HACKING
THE SCHOOL BUILDING
an innovator's guide to future-ready learning environments

BLDD ARCHITECTS

think BIG BUILD INNOVATE GROW

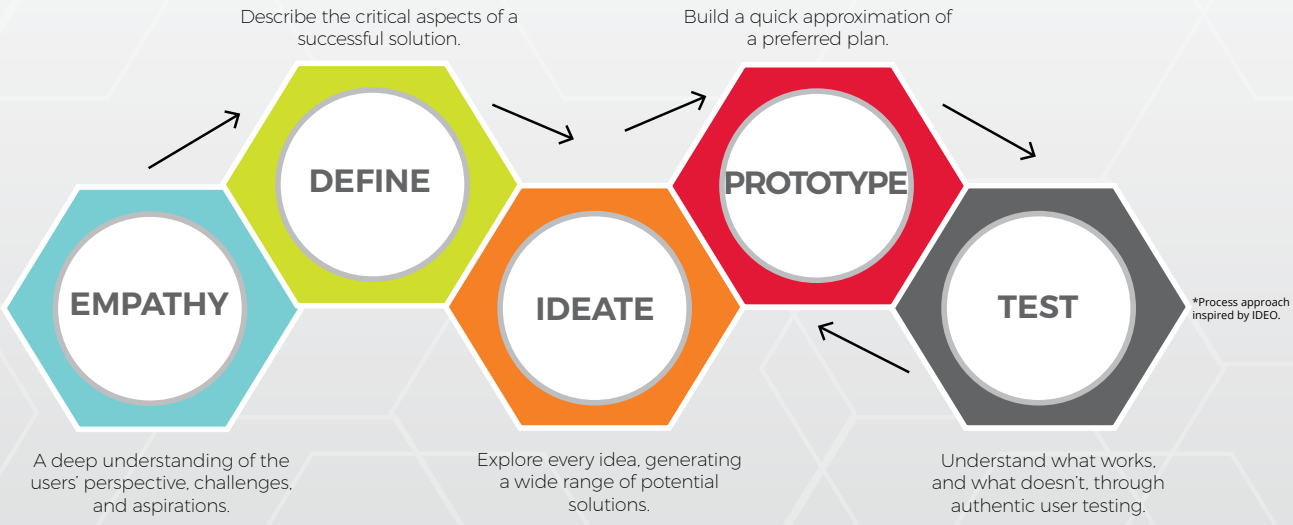
BLDD ARCHITECTS

EMPOWER TEACHERS TO think BIG

BUILD
INNOVATE
GROW

Working to harness the power of **design thinking** to:

- uncover big ideas and new approaches
- quickly explore user-designed solutions
- test options with full-scale prototypes
- empower teachers to be champions of change



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EMPATHY

A deep understanding of the users' perspective, challenges, and aspirations.

· classroom observations · staff surveys · tour exemplar spaces

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DEFINE

Describe the critical aspects of a successful solution.

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IDEATE

Explore every idea, generating a wide range of potential solutions.

- involve teachers, students, and designers
- value diverse and complimentary viewpoints

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PROTOTYPE

Build a quick approximation of a preferred plan.

- built with a “kit of parts”
- try various layouts and furniture without breaking the bank

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PROTOTYPING KIT

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Develop a kit of parts

WALLS - FRAMING
80/20 extruded aluminum framing
2x4 wood framing
Wood storage shelf framing

WALLS - SURFACE
Black mesh tarps
Plastic sheeting
Melamine panel boards
Fabric

LIGHTING
Clip on shop lights
Mini spotlights
Sample lighting from vendor partners

FURNITURE
Vendor partner provided
Architect provided
- Wobble stools
- Portable tables
- Stacking chairs

Pilot program purchases
Owner provided existing
Boxes and temporary improvised pieces

FLOORING
Carpet tile
Broadloom carpet with professional installation
Paints or coatings

EQUIPMENT
Mobile Markerboards
Melamine panel boards
Portable shelving
Portable work tables
Portable storage units
Laminate countertop with support brackets

TECHNOLOGY
Vendor partner provided
Owner provided

LABOR
Architect
Students
Local volunteers
District staff
Contractors

FEEDBACK
Markerboards
posters
Butcher paper
Post it notes
QR code / Google Survey
Website
Survey monkey

INFRASTRUCTURE
Power
- Extension cords
- Contractor
- District staff

Data
- Contractor
- District staff

OTHER
Bungee cords
Duct tape
Zip ties
Power tools
Hand tools
Painters tape
Paint / Marker Board paint

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PROTOTYPING PLAN think BIG

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The plan for prototyping future-ready learning spaces will evolve after addressing the following planning considerations:

DETERMINE LENGTH OF TIME FOR PROTOTYPING

2-3 days
3-4 weeks
months
semester
school year

EXPLORE ALTERNATIVE PROTOTYPING STRATEGIES

Virtual Reality Models
"Hacking" existing space for use as a prototype
Offsite warehouse as prototype location.

ESTABLISH STUDENT EDUCATION COMPONENTS

Education
Engagement
Ownership

DETERMINE SYNERGY WITH CURRICULUM

Identify programs that will use prototype spaces and customize as desired.
Assist administration with communication to staff

DETERMINE PROTOTYPING CONSTRUCTION CONVENTION

Determine level of "finish"
- "crude or rough" to "finished construction"

Determine major structural elements and prototyping conventions
Determine staging required

DETERMINE WORKFORCE NEEDED

Contractors (if any)
Architect as installer
District staff

OBTAIN VENDOR COMMITMENT

Furnishings Vendors
Technology Providers
Finish Vendors and materials

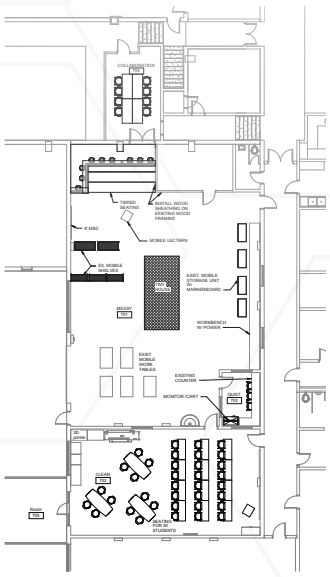
ESTABLISH PROTOTYPE BUDGET, SCHEDULE, AND REGULATORY REQUIREMENTS

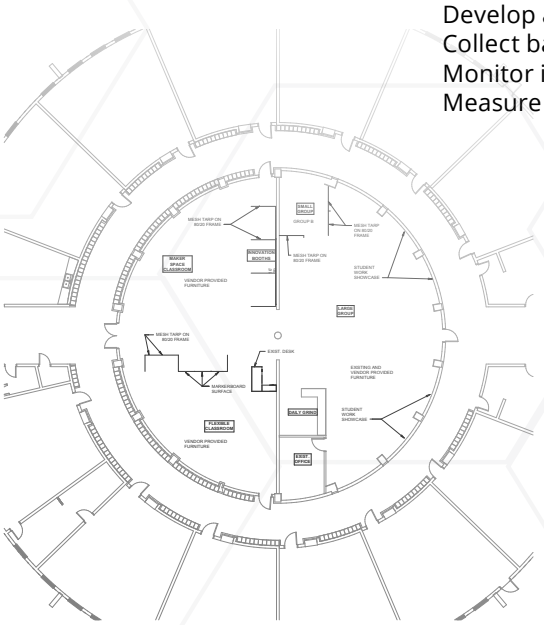
Prototype materials: architect furnished vs. purchased
Furnishings: staging provided vs. purchased
Technology: vendor provided vs. purchased
Determine code requirements and submittals
Create logistics plan: pre-prototype work, contractor modification of existing construction, prototype installation, testing duration, tear down and new prototype installation

ESTABLISH EVIDENCE BASED DESIGN PROTOCOL

Define evidence based design goals and objectives
Find sources of relevant evidence
Critically interpret relevant evidence from:
- stakeholder interviews
- learning activity observations
- exemplar tours

Create and innovate (evidence based design concepts)
Develop a hypothesis
Collect baseline performance measures
Monitor implementation
Measure post occupancy performance results





PROTOTYPE LAYOUT

Charles City High School
Charles City, Iowa


EXISTING SCHOOL LIBRARY


CONFERENCE CENTER


EXISTING SCHOOL LIBRARY

EMPTY WAREHOUSE

EXISTING COMMUNITY COLLEGE CLASSROOM


EXISTING SCHOOL AG CLASSROOM

"HACKING" ANY SPACE WILL WORK!

WHERE TO PROTOTYPE?

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TEST

Understand what works, and what doesn't, through authentic user testing

- hold classes in prototype
- let students and teachers experiment and re-arrange
- listen to what they have to say

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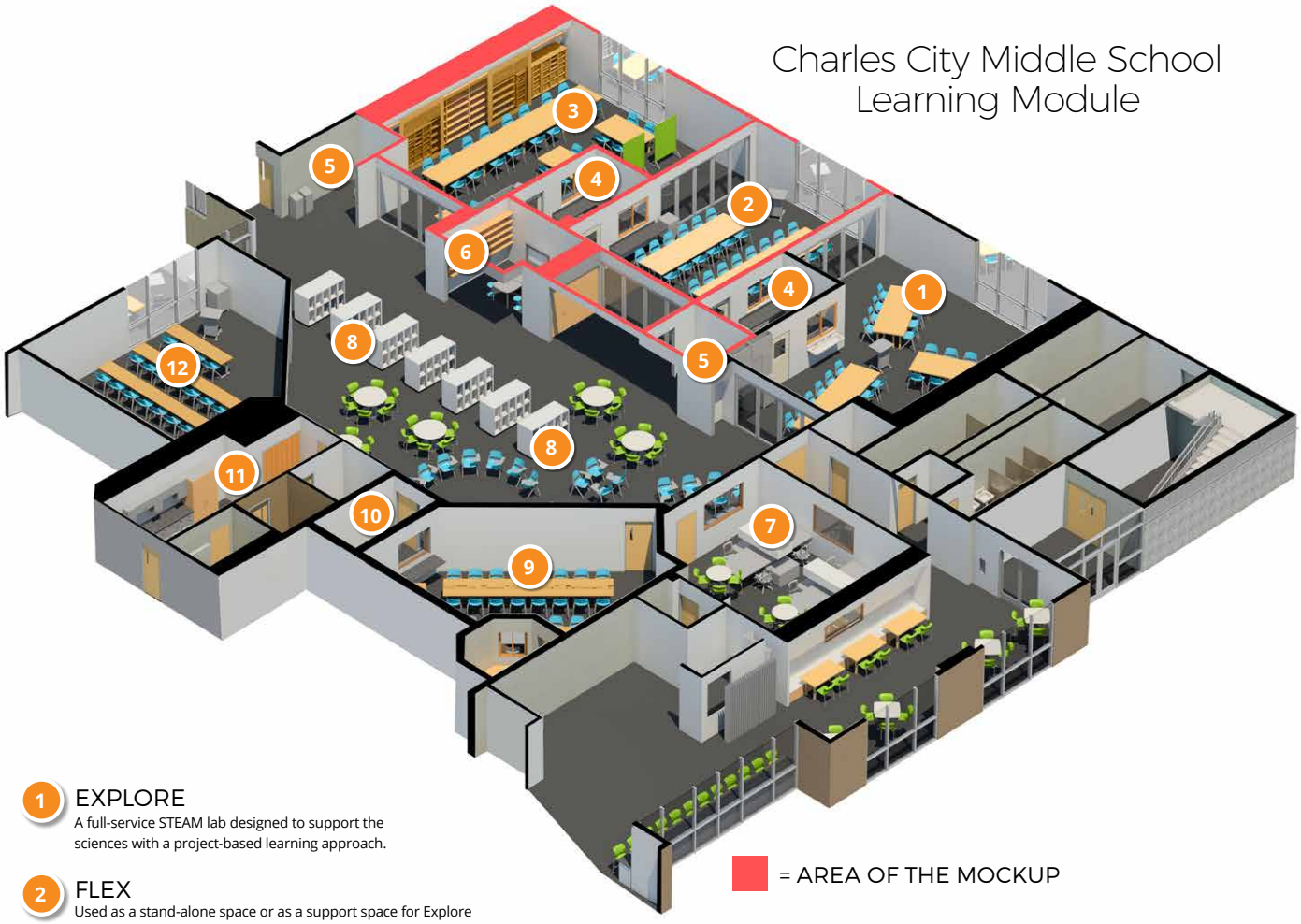
TAKING PROTOTYPING AND TESTING TO A NEW LEVEL AT THE IASB CONVENTION IN IOWA.

Working collaboratively with Charles City Middle School, a full-scale classroom mock-up was created and featured at the 70th annual IASB 2015 Convention in Iowa. Students from the Charles City School District were on hand to test out the full- scale classroom mock-up. Attendees could walk through the interactive space and see the components that make up the flexible learning environments that showcased the Classroom of the Future.

THE FUTURE IS NOW

Our students deserve to be educated for their future, not our past.

Charles City Middle School Learning Module



= AREA OF THE MOCKUP

1 EXPLORE
A full-service STEAM lab designed to support the sciences with a project-based learning approach.

2 FLEX
Used as a stand-alone space or as a support space for Explore and Design. The operable partition allows two or three labs to be opened up to each other for co-teaching.

3 DESIGN
Another full STEAM environment that can easily be configured to support larger format 2D and 3D.

4 WET/PREP
Provides access to water and supplies, and also acts as a contained messy space. All surfaces are waterproof and can be hosed down after the occasional "experiment gone wrong."

5 CAVE
A sanctuary for individual or small group work.

6 CAMP
Small group sharing, collaboration, and communication at a comfortable scale.

7 PLAN
Home base for teaching staff, designed to help facilitate co-teaching and cross-disciplinary instruction.

8 GATHER
At the center of the studio, Gather serves as a breakout space for all the other environments or a central gathering space for the entire studio.

9 MEDIA
A musical instruction room, recording studio, computer lab, videography studio, graphic design lab, etc., and is an instant draw for students.

10 PRACTICE
Constructed with sound absorptive walls for 1-on-1 musical instruction or small ensembles.

11 SPECIAL EDUCATION
A suite of spaces strategically located to allow for use by two learning studios. Full immersion of students is enhanced by adjacency to the main learning studio.

12 LISTEN
The mobile furnishings and interactive whiteboard allow this space to adapt to directed learning and small group work.

GATHER

LEARNING MODALITIES

peer tutoring
team collaboration
project-based learning
student presentation
performance based learning
interdisciplinary learning
interdisciplinary instruction

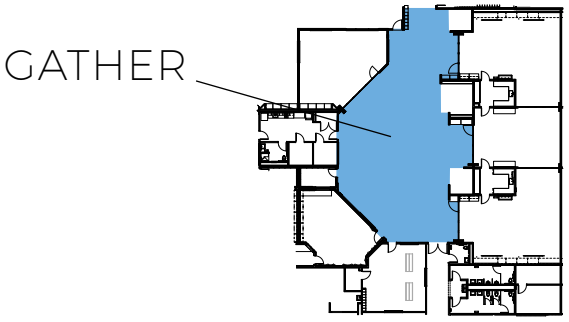
KEYWORDS

collaborate
study
connect
share
perform
lecture
move
engage

Gather can be a destination space, or something you pass through. At the center of the studio, it serves as a breakout space for all the other spaces or a central gathering space for the entire studio.

With lockers and furniture on wheels, students and staff can reconfigure Gather to suit their needs. Lighting and ceilings reinforce the idea of a stage without limiting the use of the space. Natural light filters in from the Listen, Explore, Design and Flex to create a dynamic space.

The Gather creates a sense of community among the studio population. Students can hang out, study, eat, perform, and connect.



DESIGN

LEARNING MODALITIES

team collaboration
project-based learning
student presentation
interdisciplinary learning
art-based learning
design-based learning
interdisciplinary instruction

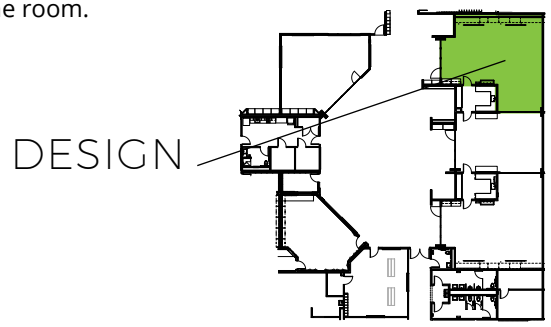
KEYWORDS

create
design
innovate
stimulate

Design, like Explore, is a full service STEAM environment. Feel free to make a mess and kick up some dust. The furniture in this space is selected to support larger format 2d and 3d art as well as fashion design, illustration, painting, sculpture, set design, etc.

Teaching staff have a designated resource room near the learning studio as a home base as well as a designated docking station within Explore and Design for the current unit's supplies. Student work can stay in the lab thanks to the wall of storage available.

Natural daylight is provided to aid in the visual arts and to improve the wellbeing of staff and students. Automatic shades are tied into light sensors to automatically adjust the light levels in the room.



FLEX

LEARNING MODALITIES

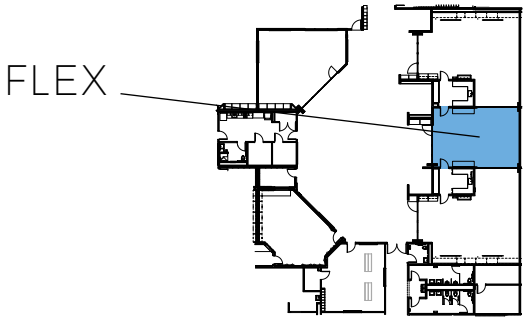
team collaboration
lecture format
project-based learning
inter-disciplinary learning
design-based learning
interdisciplinary instruction
play-based learning

KEYWORDS

stimulate
create
assess
research
test
active
multipurpose

Flex is a stand-alone space, but also a support space for Explore and Design. The operable partition allows two or three labs to be opened up to each other to allow for co-teaching.

Flex is the chameleon of the learning studio. With access to both Wet/ Prep spaces, it can be used as a lab. But if additional directed learning space is needed, Flex can fit the bill for that, too.



EXPLORE

LEARNING MODALITIES

team collaboration
project-based learning
research
interdisciplinary learning
naturalistic learning
interdisciplinary instruction
play-based learning

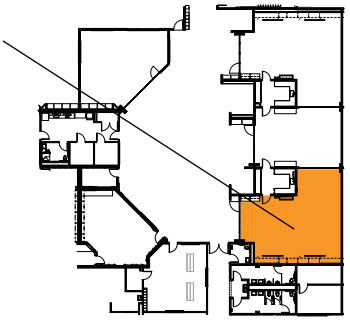
KEYWORDS

stimulate
create
assess
research
test

Not your traditional science classroom, Explore is meant to support the sciences, but can do so much more! Automation and robotics are right at home in this space alongside genetic testing analysis and sustainable architecture.

Storage for each student's work is provided within the space so projects can evolve over a few days or a few months. Interactive whiteboards, storage, tables, and chairs are all easily reconfigured to support the learning activity at that moment.

EXPLORE



CAVE

LEARNING MODALITIES

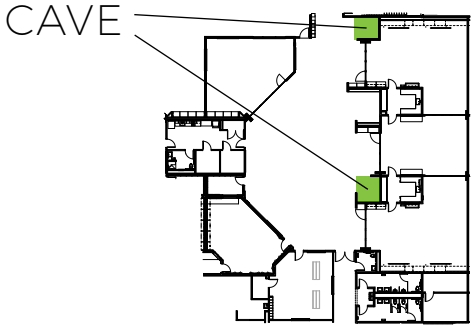
independent study
peer tutoring
team collaboration
one-on-one learning with teacher
social/emotional/spiritual learning

KEYWORDS

collaborate
listen
study
introspective

Cave is a sanctuary for individual or small group work. It's the quiet place that some students need to take a step back and really focus. The lighting and atmosphere are comforting and welcoming.

Its proximity to the Gather allows for the feeling of privacy, but still maintains the passive observation needed for security.



CAMP

LEARNING MODALITIES

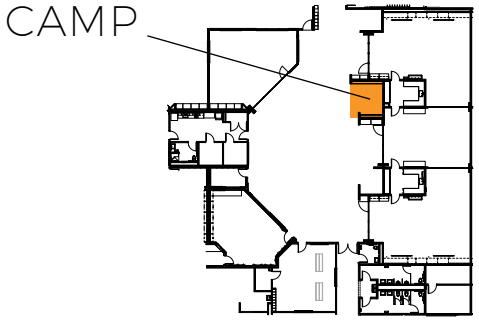
independent study
peer tutoring
team collaboration
one-on-one learning with teacher
student presentation
social/emotional/spiritual learning
storytelling

KEYWORDS

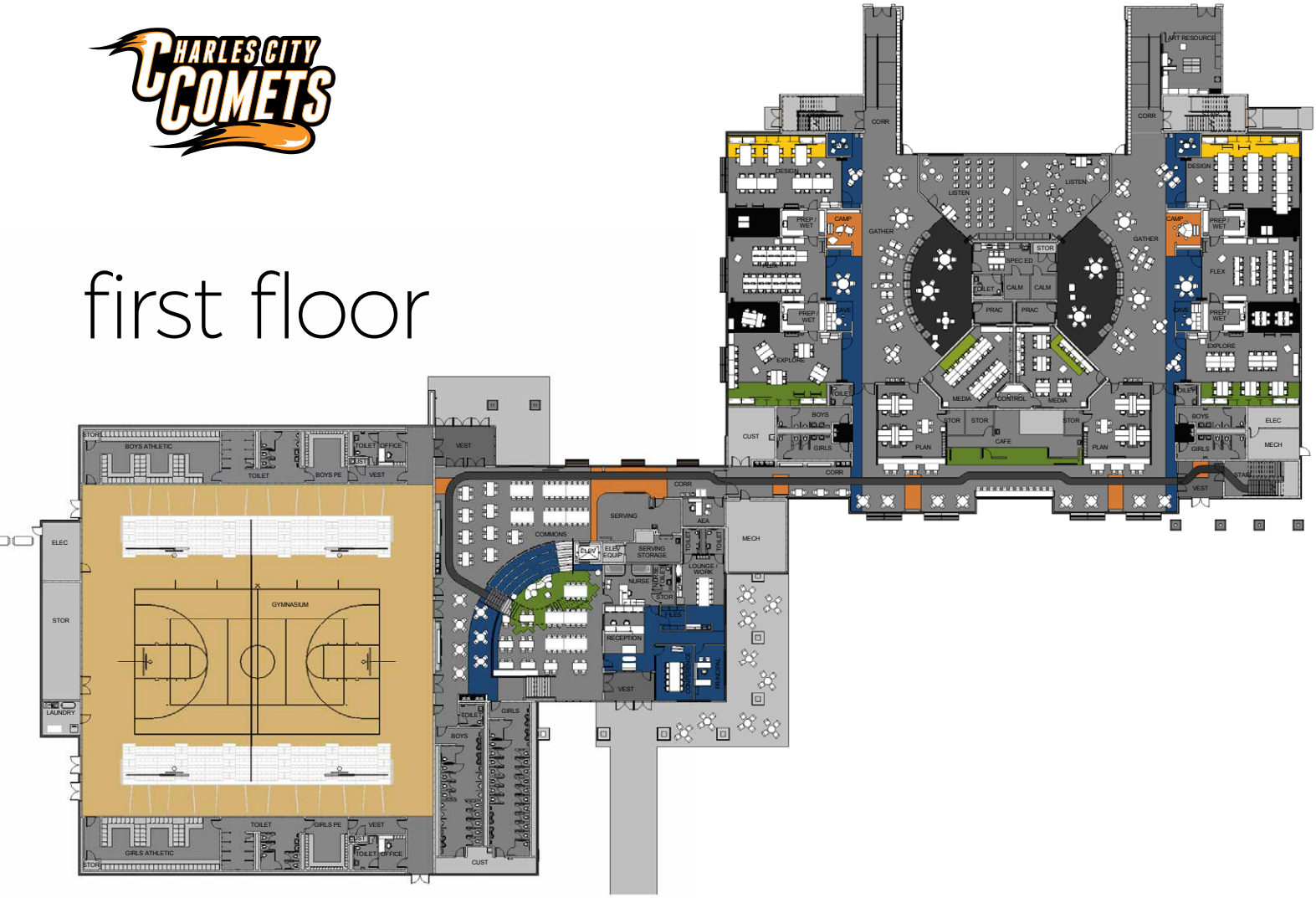
collaborate
research
connect
share

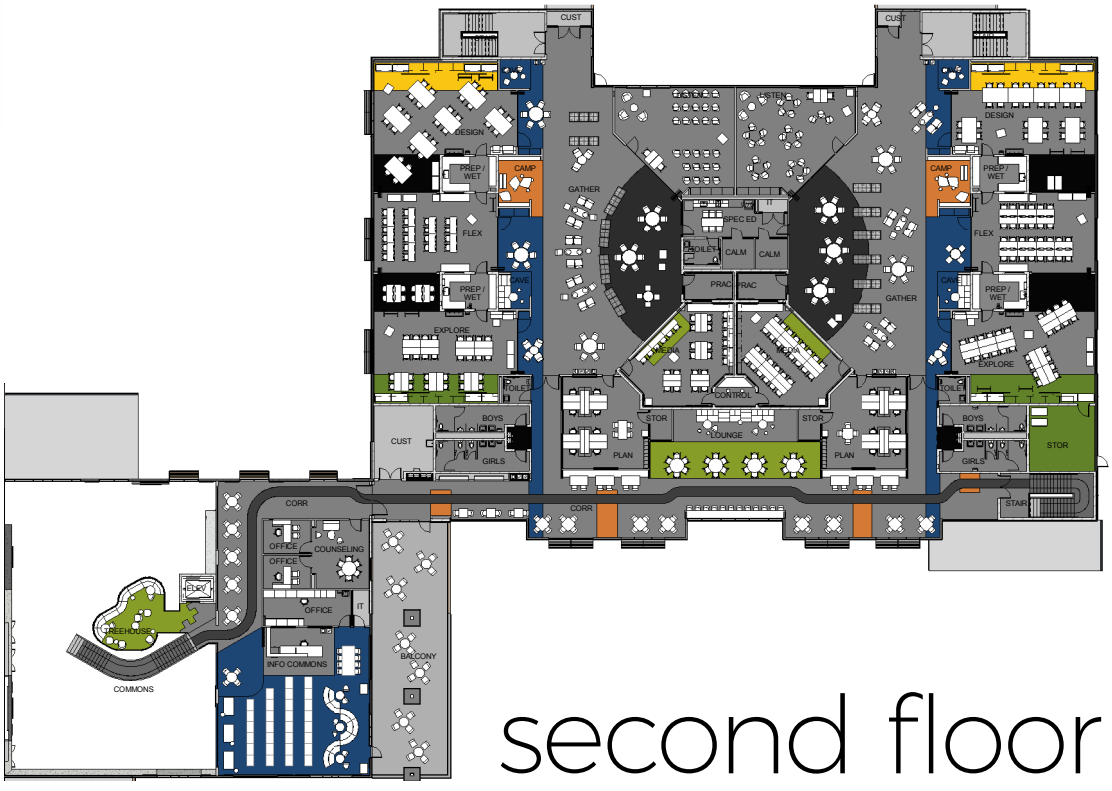
While there aren't s'mores at this camp, the idea behind the campfire still stands in Camp. Small group sharing and collaborating are the idea behind this space. Communication is one of the primary tenets of 21st Century Education and the Camp allows a space for that to happen at a comfortable scale.

Book shelves can hold staff or library materials, turning this space into a multifunctional research and collaboration area.



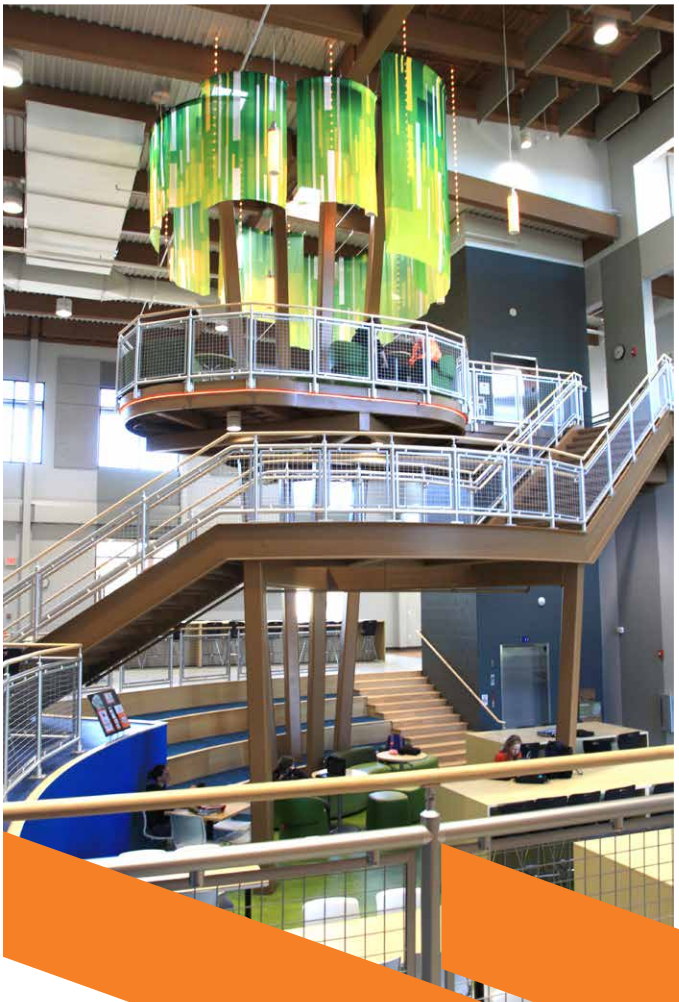
first floor





second floor

CHARLES CITY COMETS



FUTURE-READY LEARNING SPACES

RESULTS

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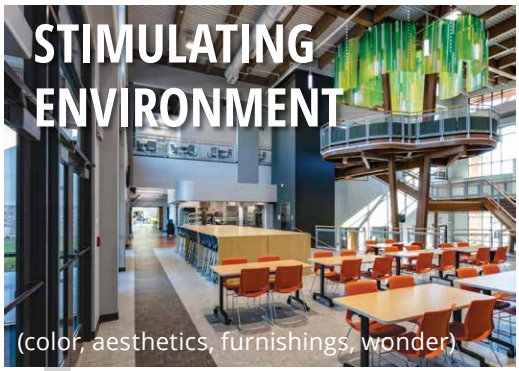
connecting SCHOOL FACILITY CONDITIONS AND STUDENT OUTCOMES

evidence based design study

This study is designed to measure before and after renovation/construction effects on student outcomes by analyzing a relationship between the following variables:



The goal of this study is to develop the research to inform architectural design solutions that can improve student outcomes.

SURVEY DESIGN
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connecting SCHOOL FACILITY CONDITIONS AND STUDENT OUTCOMES

evidence based design study

"Do buildings really make a difference?"

It's a logical question, and one that school designers and administrators are asked regularly. One school district noted seeing changes in student behaviors following their construction project (changes that were validated by district data), which they attributed to the newly remodeled environment. Administrators explained that students appeared to be more relaxed in the newly renovated building.

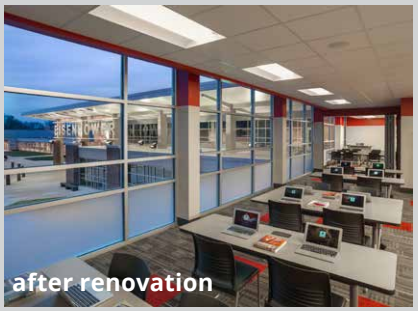
Investigation of another recently renovated High School revealed that second school not only saw a decline in student discipline referrals, but average attendance also rose, and truancy declined.

If the building can improve education, then it makes sense to figure out exactly how and why and replicate that success.

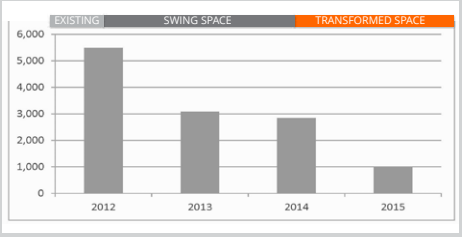
To that end, **a team of educational experts, school research scientists, and design professionals** was assembled to develop a rigorous study, to understand if the building design might contribute to changes in student outcomes, as hypothesized by the building administrators.

"Do buildings really make a difference?" ANECDOTAL EVIDENCE

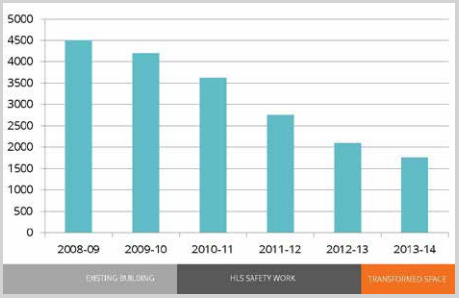
Eisenhower High School • Decatur Public Schools #61 • Decatur, Illinois



Eisenhower High School DISCIPLINE REFERRALS



Washington High School DISCIPLINE REFERRALS



Washington Community High School #308 • Washington, Illinois

Hypothesis #1

Improved movement patterns will reduce travel stress and reduced travel stress will reduce student discipline problems.

MOVEMENT PATTERNS
(density, distance to open space, traffic flow)

STUDENT BEHAVIOR

A "movement score" was created as an average of 9 items.

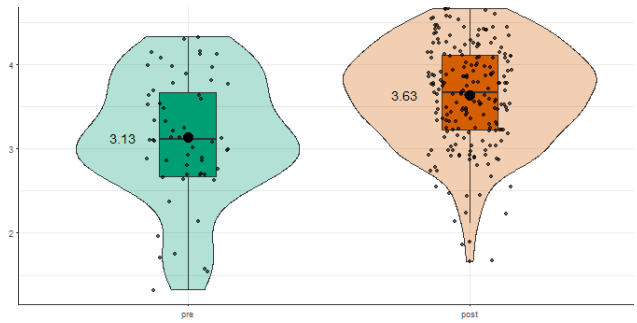
Sample questions measuring design variables:

Is it crowded?
I feel crowded ● ● ● ● ● *I have plenty of room*

When everyone is in the halls, how loud is it?
Disruptively loud ● ● ● ● ● *I don't even notice it*

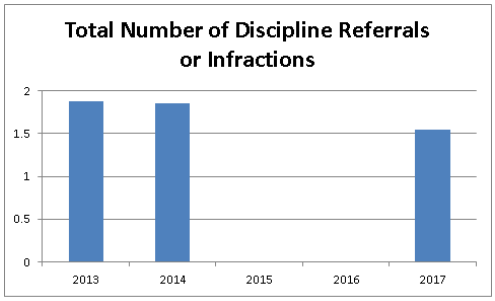
Students reported on average better movement patterns in the post-test than in the pre-test

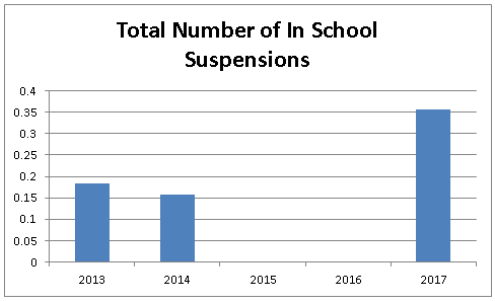
Pre (mean, 95% CI) = 3.13 (2.93 – 3.33)
Post (mean, 95% CI) = 3.74 3.63 (3.55 – 3.72) **+.50**

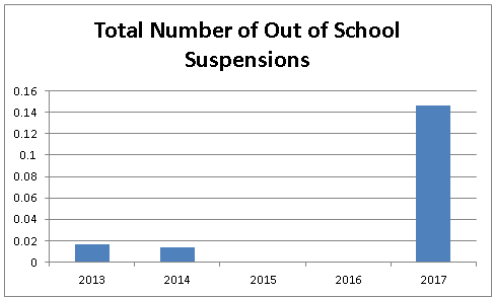


** NOTE: 57 pre-tests, and 400 post-tests for this scale*

Outcome variable measurements:







A better "movement score" was recorded in the new space, but one year of discipline data showed mixed results.

Post occupancy observations commentary – What We Learned

One year's data is not enough data to determine association. While average discipline referrals fell, in school and out of school suspensions increased. It is possible that movement patterns in and of themselves may not lower student discipline referrals as hypothesized.

The sound during lunch can be extremely loud. Additionally, lunch was envisioned to occur in decentralized locations (the learning studios and the Meadow immediately outside), but as the idea was investigated, lunch was decided to be held in a traditional centralized location, the commons.

After discussing these results with the principal, there are other moderating variables that can have an impact on student anxiety, possible setting the stage for either improving or worsening student discipline results. The concentration of students in the central commons location, combined with the lack of necessary sound absorption may build anxiety in students that contributes to the spike in discipline referrals that occur shortly after the lunch period.

How will we use this information?

Next steps: Work with the school district to reduce sound in Commons and measure the outcome. Measure sound levels in the high school where discipline levels fell; investigate other variables such as average lighting levels throughout as well as personal area per student, and time to eat. Compare this information to Charles City, and recommend changes where significant differences exist.

Hypothesis #2

Students that learn in an environment that they report to be more stimulating will also report higher levels of engagement.

STIMULATING ENVIRONMENT

A "stimulation score" was created as an average of 9 items.

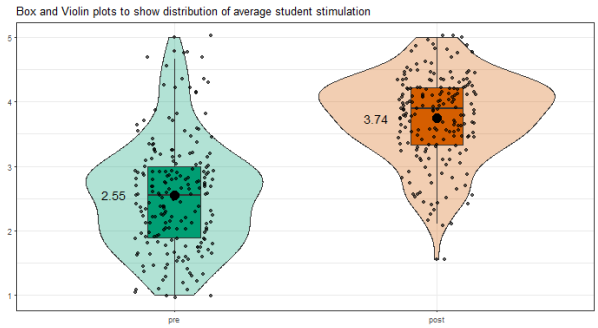
Sample questions measuring stimulation variables:

Is it colorful?
Not colorful at all ● ● ● ● ● *Very colorful*

Are there spaces that feel fun and make you think "wow" when you see them?
No fun spaces ● ● ● ● ● *There are really fun spaces*

Students reported on average better stimulation scores in the post-test than in the pre-test.

Pre (mean, 95% CI) = 2.55 (2.43 – 2.67)
Post (mean, 95% CI) = 3.74 (3.65 – 3.84) **+.79**



STUDENT ENGAGEMENT

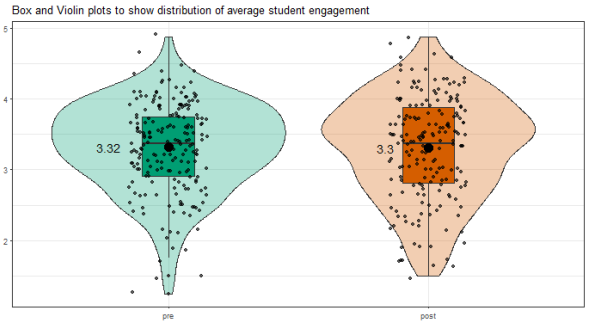
An "engagement score" was created as an average of 8 items.

Sample questions measuring stimulation variables:

How welcoming is the building?
I'm out of place ● ● ● ● ● *I feel like I belong*

Students did not report significantly different engagement scores on average on the post-survey

Pre (mean, 95% CI) = 3.32 (3.23 – 3.41)
Post (mean, 95% CI) = 3.30 (3.20 – 3.41) **-.02**



While there is a slightly positive relationship between stimulation and engagement, a stimulating physical environment alone may not produce a dramatic change in student engagement in grades 5-8.

Post Occupancy Observations Commentary – What We Learned

Given the volumes of information from industry resources and publications that suggest that engaging environments may have a positive impact on student engagement, this finding was suprising. The analysts noted that the engagement scores for Charles City students were quite high, and suggested that there may be a ceiling effect.

Working to make sense of the data and its jarring rebuke of our expectations, the qualitative input that was requested at the end of each section of questions on the survey was reviewed. At the end of the engagement section, students were asked: "Is there anything else you would like to say about how you feel when you're at school?"

Some of the students' responses:

- Bored. Unless in science and math.
- I feel like I just come to school and everybody bullies me
- It is boring
- Some people at the school make you feel not welcome
- When we're given too much home-work/tasks, I feel very tense.
- I don't think it's the school that make kids feel unwelcome, it's the other children

These comments helped explain how overreaching the expectations may have been given the daily experiences of the average middle schooler.

How will we use this information?

Next Steps: As more and more educators go through project-based learning training and use the building to deliver engaging instruction, search for association that may result from the combination of engaging programs + engaging environment in achieving gains in student engagement.

Hypothesis #3

In schools designed to meet the individual needs of the learner, teachers will report higher student achievement.

LEARNING SETTINGS

Teachers were asked 21 items asked about different aspects of the learning settings (flexibility, environment, accommodations)

	Pre Mean	Post Mean	Difference
Reconfigure for activities (furniture)	2.78	4.68	1.90
Accommodations (social)	2.78	4.52	1.74
Reconfigure for activities (spaces)	2.78	4.44	1.66
Degree students can shape their LE	2.57	4.04	1.47
Sound levels (1 = loud, 5 = just right)	3.00	2.84	-0.16
Accommodations (private spaces) (1 = inadequate, 5 = excellent)	3.13	2.84	-0.29
Accommodations (quiet spaces) (1 = inadequate, 5 = excellent)	3.13	2.84	-0.29

The four items with the largest positive differences, and the three items with negative differences

- The items showing larger differences seem to indicate a greater degree of flexibility, as well as accommodations for social activity
- The items showing negative differences describe higher sounds levels, and perhaps less accommodations for private and quiet spaces
- Two different things may be measured with these items: meeting needs of students, and meeting needs of teachers

STUDENT ACHIEVEMENT

An "achievement score" was created as an average of 14 items. Teachers reported student achievement.

Sample questions measuring stimulation variables:

Describe the development of your current students' 21st century skill or abilities in the following areas:

Responsibility

Blames others for lack of success ● ● ● ● ● *Takes full responsibility for success and failures*

Innovative thinking

Stays strictly within the guidelines ● ● ● ● ● *Looks beyond conventional approaches*

Teachers reported **increased perception of student achievement** on average from pre-test to post-test.

Pre (mean, 95% CI) = 2.97 (2.66 – 3.27)
Post (mean, 95% CI) = 3.41 (3.11 – 3.71) **+.44**

Our analysts concluded that learning setting design was primarily responsible for the increases in perceived student achievement.

Post Occupancy Observations Commentary – What We Learned

Using a mediation model, the analysts were able to identify an association between learning settings and student achievement... essentially, the redesign affected learning environments, and learning environments affected student achievement. The two factors most closely associated with these changes were: the ability to reconfigure the environment, and creating a social and collaborative environment.

Through instructor feedback it was learned that there were mixed results regarding assigning space based upon use rather than program. There are some programs that may be so environmentally specific that they cannot be co-located in a multi-use space designed for like activities (middle school art, for instance).

How will we use this information?

Next Steps: Continue to explore and invent environments that can be reconfigured, and develop designs that create a social and collaborative environment. Given the decline in scores for spaces needing to be private and for the purpose of completing quiet work, include provisions to acoustically and physically isolate those spaces; glass doors may be the best solution to provide acoustical isolation while maintaining an open, social and collaborative environment.

connecting SCHOOL FACILITY CONDITIONS AND STUDENT OUTCOMES

evidence based design study

Appendix

The study approach

The study was designed with the assistance of research scientist, Dr. Christine DeRosa. An online survey was developed to gather data and would be administered before construction (to collect baseline data) and after the remodeled building had been occupied for most of a full school year. A 5-point Likert scale was adopted as the convention used to gather information to understand the degree to which survey respondents agreed or disagreed with particular statements, allowing a quantitative analysis. The study also sought data that could be analyzed qualitatively.

In developing the survey instrument, existing studies were reviewed to understand the findings of previous research, and how they might impact the research. The research was also reviewed to identify particular survey questions that used constructs that have been rigorously tested, and how those constructs could be incorporated in the research.

After reviewing the individual questions to be incorporated into the survey with Dr. DeRosa, and simplifying the language to a second grade level, focus groups were held with 5th and 6th grade students at a local elementary school to understand how accurately and clearly the questions were written (did students understand the questions?). Dr. DeRosa also administered the survey to high school seniors, and interviewed the students afterwards to learn where the survey language may have been unclear, and how the language could be strengthened.

DEMOGRAPHICS & SAMPLE CHARACTERISTICS

Charles City Data Only

Students
445 total
238 Male, 207 Female
81 6th grade, 147 7th grade, 217 8th grade

Teachers
48 total

SURVEY DESIGN
Research Scientist Dr. Christine DeRosa

SURVEY ANALYSIS
Robin Donatello,DrPH
Assistant Professor Department of Mathematics & Statistics
California State University Chico
Bret Moulton,MPH Statistician I Department of Preventive Medicine
University of Southern California

BLDD ARCHITECTS

Samuel J. Johnson, AIA, LEED AP, REFP
Rachel Emmons

SCHOOL FACILITY CONDITIONS AND STUDENT OUTCOMES

survey instrument

Hypothesis #1

Improved movement patterns will reduce travel stress and reduced travel stress will reduce student discipline problems.

MOVEMENT PATTERNS

(density, distance to open space, traffic flow)

SAMPLE QUESTIONS

Is it crowded?

I feel crowded — I have plenty of room

When everyone is in the halls, how loud is it?

Disruptively loud — I don't even notice it

Is there enough space?

There's not much space — There's lots of space

Is it easy or hard to get where you're going?

Very Hard — Very Easy

Can you easily see outside?

No, not at all — Yes, Easily

Hypothesis #1

Improved movement patterns will reduce travel stress and reduced travel stress will reduce student discipline problems.

STUDENT BEHAVIOR

SAMPLE QUESTIONS

Total number of discipline referrals?

Total number of in-school suspensions?

Total number of out-of-school suspensions?

Hypothesis #2

Students that learn in an environment that they report to be more stimulating will also report higher levels of engagement.

STIMULATING ENVIRONMENT

SAMPLE QUESTIONS

Are there spaces where you like to hang out with your friends?

Not really — Yes, a lot

Are there spaces that feel fun and make you think “wow” when you see them?

No fun spaces — There are some really fun spaces

Do you like the way it looks?

No, it’s ugly — Yes, it’s beautiful

How comfortable is the furniture?

Not comfortable at all — Very comfortable

Does your school have any areas that look really interesting?

No, they’re mostly boring — Yes, they’re mostly interesting

Hypothesis #2

Students that learn in an environment that they report to be more stimulating will also report higher levels of engagement.

STUDENT ENGAGEMENT

SAMPLE QUESTIONS

How welcoming is the building? (sense of community)

I'm out of place ●●●●● I feel like I belong

I feel motivated when I am at school.

Strongly disagree ●●●●● Strongly agree

I feel like I belong here at my school

I Strongly Disagree ●●●●● I Strongly Agree

I am excited to learn when I'm at school.

I Strongly disagree ●●●●● I Strongly agree

I feel happy when I am at school.

I Strongly disagree ●●●●● I Strongly agree

Hypothesis #3

In schools designed to meet the individual needs of the learner, teachers will report higher student achievement.

LEARNING SETTINGS

SAMPLE QUESTIONS

Can spaces be reconfigured for multiple activities?

Not at all ●●●●● Yes, quite a bit

How well do the learning environments allow for different learning styles?

Visual (lots of display areas)

Unsuitable ●●●●● Suitable

To what degree do students have the opportunity to shape their learning environment?

Not at all ●●●●● Quite a bit

To what degree do you feel that the environment provides the flexibility needed to meet the needs of all students?

Not at all ●●●●● Quite a bit

As far as technology is concerned, do students have the use of the following tools as needed?

Hardware, Software, Infrastructure (Access to Wi-fi and appropriate bandwidth).

Insufficient ●●●●● Excellent

Hypothesis #3

In schools designed to meet the individual needs of the learner, teachers will report higher student achievement.

STUDENT ACHIEVEMENT

SAMPLE QUESTIONS

Describe the development of your current students' 21st century skills or abilities in the following areas:

Responsibility

Blames others for lack of success ●●●●● Takes full responsibility for success and failures

Innovative thinking

Stays strictly within the guidelines ●●●●● Looks beyond conventional approaches

Ability to demonstrate understanding of information and processes

Does not use knowledge to solve problems ●●●●● Uses knowledge to solve problems

Models Integrity and Leadership

Integrity

frequently does not do what is right ●●●●● consistently does what is right

Leadership

Is rarely able to persuade and influence others ●●●●● Is consistently able to persuade and influences others

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