

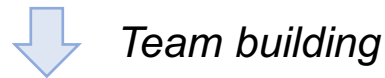
Toward Disease-Resistant School Communities by Reinventing the Interfaces among Built Environments, Occupants, and Microbiomes

#1952140

**Shuai Li, University of Tennessee Knoxville
PG, FY2020**

Principal Research Investigators (Name, Institution)

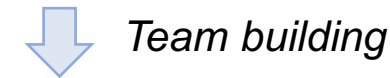
- **Shuai Li**, Civil Engineering, University of Tennessee
- **Qiang He**, Environmental Engineering, UTK
- **Xueping Li**, Industrial & System Engineering, UTK
- **Tami Wyatt**, Nursing, UTK



- **Qingyan Chen**, Mechanical Engineering, Purdue University
- **Courtney Cronley**, Social Work, UTK
- **Jiannan Cai**, Construction Management, The University of Texas at San Antonio (*Hispanic-serving institution*)
- **Adrienne Cooper**, Environmental Engineering, Florida Memorial University (*Historically black colleges and universities*)
- **Eric Du**, Virtual Reality, University of Florida
- **Jian Liu**, Electrical and Computer Engineering, UTK

Community Partners (Name, Institution)

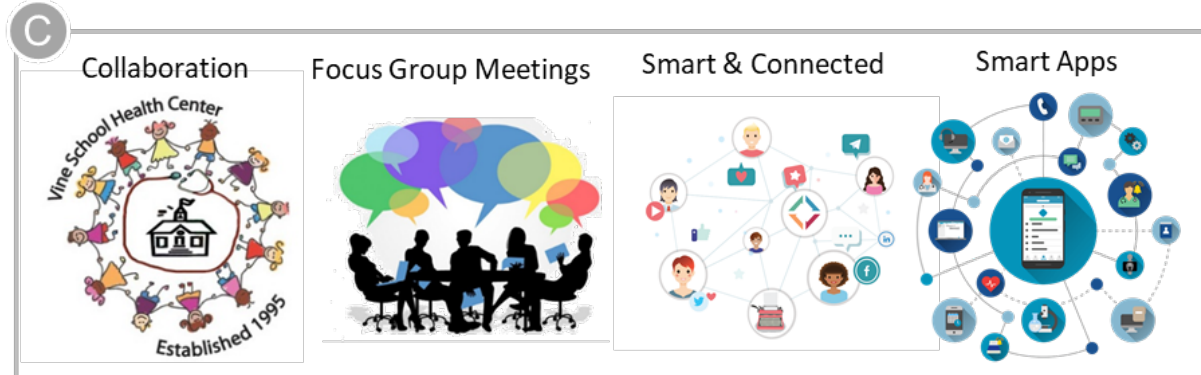
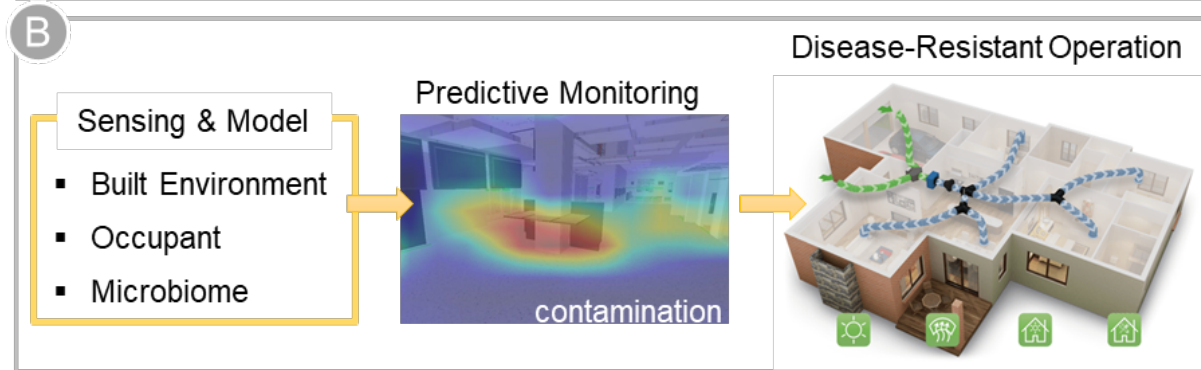
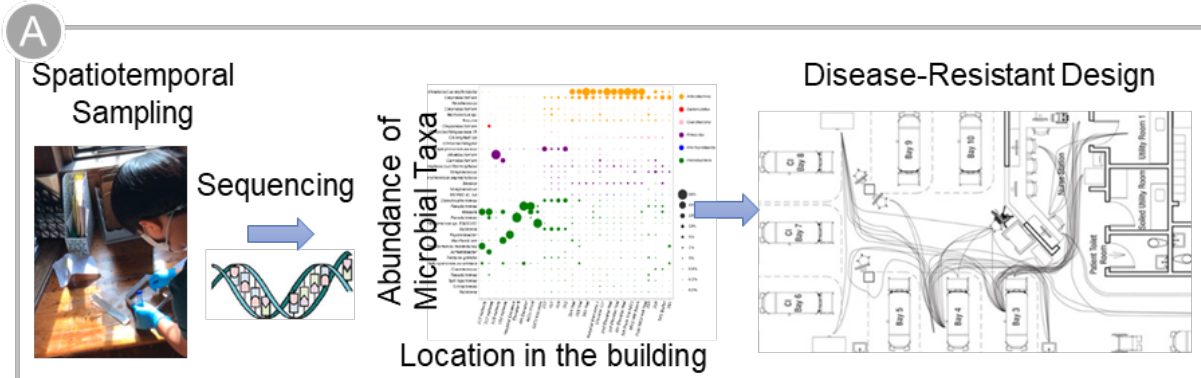
- **Nan Gaylord**, Vine School Health Center
- **Tammy Van Dyk**, East Tennessee Children Hospital



- **Cheryl Ball**, Knox Education Foundation
- **Willie Burroughs**, San Antonio Independent School District (SAISD)
- **Chris Salley**, SAISD
- **Michael McBrien**, Webb School of Knoxville
- **Matt Ryerson**, United Way of Greater Knoxville
- **Michael Walton**, Green Space
- **Richard Kingston**, Knoxville Community Development Corporation

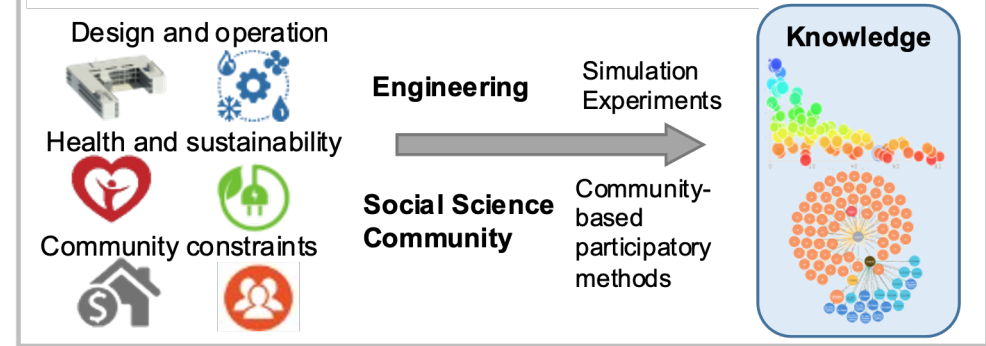
Project Overview

Our Planning Grant

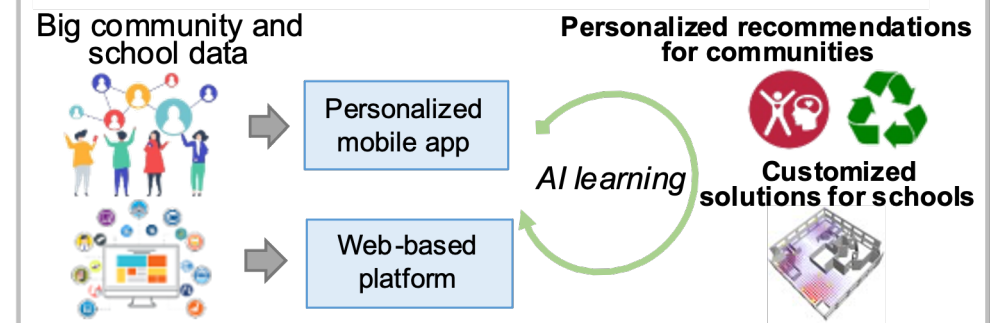


Project Vision for IRG

Theme #1 School Environmental Modeling



Theme #2 Federated AI Analytics of Community Data



Research Consortium with Community Engagement



Project Overview

Use-Inspired Research

- **How to make school environments healthy and sustainable?**
 - **Engineering**: develop knowledge-based design and operation adaptation
 - **Social Science**: evaluate the social acceptance and intelligence of the adaptation
 - **Community**: ensure the desirability, feasibility, and viability of the adaption.
- **Seven** community partners
- **Four** states across U.S. : Tennessee, Florida, Texas, Indiana
- **Five** cities: Knoxville, Gainesville, Miami Gardens, San Antonio, West Lafayette



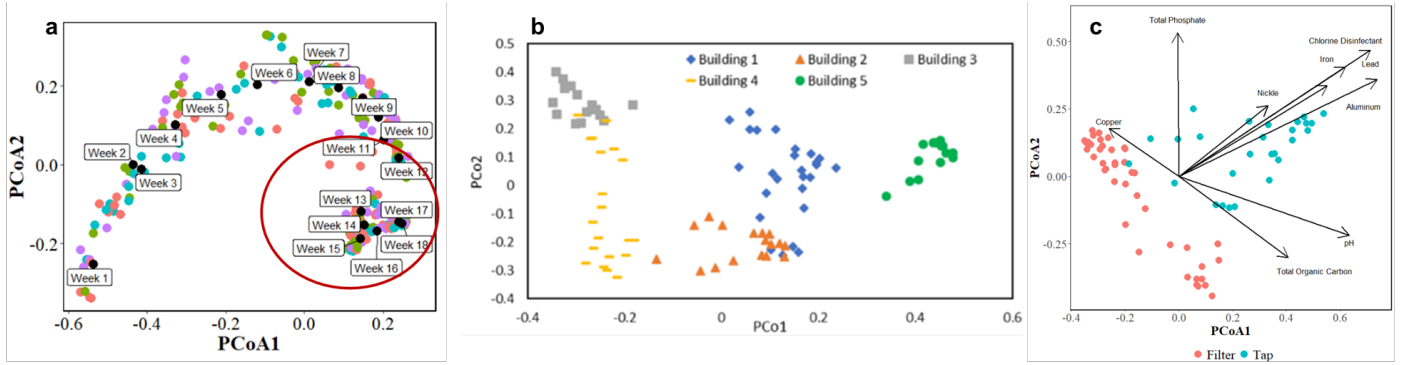
PG Activities

- **Convergence Project Team Building**
 - **10** domain experts from **5** institutions (including a Hispanic-serving institution and a HBCU)
 - **100** schools serving **75,000** students
 - Multiple community partners
- **Research Refinement and Concept Proofing**
 - About 4000 samples collected in built environments
 - Exposure and infection modeling and operation cost assessment
 - Community-centric engagement model for development and implementation
 - Crowdsourced big data for personalized intervention

Project Update

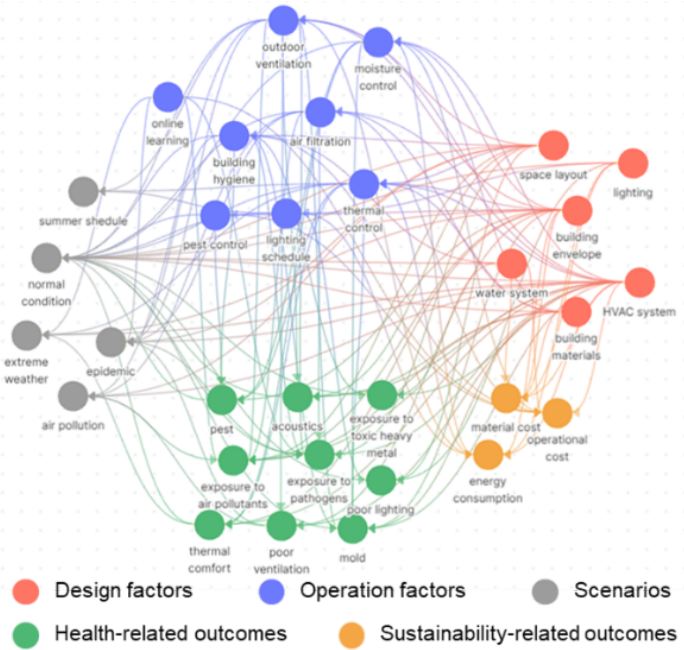


K-12 students taking microbiome samples in Schools

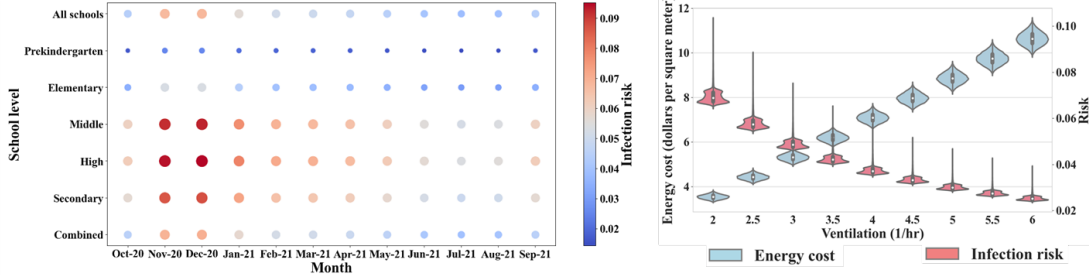


a) Impact of COVID-19 mitigation practices on microbial exposure in four adjacent classrooms by long-term indoor microbiome monitoring. Red circle: indoor microbiomes post COVID-19 mitigation practices, b) microbiome composition is distinct in buildings of different layout, c) Impact of point-of-use filtration on microbial and heavy metal exposure via drinking water in campus buildings. Dots: drinking water microbiomes; arrows: drinking water quality parameters.

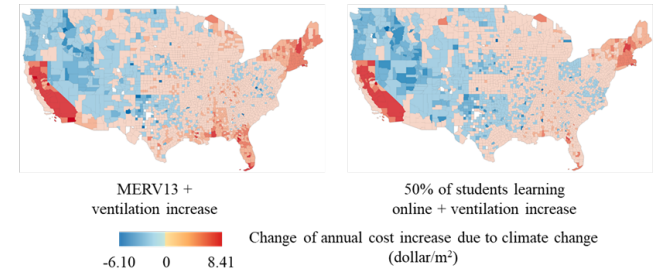
Contaminations in School Buildings with Different Design and Operation Factors



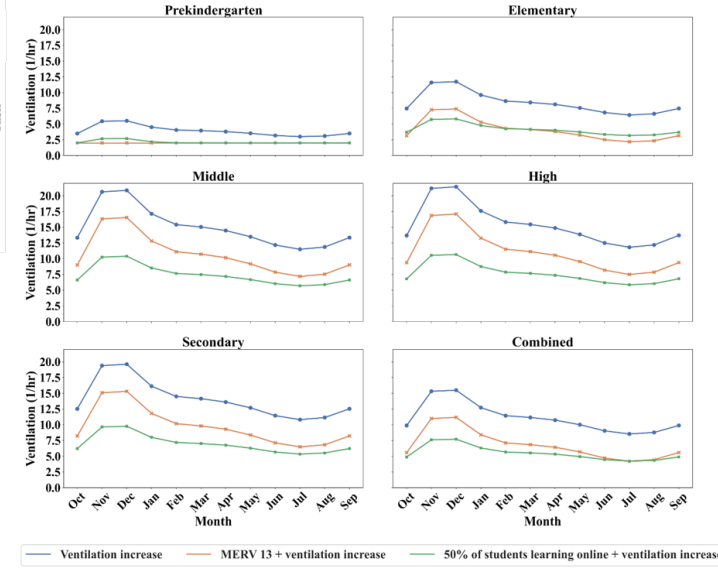
Design and Operation Factor Identification



Infection risk in different levels of schools Trade-off between infection risk and energy cost



Changes in energy cost under different interventions



Infection risk under different interventions

National Assessment of Airborne Infection Risk and Energy Cost in U.S. Schools

Project Evolution

Challenges from Communities

Restricted School Access



Data Privacy Issues



Motivation for Participation



Solutions

Virtual engagement to achieve broader acceptance and implementability

Privacy-preserving community data collection and processing

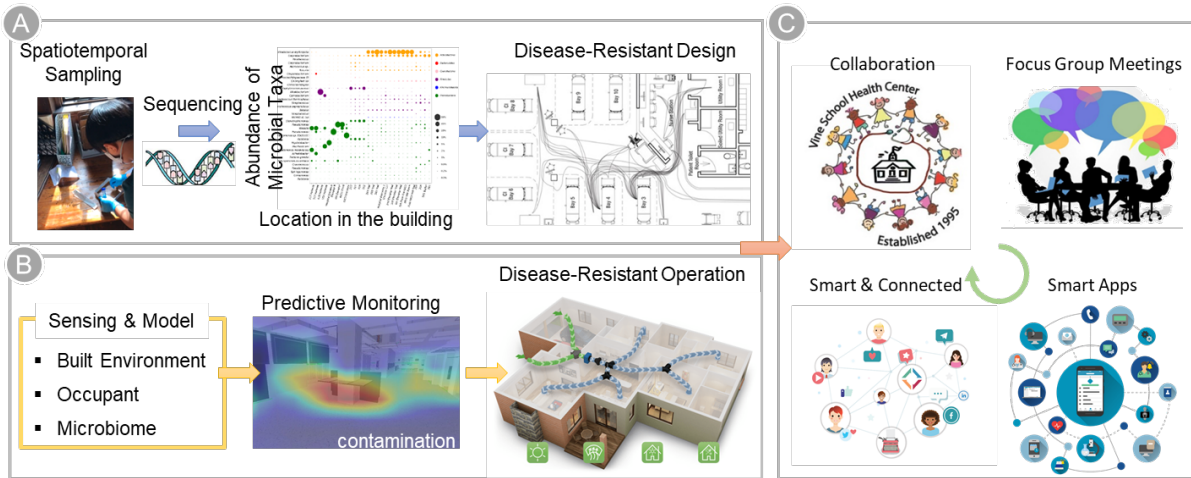
“Citizen science” approach with experiential learning

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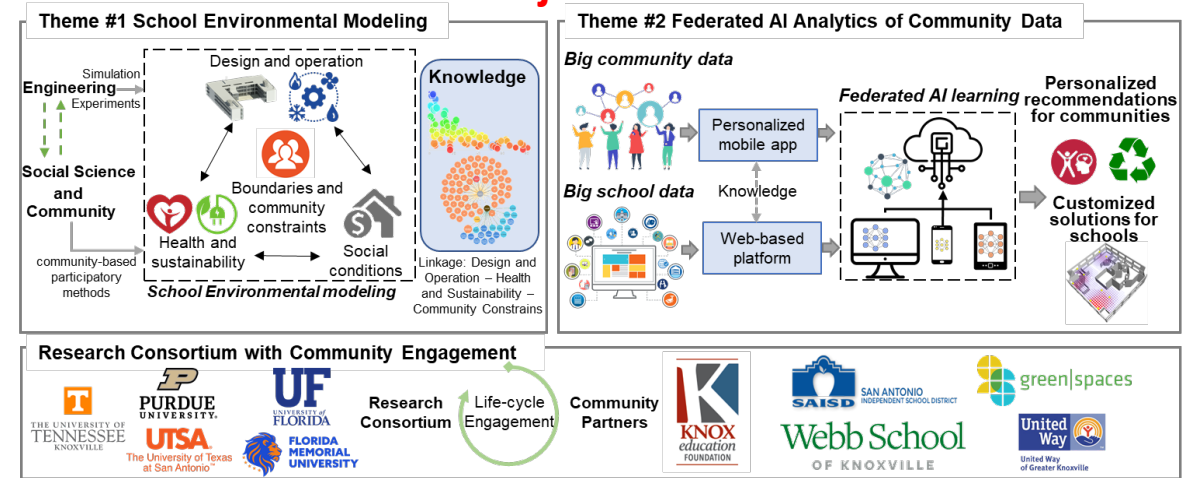
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Shuai Li, University of Tennessee Knoxville
PG, FY2020

Visual Schematic



Project Vision



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