

# Personalized Learning, Personalized Space

### RESEARCH TEAM:

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### INSTITUTION:

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### SPONSORS:

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## EXECUTIVE SUMMARY

### PURPOSE OF STUDY

The purpose of this project was to:

1. Examine the psychological and physiological effects of learning environments on students to determine how changes in an environment might improve Personalized Learning (PL);
2. Develop and pilot-test a sensory design lab (SDL) that measures heart rate, anxiety, and behavior in relation to interior design elements in real time in a high school setting;
3. Assess the effects of furniture choice and arrangement as well as environmental conditions (sound, temperature, light) on heart rate, self-reported anxiety, reported achievement, and movement; and
4. Explore effects of interiors on learning to generate discussion, further research, and changes in educational systems.

### RESEARCH SUMMARY

The CADRE research team developed a sensory design lab to track psychophysiological changes in a controlled space, specifically enabling the analysis of the effects of interior elements on students within a learning environment. The 10' x 10' x 8' agnostic prototype was installed in the Dallas Independent School District High School that supports personalized learning, and allowed for 30-minute study sessions with groups of up to three students tracking sound, light, temperature, humidity, participant location, movements, and heart rate. Behavioral data was collected manually, and a personalization index offered a means for assessing degrees of personalizing the space.

Students in groups of three personalized the space more than smaller groups, and chairs were preferred over stools. Students who faced the entrance reported higher self-achievement than students facing the back wall. Chairs were preferred to stools, and stools were used as an additional surface for belongings. Participants often leaned back while seated. Although not varied for this

experiment, sound levels were most salient of the environmental variables, which changed mainly due to conversations and ambient noise. Higher mean sound levels were correlated with smaller reductions in anxiety levels and lower achievement. Anxiety noticeably lowered between participants' initial states and concluding ones. Higher temperature and higher mean sound levels were associated with higher heart rate despite there being no direct correlation between anxiety levels and heart rate. Greater fidgeting was associated with low minimum sound levels and with greater reduction in anxiety levels, but not with greater achievement.

Having visual prospect can contribute to cognitive performance; therefore, sufficient space allowing seating orientation change and a view can be beneficial. Larger groups' greater degrees of personalization suggest that personalizable space may be more desired when in groups. There may be an optimal range of sound levels in cognitive performance—not too loud which can cause anxiety, but also not too low that can cause students to feel restless.

## IMPLICATION HIGHLIGHTS

- Ergonomic aspects in furniture selection should be considered by schools.
- Acoustic design should be carefully considered to be “optimal” avoiding too loud or too quiet.
- Interior designers should consider larger level of personalization in areas where students will work in groups.
- Space to locate belongings can help students' to keep the immediate learning environment more organized.
- Elements of “prospect” may help students feel a sense of achievement.



## PERSONALIZED LEARNING, PERSONALIZED SPACE

### BACKGROUND

Competency-based or personalized learning is a method of education tailored to individual students to help further their academic and professional careers. This is achieved by adapting learning to students' educational needs, interests, and talents to the pace, time, location, learning materials, and activities that best suit them.

The effectiveness of this paradigm may be subject to the learning environment; yet, the relationship between the built environment and the outcomes of PL paradigm is unknown. Dallas is one of the fastest growing economic regions in the U.S. and the Dallas Independent School District (DISD) is the 14th largest urban school district. In the fall of 2013, DISD was among 20 districts across the nation to receive a grant from the Bill and Melinda Gates Foundation to develop a strategic vision for the development and implementation of PL models in

local public schools. Few studies have investigated the effectiveness of these design strategies on the intended outcomes listed above. To encourage and enable school systems to invest in the substantial capital investment of renovating traditional spaces so that they support PL, such evidence is vital.

## METHODOLOGY

The team developed a pop-up sensory design lab. The lab is a room-in-room system that is portable, trackable, and flexible. The size of the lab, 10' x 10' x 8', was determined by the room where it would be installed in the school. The SDL was built with wooden beams and 3D printed brackets and clips, the SDL is portable and flexible to suit a number of environments. Its mobility facilitates replicating the method of data collection in a variety of spaces. The lab is equipped with five custom-made environmental sensors measuring illumination, sound levels, temperature, and relative humidity every few seconds; two thermal cameras to document inhabitants' behavior while protecting their privacy; and fitness wristbands recording each participant' heart rate.

This project provided the opportunity to take a comprehensive, mixed-method approach (balancing qualitative and quantitative methods) to investigate the role of interior design in facilitating a PL program. 30 students (up to three high school students at a time) participated in the experiment and performed a 30-minute independent work session in the lab. Students were instructed to set up the SDL using four chairs, four stools, a table, and a mobile whiteboard provided by Herman Miller. Data measuring stress and anxiety, humidity, temperature, luminosity, sound intensity, participant movements, and actions were all collected and analyzed.

## KEY FINDINGS

- Participants reported they appreciated the chairs provided because they could lean back.
- The higher the sound levels, the less anxiety levels decreased, and more self-reported achievement decreased; when it was too quiet, students displayed more restless behavior. Acoustic design should be carefully considered to be “optimal,” avoiding too loud or too quiet.
- Students in a group of three showed higher personalization index scores than those in groups of two or by themselves. Interior designers should consider enabling more personalization in areas where students will work in groups.
- When students displayed higher anxiety levels at the beginning of an experiment, they were less likely to personalize their workspaces.
- Students who faced the entrance wall reported higher self-achievement. It would, therefore, be beneficial to provide seating that can change orientation and has access to a view.
- Students reached for their backpacks during the work session or placed their belongings on secondary seating. Providing space in the immediate vicinity may help students locate belongings and be more organized.

## PUBLICATIONS

- Chung, S. (2017, June 02). First Friday Research Case Study: Personalized Learning, Personalized Space. ICON-American Society of Interior Designers. Retrieved from <http://icon.asid.org/index.php/2017/06/02/first-friday-research-case-study-personalized-learning-personalized-space>
- Nanda, U., & Bryan, A. (2016, May 27). Personalized Learning Spaces. ICON-American Society of Interior Designers. Retrieved from <http://icon.asid.org/index.php/2016/05/27/personalized-learning-spaces>

## PRESENTATIONS

- Nanda, U. (2017). “HKS’ Sensory Well-Being Cocoon 2.0”. 2017 South by Southwest (SXSW) EDU Conference & Festival. Austin, TX. March 6–9.
- Nanda, U., Kolstad, J., May, H., & Bailey, J. (2016). “HXS: architectural human experience lab”. 2016 Academy of Neuroscience for Architecture, Connections: BridgeSynapses. La Jolla, CA. September 23–24.

## RESEARCH BIO

**UPALI NANDA, PH.D., ASSOC.AIA, EDAC, ACHE** (*executive director, Center for Advanced Design Research and Education (CADRE), director of Research, HKS Architects*) is responsible for spearheading and implementing research projects globally and the principal investigator of this project.

**GIYOUNG PARK, PH.D., AIA, LEED AP BD+C** (*Fitwel ambassador, senior design researcher, HKS Architects*) is an environmental psychologist and registered architect focused on built environment, social capital, communication technologies, and human well-being, and lead researcher of this project.

**ANGELA RAMER** (*design anthropologist/research analyst, HKS Architects*) brings a unique, humanistic, and holistic research approach to HKS design projects that highlight understanding the realities of human experience in built environments.

**JON BAILEY** (*associate, Laboratory for Intensive Exploration (LINE), HKS Architects*) works around the interaction and relationships between multiple systems (ecological, physiological, or building) and has a background in advanced digital modeling techniques, parametric and algorithmic modeling, and digital fabrication.

**TIMOTHY LOGAN** (*associate, Laboratory for Intensive Exploration (LINE), HKS Architects*) focuses on developing tools to help manage increasingly complex building designs and straddle the gaps between the multiple software tools used within the architectural practice.

**AARON HOLLIS** (*architectural designer, Education; HKS Architects*) focuses on applied research and technical applications. He worked closely with DISD in exploring the potential impact of personalized learning (PL, herein) upon the physical classroom environment and proposing design solutions to better facilitate this new program.

**JONATHAN ESSAY** (*computational designer/lab researcher, HKS Architects*) investigates in spatial design, digital fabrication, digital analysis/design, architectural research, material research, research methodology, applied architectural theory, technology and its relation to human experience, and exploratory generative techniques.

## ADVISORS

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