
- If additional area is needed, highly specialized space can be created new.
- Savings from renovations & additions versus all new construction make room in budget for equipment and furnishings needed for STEM programs.
Opportunities for Inserting STEM

Large-Volume Space

- Spaces like cafeterias or multipurpose rooms are often not up to the demands of their current use but...
  - central location ideal for staff resource sharing
  - height and open spans ideal for collaboration areas, galleries and maker spaces
Opportunities for Inserting STEM

Dual Use Space

- Presentation for STEM projects can happen in areas that support other general programs like black-box theatres.
Opportunities for Inserting STEM

Well-Positioned, Underutilized Space

- Underutilized resources or support areas with less positional value can be relocated to open up areas for support STEM demands.
Opportunities for Inserting STEM

Well-Positioned Areas for Additions

- Well-intentioned interventions of the past (courtyards, open-plan classrooms, etc.) often become today’s problems.
- The location of these areas is often ideal for centralized high-accessibility uses.
- Insertions in these spaces lessens conflicts with growing site needs for athletic fields or site circulation
...A lot of times, people don’t know what they want until you show it to them.

~ Steve Jobs
Evolution of Furnishings…

- Industrial-age model, with teacher at the front of class
- Boxy rooms with rows of student desks
- Limited ability to change setup, work in groups
- Reflected a “factory” production of students preselected into “tracks”
Evolution of Furnishings… to Flexible!

- Increased focus on group work, collaboration and exploration
- Giving students and teachers more agency and engagement in the learning process
- Reflects emphasis on student/teacher adaptability to achieve individualized results
“Sitting Still” no longer equated with “Paying Attention”

- Furnishings take on the task of adapting to individual learning styles
- Low-conscious physical movement during assimilation of new information improves retention by forming multiple synapses to connect new information with previous knowledge
- Use of color channels focus and reduces tension in learning environment to improve retention.
- Flexible furnishings provide opportunities for teachers to accommodate the individual learning styles of a student.

This high school's blended learning lab takes on the characteristics of a modern office creative suite...
Flexibility and Efficiency Maximizes Utilization

With a smaller footprint or “Right Size”, budget can be redirected to quality.

- This commons area...
  - serves as part of the cafeteria
  - is used for podcasting in the evening
  - is used for small group pullout throughout the day
  - can be monitored from both administration & guidance offices
Flexibility and Efficiency Maximizes Utilization

When STEM suites can share larger resource areas or allow mixed use of common space, more area is available for additional programs.
Like a cliché date-night movie, after holistically addressing issues you may find that “love was there all along”.

**STEM space may already be waiting for you.**
Westmont Hilltop High School

Case Study
Westmont Hilltop High School

High School built in the 1950s

The Issue: District-Wide organization called for student realignment and the creation of two semi-autonomous communities.
Westmont Hilltop High School
STEM Programming Strategies

More than just HAVING the space, it needs to be AVAILABLE for student use.

Challenge:
Low Student–Teacher Ratio

- Project work time
- Science and tech lab time
- Independent study

Teacher availability for supervision can be tough!

On the up side:

- Students only need basic supervision, not instruction
- Full directed attention of staff may not be necessary
- Exploit opportunities for supervision by proximity

High Availability
Taking advantage of formerly dedicated cafeteria space for small group space

- Classes can utilize the area to create large open cleared spaces for “arena” activities
- Classes can be broken into project groups in an area that allows bigger movements

Using the same area for independent studies

- Supervision can be covered from multiple vantage points
- Double coverage views afforded during peak usage

Community Bonus

- Location allows extended hours usage and doubles as concession and auditorium “reception” space
Westmont Hilltop High School

Before
Westmont Hilltop High School

Before
Westmont Hilltop High School

Before
Westmont Hilltop High School
Westmont Hilltop High School
Indiana Area High School

High School built in 1962

The Issue: Inclusion of STEM programs and IDEAL learning program

Grades 9-12  850 Students
Indiana Area High School
Indiana Area High School

Library

Teaching Area

- Multiple levels of units
- 2 double-sided units with storage
- 16 units can be reconfigured as needed
- Each unit can be moved to accommodate varying needs
- Can be combined with other tables for flexible seating

 Shelving

- 8 perimeter units (42” x 38” x 30”)
- 6 double-sided units (42” x 38” x 30”)
- 4 wall-mounted units (42” x 38” x 30”)
- 2 double-sided units (30” x 30” x 30”)
- 2 wall-mounted units (30” x 30” x 30”)

MCKISSICK ARCHITECTURE

66
Indiana Area High School

Before
Indiana Area High School

Before
Indiana Area High School

COMMINS & GALLERY

Senior Lunch Configuration (Remodeled)
- Increased to include 360-degree view
- 4 additional student seating in cafeteria area and booth near entrance

Study Hall Configuration
- Bleachers of 8 bays in spectator seating (including lounge chairs with throw
- 11 additional student seats in library reference areas (direct through window
- 1 student in annex and 4 students in annex have access to study hall for group

Gallery with Soft-Seating Modular Bleachers/Benches
- Seating area would serve 6 to 10 students and shape perimeter could seat 6 to 7 students
- Additional seating would accommodate 10 student chairs seating or using one of the adjacent tables in the north

MCKISSICK ARCHITECTURE
Indiana Area High School
Indiana Area High School

IDEAL LAB

Autonomous Program Support
- Ideal layout for teaming, flexible and support furnishings to facilitate the wide variety of tasks as required.
- Cubicles that offer computer and power board/data.
- Small conference tables for student-parent discussions.
- Includes storage for student information.
- Long, curved bench to accommodate students who may feel uncomfortable or visual with the back of the learning line.
- Office cabins create the comfortable and intimate conversational grouping in order to enhance educational experiences.
- Conference room can be used for private discussions with parents or other educators.

Flexible Learning Environment
- A vast system throughout all adjacent spaces hosts multiple whiteboards which can be used for brainstorming, research, and other tasks.
- Students are able to rearrange their workspaces.
- Small-group collaborative spaces are furnished with shared casual workspace furniture to accommodate group discussions.
- Conversations with white or collaboration tables to support individual or small group.
- Whiteboards and furniture are designed to be mobile.
- Individual student workstations can be easily reconfigured to allow for movement based on task needs with the furniture.
- Closet provides storage for individual needs.
- Conference area can be used for small group activities and along with the main entry, can serve as a resource/library.
- Conference room can be used to accommodate for small group activities.
- Flexible furniture can be arranged to accommodate for small group activities.
- Flexible furniture can be arranged to accommodate for small group activities.

1/4" = 1'-0"
Indiana Area High School

Before
Indiana Area High School

Before

05/14/2014
Indiana Area High School

Before
Indiana Area High School

Before
Indiana Area High School

Before
Indiana Area High School
GAMING STUDIO
Presentation & Seminar Use
- Mixed-use community and collaborative learning space
- Mobile computer tables have embedded laptop rails, which can be closed as needed to allow students to move between "screening zones" and "staging" areas
- Room can be arranged to face front or back
- Two viewing positions with viewing tables provide presentation accommodation
- Fixed audio/video equipment with automated audio system configured to boost the stage wall.

Technology Classroom Use
- Mobile computer tables can seat 20 students
- Flexible educational equipment and workspace on new conventional software development ergonomics
- Mobile projectors and monitors can be used from table shapes and can be lowered or raised as needed
- There are a variety of options for different presentation and audio configurations
- Room can be set up for additional monitors and consoles, and can be configured to classroom, computer lab, or an any other configuration
- Classroom window is ideal for virtual reality and other interactive technologies
- Mobile seating allows students to engage in traditional and non-traditional learning activities

Humanities Classroom Use
- Mobile computer tables have integrated laptop rails which can be closed as most desktops are completed, creating an ideal workspace
- Two viewing positions with viewing tables provide presentation accommodation
- Room can be arranged to face front or back
- Flexible educational equipment and workspace on new conventional software development ergonomics
- Fixed audio/video equipment with automated audio system configured to boost the stage wall.

Support spaces can be reconfigured to create flexible seating arrangements and other flexible seating configurations to support collaborative and non-traditional learning needs.
Windber Area Middle/High School
Windber Area Middle/High School

Built in 1919 with additions in the 1950s.
The Issue: Steep decline in student enrollment resulted in a facility that is oversized and inefficient.

Renovated Area 19,779 SF
Cost per SF $187.54/SF
Renovation Cost $3,709,348
Equivalent New Cost $4,746,960
Windber Area Middle/High School - Before
Windber Area Middle/High School - After
Windber Area Middle/High School

Before
Windber Area Middle/High School – Former Administration
Granite Falls Middle School

Case Study
Granite Falls Middle School

Built in 1935 next to an oak tree that had been growing on the hilltop since 1768.
The Issue: Historic school in an aging facility which couldn’t meet the rigorous 21st Century educational standards.
Granite Falls Middle School

Rooted in the center of the community...

Drone video shows relationship of tree to school to town.
Granite Falls Middle School

Parent Driver Arrival Entrance (Staff Parking at Forefront)
Granite Falls Middle School

Plan: Main Level (Knowledge Commons & STEM Enlargement)

MCKISSICK ARCHITECTURE
Renovated Facilities Create Unique Opportunities

The static resource portion of this library will be located several feet higher than the main floor in existing space

- supervision of multiple areas by limited faculty allows more access with the same instructional cost
- the "monitor" is also positioned as a resource so that oversight is non-threatening
Granite Falls Middle School
Granite Falls Middle School

MAKER SPACE (Looking into Knowledge Commons)

MCKISSICK ARCHITECTURE
Granite Falls Middle School

Renovated Area: 21,966 SF
Cost per SF: $147.22 /SF
Renovation Cost: $3,233,840
Equivalent New Cost: $4,173,540
Questions?
Thank You!

2019 North Carolina Conference