SUSTAINABLE MULTIFAMILY KITCHEN DESIGN: A STUDENT ELICITATION APPROACH

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ABSTRACT

This case study focuses on the sustainable design of a demonstration kitchen space within a multifamily residence through a student lens. A project-based learning opportunity for undergraduate students in a senior-level kitchen and bath design studio was created to redesign a multifamily starter kitchen space into a multifamily sustainable kitchen space within the Center for Real Life Kitchen Design at Virginia Tech. Upon completion of this student project, a content analysis was employed to uncover sustainability themes within these student projects. As students are making the environment and sustainability priorities in their shopping choices, uncovering student themes regarding multifamily sustainability kitchen design criteria can uncover trends important to this millennial generation (The Nielsen Company, 2015; Timm, 2014). Furthermore, as demand for sustainability increases, comparing student themes to multifamily industry sustainability certification systems may unearth potential gaps in the industry which need to be addressed. Although there are several sustainability certification agencies that apply to multifamily in general, there is no one specific source for sustainability guidelines for kitchens, much less in multifamily units. This lack of guidelines and the inconsistency between existing certification programs make it confusing for consumers, developers, designers, and students to value and weigh elements of a sustainable kitchen project, especially with respect to multifamily housing.

By examining kitchens using current sustainability certification programs as well as this case study, recommendations can be put forth to shape guidelines for sustainable multifamily kitchens that are both clearly understood and sensitive to the environment. Ultimately, this could lead to sustainable kitchen design features becoming more commonplace in the multifamily resident home.

KEYWORDS:

sustainable kitchen design, project-based learning, demonstration kitchen, green building certification for multifamily housing, content analysis methodology

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INTRODUCTION

Since 2009, in the wake of the economic downturn, there has been an increase in multifamily construction (Caulfield, 2014). From an environmental sustainability lens, this is encouraging as the average multifamily resident building footprints are smaller. As of 2010, the average single family home in the United States was 2,392 square feet while the average square footage of a multifamily residence was 1,172 square feet (United States Census, n.d.a; United States Census, n.d.b). Therefore, multifamily developers and residents are acting more sustainably by lessening their building footprint, wittingly or not. While lower square footage is one way to mitigate negative environmental impacts of the built environment, there are many other opportunities within a multifamily residence to incorporate environmentally friendly features.

Adhering to third party green building certifications is another approach to incorporate more environmentally friendly features into the multifamily residence. There are multiple green building certifications available for use when the goal is to adhere to sustainable design guidelines in the multifamily context. In the United States, the two leading building level certifications are Energy Star® and Leadership in Energy and Environmental Design (LEED). Energy Star® for multifamily buildings, released in September 2014 (Energy Star, 2016), focuses strictly on energy efficiency and uses a comparison to peer buildings to determine if a building can qualify for certification. LEED for Homes is a more comprehensive third party building certification that focuses on location and transportation, sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, innovation, and regional priority. A building can earn credits within each category to reach various certification levels. As green building certifications are now being tailored to multifamily housing, the multifamily property management industry is also increasingly promoting sustainability initiatives (Hopkins, Read, and Goss, 2017). This trend towards sustainability is warranted since there is a connection between green features and consumer satisfaction (Dermisi and McDonald, 2011; Devine and Kok, 2015; Farhar and Coburn, 2008; Parkinson, De Jong, Cooke, and Guthrie, 2013).

Kitchens reflect a substantial portion of the home investment and are also heavily occupied by energy-using appliances. Greening the multifamily kitchen space provides further opportunities to advance environmental sustainability (hereafter "sustainability") while adding visually stimulating features. Kitchens, one of the most heavily used spaces in a home, are noted as being one of the strongest returns on investment and drivers of multifamily property rentals and sales (Joint Center for Housing Studies, 2015). Furthermore, these spaces are a major place of interface for daily human activities with a high concentration of built-in materials whose manufacturing and disposal directly affect the environment. Because of this broad impact, sustainable design guidelines for kitchens are crucial to addressing and mitigating environmental issues.

This case study focuses on the sustainable design of a demonstration kitchen space within a multifamily residence through a student lens. A project-based learning opportunity for undergraduate students in a senior-level kitchen and bath design studio was created to redesign a multifamily starter kitchen space into a multifamily sustainable kitchen space within the Center for Real Life Kitchen Design at Virginia Tech. Upon completion of this student project, a content analysis was employed to uncover sustainability themes within these student projects as well as gaps within the industry. The paper starts by providing a background on the Center for Real Life Kitchen Design at Virginia Tech. Next, the sustainability kitchen project-based learning opportunity is put into context. The student multifamily sustainable kitchen designs are then

analyzed. This is followed by the highlights of the final completed sustainable kitchen. The paper concludes with the key findings of the study as well as areas recommended for future research.

THE CENTER FOR REAL LIFE KITCHEN DESIGN

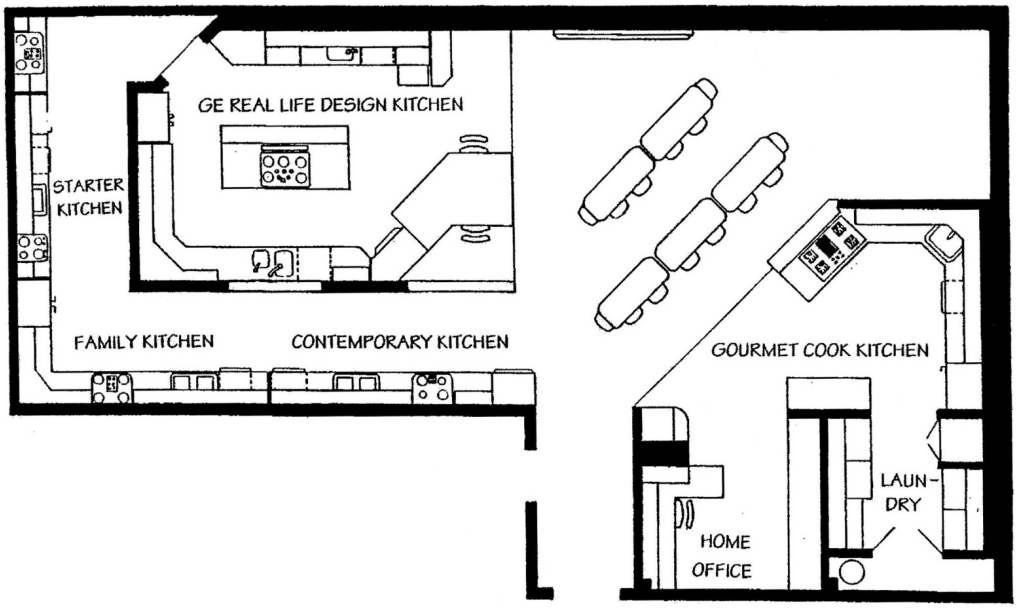
The Center for Real Life Kitchen Design at Virginia Tech (hereafter "The Center") opened in the fall of 1998. The Center, a collaborative effort of the faculty in the Department of Apparel, Housing and Resource Management and the kitchen industry, is unique in the nation. The Center was originally made up of five operational and very different kitchens as illustrated in Figure 1. The kitchens represented various price levels and space designs, and reflected the diversity of today's households. The Center illustrated how to accommodate young children, older adults, and people with disabilities in a residential kitchen area. The original mission of the Center was:

> *. . .to foster educational opportunities related to the demonstration and application of products, materials, and technologies in residential kitchen and bath design. The Center serves as a meeting place for a variety of educational endeavors as well as university/industry collaborative efforts.* (Beamish, Emmel, and Parrott, 2003)

The Center is regularly updated, particularly with respect to appliances. In 2007–2008, a major renovation of the Center included installation of the Outpost Kitchen, remodels of the Gourmet Kitchen and laundry area, and material/product updates to the GE Real Life Design Kitchen. Between fall 2015 and spring 2017, areas of the Center were extensively renovated, and these renovations are a focus of this paper. These renovations were undertaken to enhance and strengthen the mission and purpose of the Center.

The kitchens in the Center are labeled to reflect their design theme. As of fall 2015, the largest kitchen was the GE Real Life Design Kitchen and the other kitchens were the Traditional

FIGURE 1. The Center Layout prior to fall 2007.



(Family) Kitchen, Starter Kitchen, Gourmet Kitchen, Contemporary Kitchen, and Outpost Kitchen. Additional areas incorporated into the Center were a classroom, laundry area, home office, and library.

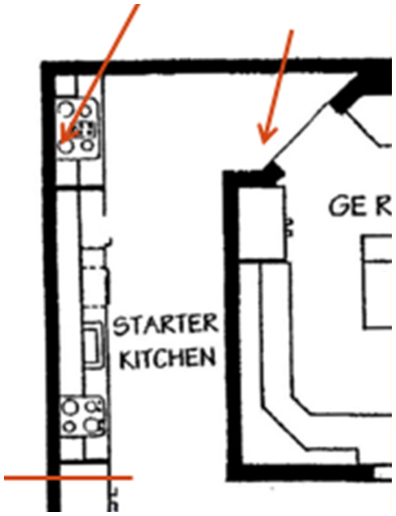
The Center is used for undergraduate classes, research, continuing education programs, tours, and meetings. Students, consumers, researchers, and professionals in kitchen design and construction have opportunities to learn about new products, applications, and technologies in residential kitchens. As opposed to solely learning by lecture in the traditional classroom, the Center provides a truly project-based student learning opportunity.

PROJECT-BASED STUDENT LEARNING OPPORTUNITY

Project-based learning provides students an opportunity to investigate authentic problems. In order to be effective, a problem must be presented that organizes and motivates the project as well as a final product that addresses the problem (Blumenfeld et al., 1991). However, the problem must give students enough freedom to explore it using various approaches. With these components effectively in place, project-based learning can provide a realistic environment where students can link concepts from the classroom to a real-world scenario. Outcomes can include a greater drive to learn and more meaningful learning (Bell, 2010).

In this case, in keeping with the ethos of the Center providing a truly hands-on experience, a project-based student learning opportunity was created in fall 2015. Cognizant of the need to continue to update the Center as a cutting-edge teaching and research space, students were asked to participate in a redesign and renovation to the Starter Kitchen; specifically developing a comprehensive design for the kitchen. The original Starter Kitchen was a space-saving environment with a functional layout suitable for various multifamily housing markets. The kitchen was described on the Center's website as: "Though simple in layout, the kitchen provided great style and features that are suitable for people on the go" (Starter Kitchen, 2015). Figure 2 shows the area of the existing Starter Kitchen and the increased space that was provided by removing a range that was not part of the kitchen. This also gave the students the opportunity to turn

FIGURE 2. Space Options for the New Kitchen Layout.



the corner and use the end wall if they chose. Removal of the angled entry to the GE Real Life Design Kitchen also provided additional design possibilities.

In order to transform the Starter Kitchen, students were given the following descriptive assignment:

> The **Starter Kitchen** is typical of a kitchen found in an apartment or retirement home, where limited space is devoted to the kitchen. The redesigned and renovated kitchen will be slightly larger and more upscale, demonstrating new technology and a focus on sustainability.

Students were to prepare a floor plan, elevations, mechanical plan, and complete product specifications for their design. Participation in critiques and group meetings on the project were required. Students were also able to engage with industry partners and faculty to plan, design, and implement this new project.

In preparation for the design phase, students and faculty traveled to GE Appliances in Louisville, Kentucky, to gain up-to-date knowledge on appliances and technology. GE Appliances committed to providing the appliances for the renovated kitchen and became a partner in the design and development process. As the Starter Kitchen project evolved in the design studio, the interest in and emphasis on sustainable features and products grew. Students began to envision their kitchen in an upscale, urban environment. The eight design students who participated in this project had taken at least one class in multifamily property management as required by their major. The Department of Apparel, Housing and Resource Management has a nationally recognized major in Property Management, and the design students have a basic knowledge of the multifamily housing market. Additionally, all the design students are required to take a class on environmental issues in housing. Thus, the design students were able to integrate their knowledge of kitchen design, sustainability, and multifamily property management into their designs and the Starter Kitchen became the Multifamily Sustainable Kitchen.

RESEARCH METHOD

As the faculty team moved to incorporate the students' design for the Multifamily Sustainable Kitchen into a single design to implement in the actual renovation, the question arose: How sustainable would the Multifamily Sustainable Kitchen really be? To help determine this, a content analysis of the student designs was conducted to evaluate the implementation of sustainability features and principles. A content analysis methodology, which looks at patterns for symbolic meaning, was deemed appropriate as this research method helps to uncover trends in material which may otherwise go unnoticed (Neuman, 2003). The eight student design projects were then reviewed twice by a faculty member. The first review was to identify all the features that the students had identified in their individual projects as sustainable. The second review was to identify features that could be considered sustainable that had not been identified by students.

Analysis of the Multifamily Sustainable Kitchen Designs

Table 1 displays the twenty-five different sustainable features identified by students sorted by student project frequency. Table 2 displays eight sustainable features identified by faculty that were not identified on student projects, sorted by student frequency.

TABLE 1. Twenty-Five Sustainable Features Identified in Student Projects.

Sustainable Feature	Frequency
Energy Star® Appliances	5
Recycling center	3
Recycled tiles for backsplash	3
LED lighting	3
Silestone® Eco Line for recycled countertop	3
Grow own produce—indoor planters	2
Compost—specified composter	2
Convection range	2
Open shelves in place of cabinets (less material)	2
New technologies (not specified sustainable)	1
Sustainable hardwood cabinetry	1
Cabinetry—Kitchen Cabinet Manufacturer Association Environmental Stewardship® program	1
Cabinetry—local service and production (not defined)	1
Cabinetry company environmentally responsible practices	1
Water Sense® labeled faucets	1
Concrete floor and countertop—identified as sustainable, minimal waste & assists in maintenance of air temperature	1
Compost—no composter specified	1
Bamboo countertops	1
CFL (compact fluorescent) lighting	1
Ice Stone® sustainable countertop	1
Reclaimed wood flooring	1
Recycled cabinet hardware	1
"Eco-friendly" materials	1
Smaller sized appliances	1
"Sustainable" appliances	1
Total	**41**

TABLE 2. Eight Sustainable Features Observed by Faculty; Not Identified by Students.

Sustainable Feature	Frequency
Standard size range with 2 ovens	3
Touch control faucet (Kohler Sensate®)	3
LED (light-emitting diode) Lighting	3
Open shelves in place of cabinets	2
Timer switch	1
Marmoleum® flooring	1
Cork flooring	1
Dimmer switches	1
Total	**15**

There were a total of 56 sustainable features identified by all students, of which there were 31 different sustainable features identified. The most frequently mentioned feature (5) was Energy Star® appliances, while recycling center, recycled backsplash tiles, LED lighting, and recycled countertop were mentioned by three students each. Other features that faculty identified in at least three student projects were a two-oven range, and touch control faucet.

The 56 total sustainable features identified in the student projects were reviewed and grouped into five categories as illustrated in Table 3. The first defined category, design features, included items such as indoor planters for growing produce and a recycling center. Material choices, the second defined category, incorporated items such as certified sustainable cabinetry and recycled tile backsplashes. The third category was product choices, which featured things like WaterSense® labeled faucets and a composter. Lighting or controls was the fourth defined category and contained features such as dimmer switches and LED lighting. The fifth category was general, miscellaneous or not defined. Features in this category included locally produced cabinetry and "eco-friendly" materials. Product choices were most frequently included in the

TABLE 3. Sustainability Feature Category Frequency.

Sustainability Category	Frequency
Product Choices	18
Design Features	11
Material Choices	9
Lighting and Controls	9
General, Miscellaneous, Not Defined	9
Total	**56**

student designs and were the only category included in all the student projects. Design features were the second most included category in relation to sustainability features. Material choices, lighting and controls, and the general, miscellaneous, or not defined category all tied for the least cited by students. The most frequently selected sustainable feature was Energy Star® appliances (5 of 8 students). Only one student had sustainable features in all the categories.

Features of the Completed Sustainable Kitchen

The student designs were upscale and for urban, mostly west coast locations. Working with the completed student designs and various vendors, the Starter Kitchen underwent renovations which included many environmentally conscious design features. Some features qualified for LEED credits. For example, Energy Star® appliances qualified for credits under the Energy and Atmosphere-Minimum Energy Performance category. LED lights, which reduce energy consumption, can qualify for LEED credits under the Energy and Atmosphere—Lighting category. Advanta® cabinets are now featured throughout the space as well and can qualify for LEED credits under the Materials and Resources—Construction Waste Management, Materials and Resources—Materials Reuse, Materials and Resources—Recycled Content, and Indoor Environmental Quality—Low-Emitting Materials Composite Wood. Greenguard® Indoor Air

FIGURE 3. Starter Kitchen prior to Renovation.

(Source:http://web.archive.org/web/20150905150021/http://www.ahrm.vt.edu/about/ahrm-spaces/center-rlkd/starter.html)

Quality Certified backsplash tile as well as countertops made from various recycled materials were installed to further the sustainability of the design. Additionally, a range with two smaller ovens was selected which can be more energy efficient in use. A recycling center was included, and no new materials were added to the concrete floor and the unfinished ceiling. Figures 3 and 4 show the transformation of the multifamily kitchen space.

The renovations to the kitchen were completed in spring 2017. With the update, the Center was renamed to be the Center for Real Life Design and a new, but similar mission was established.

> *The center's principal mission is to study and demonstrate residential design solutions that meet the needs and interests of families and consumers. The center includes six operational kitchens, which represent various price levels, product selections, and space designs. These kitchens also reflect the diversity of today's households, by including features that accommodate young children, older adults, and people with disabilities. Their new residential technologies and sustainable materials also reflect current trends in residential design.* http://liberalarts.vt.edu/research-centers/center-for-real-life-design.html

Students in the Residential Environments and Design major can now better understand specific design issues and product selections relevant to sustainable and multifamily kitchens.

FIGURE 4. The New Loft Kitchen after Renovation.

(Source: https://vtnews.vt.edu/articles/2017/05/clahs-center-for-real-life-design.html)

DISCUSSION & CONCLUSION

As students are making the environment and sustainability priorities in their shopping choices, uncovering student themes regarding multifamily sustainability kitchen design criteria can uncover trends important to this millennial generation (The Nielsen Company, 2015; Timm, 2014). When designing a multifamily sustainable kitchen, students participating in this project-based learning opportunity most frequently focused on the product choices such as Energy Star® appliances and Kohler Sensate® touch control faucets. Furthermore, sustainable product choices were included in all student designs and Energy Star® appliances were the most frequent sustainable feature. This may be due to the widespread marketing of specific products as sustainable or energy efficient. If this is the case, these types of readily identifiable products may provide visibility and marketing opportunities when designing sustainable kitchens.

As students focused on a few sustainable features and not on emphasizing these features across all aspects of their design, this may suggest that this demographic may not have the skill set at this point in their careers to apply sustainability concepts throughout a multifamily kitchen design. With the majority of students being traditional college age without much or any industry experience, they may be unaware of the extent of sustainable features available to them. This may also be true of the kitchen design industry as there is no widely recognized single standard or certification for sustainable kitchen design. However, sustainable design is part of the comprehensive knowledge base required to become a Certified Kitchen Designer® and is included in the required texts used in programs, such as the one at Virginia Tech, which are accredited by the National Kitchen and Bath Association (Beamish et al., 2013). Recently, the required knowledge base was expanded with the publication of an additional required text on sustainable design (Davis & Fisher, 2015). These texts present a broad picture of a variety of sustainability programs and options and focus on preparing the kitchen designer to practice sustainable design in the context of a wide variety of needs in designing a kitchen. Multifamily kitchen design is not specifically addressed.

Building sustainability topics encompass practices, products, techniques, and philosophical approaches (Beamish et al., 2013). The category of student responses present an outline for covering the topics in a residential design or kitchen design studio—product and material choices, lighting, and design features. For many multifamily developers, third party certifications may be important for implementing an array of sustainable features in a multifamily residence, and designers and students designers need to be aware of the criteria that could help achieve these certifications. Certifications such as Green Squared®, FloorScore®, Recycled Content Certification®, and Cradle to Cradle® Certification address environmental concerns from a products perspective. LEED® v4 O+M Multifamily certification addresses the practices to operate and maintain a multifamily building sustainably. EarthCraft Multifamily® and LEED®v4 for Homes are certifications which can be used in multiple settings including new construction and major renovations.

As demand for sustainability increases, comparing student themes to industry sustainability certification systems may unearth potential gaps in the industry which need to be addressed. The researchers wanted to compare the student projects to various third party green building certifications, but this research project uncovered a significant gap in the kitchen design industry. Although there are several sustainability certification agencies that apply to multifamily in general, there is no one specific source for sustainability guidelines for kitchens, much less in multifamily units. The published texts of the National Kitchen and Bath Association information, discussed above, are important in educating students and professionals on sustainability

in kitchens. However, they do not address developing a certification program for a sustainable kitchen. This lack of guidelines and the inconsistency between existing certification programs make it confusing for consumers, developers, and designers to value and weigh elements of a sustainable kitchen project, especially with respect to multifamily housing. By examining kitchens using current sustainability certification programs as well as this case study, recommendations can be put forth to shape guidelines for sustainable multifamily kitchens which are both clearly understood and sensitive to the environment. This most worthy project could be marshaled by industry trade organizations such as the National Kitchen and Bath Association who may be in a good position to create an industry certification, such as the Certified Kitchen Designer® designation. The EarthCraft® certification program may also be in a good position to create a sustainable multifamily kitchen design certification, as it was the first green building certification program to focus specifically on the multifamily sector (EarthCraft, 2016).

With a generally accepted third party certification in place, further opportunities for visibility and marketing are possible (Garber, 2017). A certification for multifamily sustainable kitchen design could provide designers and developers with a roadmap to implementing sustainable features into their design. Furthermore, students could be exposed to this certification to understand the concepts and features common in sustainable multifamily kitchen design. Ultimately, this could lead to sustainable kitchen design features becoming more commonplace in the multifamily resident home.

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