connecting SCHOOL FACILITY CONDITIONS

AND STUDENT OUTCOMES
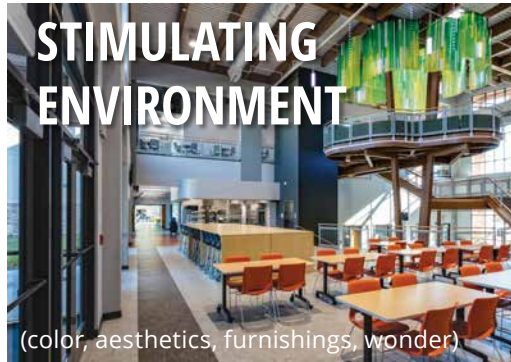
evidence based design study

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

MOVEMENT PATTERNS

(density, distance to open space, traffic flow)

STIMULATING ENVIRONMENT

(color, aesthetics, furnishings, wonder)

LEARNING SETTINGS

(acoustics, climate control)

STUDENT BEHAVIOR

STUDENT ENGAGEMENT

ACADEMIC ACHIEVEMENT

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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BLDD ARCHITECTS

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
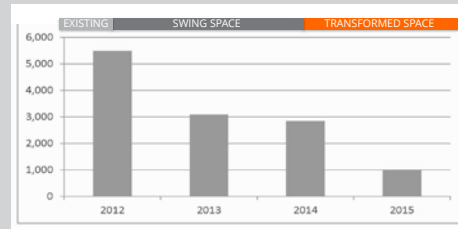

before renovation
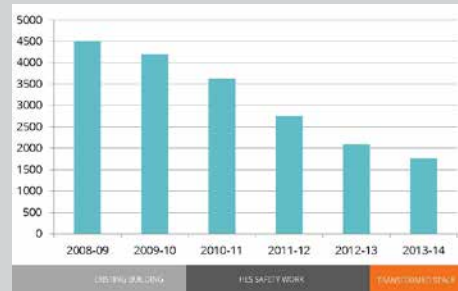

after renovation

Eisenhower High School   DISCIPLINE REFERRALS

Washington High School   DISCIPLINE REFERRALS

before renovation

after renovation

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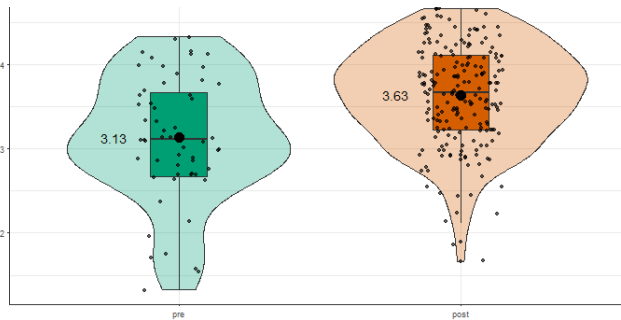
When everyone is in the halls, how loud is it?
Disruptively loud ● ● ● ● ● *I don't even notice it*

Students reported on average better movement patterns in the post-test than in the pre-test
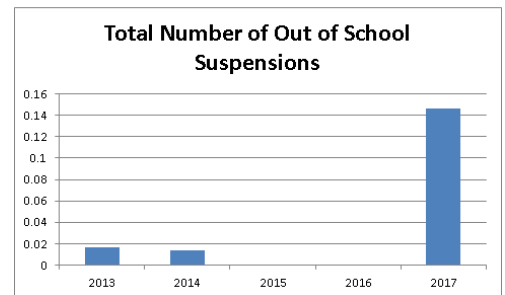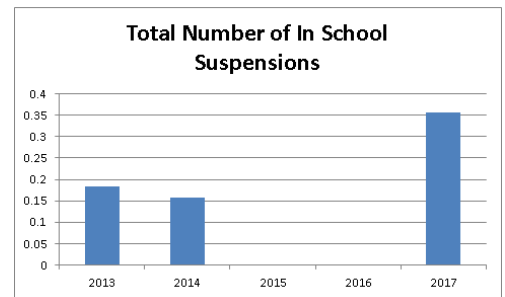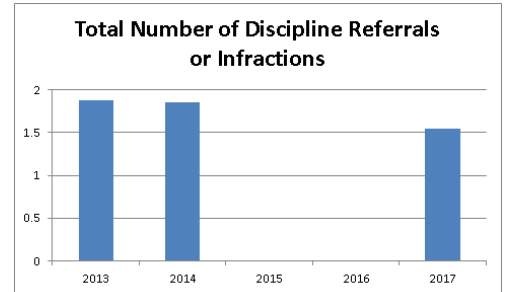
Pre (mean, 95% CI) = 3.13 (2.93 – 3.33)
Post (mean, 95% CI) = 3.74 3.63 (3.55 – 3.72) **+.50**

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

Outcome variable measurements:

Total Number of Discipline Referrals or Infractions

Total Number of In School Suspensions

Total Number of Out of School Suspensions

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

The proposed design was changed, invalidating the results. 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

STUDENT ENGAGEMENT

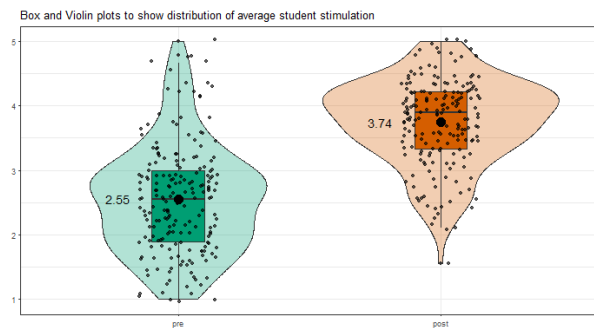A "stimulation score" was created as an average of 9 items.

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**

Box and Violin plots to show distribution of average student stimulation

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**

Box and Violin plots to show distribution of average student engagement
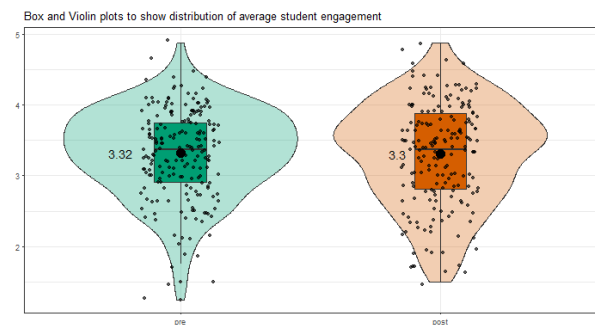
While there is a slightly positive relationship between stimulation and engagement, a stimulating physical environment alone may not produce a dramatic change in student engagement in grades 5-8.

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.

LEARNING SETTINGS

STUDENT ACHIEVEMENT

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

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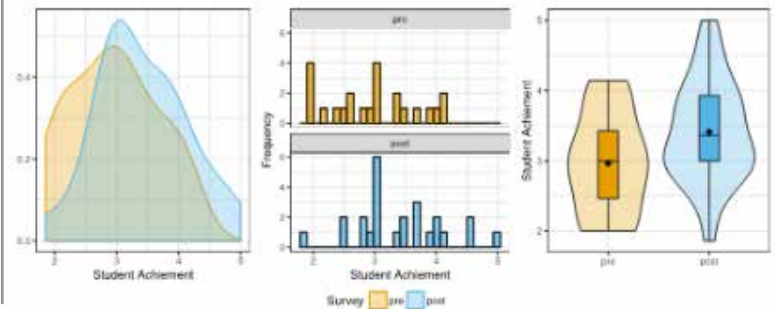*Stays strictly within the guidelines* ● ● ● ● ● *Looks beyond conventional approaches*

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.

Analysis Summary:
Because we saw statistically significant increases in means for learning settings and student achievement from pre to post, and because learning settings and student achievement have a statistically significant positive linear relationship (from linear regression test), we can come to the conclusion that learning environments are associated with improved teacher impressions of student outcomes. And since learning settings increased from pre to post, we can say that since learning settings has a positive relationship with student achievement, that the increase in learning settings contributed to the increase in student achievement.

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.

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

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BLDD ARCHITECTS

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Rachel Emmons

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   OOOOO   I have plenty of room

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

Disruptively loud   OOOOO   I don't even notice it

Is there enough space?

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

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

Very Hard   OOOOO   Very Easy

Can you easily see outside?

No, not at all   OOOOO   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?

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

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

BECAUSE
LIFE
DESERVES
DESIGN
®