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Students-Community Engaged Home Energy Project

Juntae Jake Son, Ph.D., LEED AP ID+C, Ball State University, IN

Dr. Juntae Jake Son is an Assistant Professor of Interior Design at the College of Architecture and Planning of Ball State University

Abstract

This Students-Community engaged home energy assessment project involved 50 undergraduate students in hands-on immersive learning in home energy assessment tools and techniques. The purpose of this project was to supplement students' understanding of energy efficiency assessment and analysis in residential buildings, as well as students' knowledge of energy solutions and their application in a residential setting. This project can be essential for students to apply energy assessment knowledge, skills, and tools to benefit the community and help future generations to ensure the environment.

Introduction

This article describes the students' outcomes of the service-learning project. Students in Interior Design program participated with the community partner to calculate and assess building energy and suggested solutions to help reduce building energy via this valuable project that students and the community were able to give and receive help from each other. By applying the knowledge to the community, students had a better opportunity to measure and assess building energy.
In the previous studies, Interior Design students suffer difficulties with the energy concept and green building design as well as the students and educators have not sufficiently communicated for energy-related concepts (Goldring & Osborne, 1994; Ruff & Olson, 2009). Many students have knowledge of sustainable methods and products to design residential and commercial projects (Ruff & Olson, 2009). Still, they are not aware much of how energy works in the built environment. In addition, the instruction with examples of sustainable projects is not sufficient to teach energy-related concepts to the students (McKeown, Hopkins, Rizi, & Chrystalbridge, 2002). This limitation may result in Interior Design students not being able to perform properly environmentally friendly design in green building projects.

Most of the buildings in the community need proper insulation, sustainable materials, and more sealed windows and doors to reduce energy consumption. Through a relationship with our community partner, students tried to solve a community challenge of building energy. Students provided analytical reports of actual buildings that suggest more efficient energy-saving ideas to benefit current and future stakeholders in the community.

This project aims to (i) elucidate the process of energy analysis in residential settings: Students' activities in a classroom and at the designated homes, (ii) describe the students' outcome via this service-learning project, and (iii) mention the students' evaluation after the class.

Literature Review

1) Reasons for creating awareness of energy efficiency

Molina (2014) gave a reason for saving energy; they mentioned that by saving energy, the future generation's needs would be met. Trombley and Smart (2016) saw the value in installing energy conservation measures to provide schools with both the hardware and software front end, creating awareness among students of the benefit of the project-based approach and how they can relate the project to a broader energy picture. It is also observed that students tend to create an energy-efficient solution when they voluntarily participate in some community activities through service learning and a research approach. Iordache Platis and Romanowicz (2020) distributed a questionnaire to students in the university addressing them on energy efficiency in the awareness campaign (Horizon 2020 project). The findings based on the research showed that students are most likely to change their energy-saving behaviors when they engage and participate in community activities, especially when the activities are incorporated into teaching and learning.

2) Community engagement and service-learning strategy

Community engagement and service learning go hand in hand. The service learning and research approach is a learning strategy in which students merge both learning and community service such that it enhances students' learning growth and enables them to contribute positively to the community's needs. Vanderbilt University defined service learning as a teaching and learning strategy that allows for integrating community services with instruction to enhance their learning process and develop the community (Bandy, 2016). Here student voluntarily applies for courses whereby they learn, develop skills that engage them with the community, and solve real-world problems.

3) Students' engagement and their benefits

One of the best ways students can engage themselves with the community needs is through the teaching and learning process in the university. Some institutions introduce engaging courses like research courses where students explore many community challenges and tend to provide a recommendation to them. Hamdullahpur (2019) opines that higher institutions have a great ability to engage in sustainability initiatives by partnering with social stakeholders and common initiatives by educating the community, researching community needs, and making a positive impact in solving problems. Cress (2020), Gallini and Moley (2003), and Bernacki and Jaeger (2008) contribute to the importance of students' engagement. These authors linked the civic engagement of students to their success because the students develop skills through the engagement. Therefore, students or public engagement is a motivation to improve their sustainable lifestyle towards energy consumption; the more the public participates, the more they get motivated to take proactive measures. Students benefit from community engagement in different areas such as learning growth, career development, improved social responsibilities, and relationship with the institution.

Student Activity: In-Class Relationship

This project challenged undergraduates to master specific energy assessment knowledge, skills, and tools and to engage in real-world opportunities to assess building energy systems in residential settings. At the beginning of the semester (FS 2021), the faculty placed students in teams of 7 and provided initial lectures detailing energy inspection procedures, essential aspects of an energy assessment, and analytical skills required to analyze the energy efficiency in single and multi-family homes. Each team actively discussed and determined the methods to test energy efficiency and conducted energy assessments in a total of five single- and multi-family homes, processed that include airtightness, heating and cooling, and ventilation. Following initial instruction by the faculty, each team could develop a plan detailing how to conduct the initial site visit to its home. This visit helped prepare the homeowner/caretaker for the energy assessment; they discussed project goals, energy testing procedures, and strategies, setting the client at ease with the overall process. After the site visit, they developed the contact and format of summary reports for each home and determined the most effective method of presenting the final energy assessment analysis to the community partner and homeowners/caretakers.

Student Activity: Community Relationship

Our community partner was one of the nonprofit organizations in Muncie, Indiana. They were designed to transform abandoned houses into sustainable homes in the community and works with students and the community to rehabilitate affordable homes for neighbors. The community partner facilitated opportunities for students to perform a home assessment in different types of constructions in different parts of the community. Students could be exposed to a variety of home types (e.g. single-story/multi-story construction, older/newer construction, different building materials, different building techniques, etc.) as well as interact with residents coming from a variety of socio-economic backgrounds. Finding ways to adapt as needed to these technical and social variables allowed students the opportunity to engage in diverse settings for their future professional experience.

The students' interactions with the homeowners/caretakers of the five houses studied, the evaluation techniques employed, and the analytical reports produced promoted elements of sustainable design to people in the most personal way: in their own homes, producing results that were of direct benefit in lower utility costs that can help to improve quality of life. The homeowners/caretakers could have an informed opportunity to realize the recommended improvements, contributing to the ongoing rehabilitation of aging housing stock into examples of sustainable design. The community partner worked with these homeowners/caretakers to further promote these gains, enlarging the circle of public awareness and support for turning away from the use of fossil fuels and outdated building practices and toward energy-efficient housing models that contribute to carbon reduction and mitigation of climate change.

Students Outcomes

For this project, students visited residential homes in the community area (Figure 1) and assessed home energy using various tools. Students used thermal cameras to detect thermal leakage in the houses. They also used the light meter to measure the amount of light. Using this light meter, students were able to check the light intensity near the windows where daylight is enough and

the corner of a kitchen or a room that is dark. Students also used measuring tapes to measure the size of rooms and house footprints, as well as windows and doors.

Figure 1. The house where students assessed energy consumption
URL http://rapidintellect.com/AEQweb/6070win1.pdf

Students found leakage gaps or areas using thermal cameras and measured the size of windows and doors (Figure 2). They also checked stories above ground level, heated or cooled floor area, types of foundation, and insulation levels for ceiling, wall, and roof. While checking the windows, they found window types such as single pane, double pane, or triple pane, and types of trims of the windows. Students checked appliances and equipment information, such as the number of washing machines and refrigerators. They also checked the size and fuel type of a water heater and cooling equipment. Based on the collected information, they researched the building energy and started a calculation for the yearly energy consumption in the house (Figure 3).

Figure 2. Students' final reports: Thermal camera images
URL http://rapidintellect.com/AEQweb/6070win2.pdf

Figure 3. Students' final reports: Yearly house energy consumption
URL http://rapidintellect.com/AEQweb/6070win3.pdf

The students estimated the annual cost of the house and suggested better energy-efficient appliances. They also calculated how much cost can be reduced when the homeowner upgrades with energy-efficient equipment (Figure 4).

Figure 4. Students' final reports: Conclusion and Suggestions
URL http://rapidintellect.com/AEQweb/6070win4.pdf

The project recognizes that aging housing stock and the lack of attractive housing in the community inhibit leaders' goals to improve quality of life and enhance economic development. This step up toward rehabilitation of existing homes with attention to sustainable design inspired homeowners and builders and set the community apart as a forward-thinking community combining its legacy housing and a sustainable future.

Students' Evaluation

After the semester, students responded to simple questions about their experiences and perceptions. The participants of the survey were asked through Canvas, which is one of the Learning Management Systems (LMS) (Helmandollar, 2020). Forty out of fifty students participated in the survey and answered two questions regarding general perceptions of this project. Since the survey was conducted with the voluntary participation of students, not all students participated in this survey.

Question 1: In three sentences, what was your favorite part about this project?

For this question, most students answered that they were most satisfied that they could experience hands-on work. By applying various theories that learned from the class, students answered that they could have a faster understanding of building energy evaluation. Below are some of the answers from the students.

“I like that I was given the opportunity to experience hands on work, as a first year in the program. I feel like this helps engage us in the process of actually designing a space and lets us learn more efficiently. I also like that we were given ample opportunity to learn how to be able to use different tools after being shown how to and getting to try for ourselves.”

“My favorite part about the immersive experience had to be seeing the full process play out.Designing and presenting is usually where most of the projects within the program end but this experience allowed for us to see what it really takes to implement a design in real life. The hands on portion and being part of the construction process also really taught me a lot on how we assess the energy.”

“My favorite part of the immersive experience was getting to actually get onto a project site and work hands on with something we don't generally get to experience although it is what we work with every day. On top of that, having the design that was chosen by the homeowners and being able to bring that design to reality was a really fun experience.”

Question 2: What was one new thing you learned while on site? Describe in three sentences.

Most students seem to have enjoyed themselves by experiencing what they could not learn in class. It can be seen from the students' answers that this hands-on project is a better method of education than students learning from books. Below are the answers from the students.

“Going to the sight taught me a lot of new and different things about how renovations and projects are done. The first thing I learned was the amount of time it takes for assessing energy to come into fruition; considering how small this project is it took quite sometime even with a lot of hands on the project.”

“A few things I learned while on site was some safety precautions that I didn't know before, and understanding the stages in calculating building energy. Sometimes when I look at a room I wonder how they designed it and doing this project helped me better understand how a room is actually made for reducing energy consumption and installed which is very nice to know in the future. It was very nice learning when to do each step and why because this helps us future designers understand what to do when they are creating a space, and we can describe why now because we physically did it.”

“One thing I learned is that a lot of the project gets held up because one thing is not done. In order to keep the project moving, we had to finish everything from that day before moving on. It helps keep things organized.”

Conclusion

This project can prepare the ground for developing a recurring annual course offering for students in the Interior Design program, helping the faculty to develop and enhance the course content based on the assessments' technical results, student learning assessments, student feedback, and feedback from the community partner. The project will also enable participating students to develop new technical knowledge, improve their ability to work successfully with institutional and individual clients professionally, improve study and work habits, and broaden their knowledge and experience to compete in a future job market.

Endnotes

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