

# Impact of Study Abroad Programs on Enhancing Sustainability Knowledge in Construction Education

Busra Yucel<sup>1</sup>; Salman Azhar<sup>1</sup>; Amna Salman<sup>1</sup>

<sup>1</sup> McWhorter School of Building Science, Auburn University, Auburn, AL, USA  
 bzy0027@auburn.edu, [sza0001@auburn.edu](mailto:sza0001@auburn.edu), [azs0072@auburn.edu](mailto:azs0072@auburn.edu)

**Abstract**– Study abroad programs offer immersive opportunities for students to engage with sustainability concepts beyond the classroom, yet their contributions to construction education remain underexplored. This study examines how a study abroad program enhances students' understanding of sustainability in the built environment. Participants traveled to European cities and Dubai, observing diverse architectural styles, urban planning strategies, and sustainable construction practices through site visits, industry interactions, and hands-on learning. The findings highlight the role of experiential learning in bridging theory and practice, fostering critical thinking, adaptability, and an appreciation for global sustainability challenges. Exposure to real-world applications deepened students' understanding of energy-efficient designs, circular economy principles, and innovative materials, preparing them for the evolving demands of the construction industry. This research underscores the value of integrating international experiential learning into curricula to cultivate sustainability-conscious professionals equipped with global perspectives and practical insights.

**Keywords**– study abroad, construction, built environment, sustainability, higher education.

## I. INTRODUCTION

The rise of sustainable construction has increased the demand for construction educators to develop sustainability literacy and tackle emerging challenges. Despite efforts in higher education to provide such knowledge, many construction stakeholders still lack the necessary sustainability expertise, creating a barrier to the advancement of sustainable practices [1]. Higher education institutions play a crucial role in equipping future construction professionals with the skills needed to navigate these complexities. Study abroad programs, in particular, offer a unique opportunity for students to engage with sustainability beyond the classroom, providing a broader global perspective on sustainability practices [2]. These programs not only expose students to diverse cultural and social contexts but also foster the development of essential skills such as communication, leadership, and adaptability, which are crucial for tackling sustainability challenges in the built environment. Mezirow's [3] transformative learning theory represents that proper transformation is achieved through reflection, active learning, and exposure to challenging situations, enabling individuals to gain a deeper understanding of the world and those around them.

Several studies (e.g., [2], [4]) in the education literature supported Mezirow's [3] theory by providing quantitative data

showing that nearly all students experienced some form of transformative learning, or a full perspective transformation. Accordingly, by immersing students in international settings, these experiences help them build a deeper understanding of global sustainability issues.

While it is true that international study programs may appear to require greater financial investment, Auburn University has taken specific steps to make them accessible and affordable. Students participating in these programs are not required to pay tuition for that semester, making it especially cost-effective for out-of-state students. Additionally, the university and the program offer targeted scholarships and allow students to apply financial aid toward program expenses. As a result of these efforts, more than 70% of students in our undergraduate Building Science program participate in either short-term or long-term study abroad experiences. These high participation rates reflect both the accessibility and the value students derive from international programs in terms of professional and personal growth, especially within the context of sustainability education in construction.

This study aims to explore how study abroad programs influence students' ability to become informed and effective professionals in the construction field by enhancing their understanding of sustainability concepts and their solutions. Specifically, it investigates the role these programs play in deepening students' sustainability knowledge within built environment education, highlighting their impact on shaping future professionals in the construction industry.

## II. LITERATURE REVIEW

### A. Benefits of Study Abroad Programs

Universities in the United States of America (USA) offer a variety of study abroad programs, ranging from short-term to long-term options, with diverse curricular choices, including discipline-specific programs [5]. Study abroad programs offer university students numerous advantages, including the opportunity to gain a global perspective by immersing themselves in different cultures and understanding diverse viewpoints. Existing studies have shown that (e.g., [6], [7]) these programs enhance academic growth through access to unique courses, teaching methods, and facilities, while also fostering personal development by encouraging independence, adaptability, and problem-solving in unfamiliar environments. Moreover, globalization has profoundly influenced political,

cultural, environmental, and economic spheres in recent decades [8]. Therefore, enhancing students' understanding of global issues and diverse perspectives is an important issue in higher education.

Study abroad programs can be integrated into construction curricula, allowing students to transfer course credits between domestic and international construction programs. However, Jacobs et al. [9] stated that a few construction programs in the USA have a well-established study abroad plan. Considering the substantial effect of globalization in the construction sector and economies, engagement and collaboration with individuals from diverse cultures and backgrounds is inevitable. Accordingly, future construction professionals should advance their adaptability, communication, and leadership skills [10].

Several studies in the construction education literature have evaluated the impact of study abroad programs on students' learning and knowledge retention. For example, Lu et al. [11] conducted a survey study exploring a three-week-long summer study abroad program designed for construction management students in a USA-based university. The study results showed that students experienced some growth in their global perspectives, personal development, and construction management knowledge. Accordingly, such programs provide a valuable opportunity to significantly enhance students' knowledge on vital global components of education, such as sustainability.

#### *B. Study Abroad Programs to Promote Sustainability*

According to the Higher Education Academy [12], the rise of sustainable construction has created an increasing necessity for construction professionals to develop sustainability knowledge to meet new challenges. However, the limited sustainability knowledge of construction shareholders has become a key barrier to the growth of sustainable construction [1]. Accordingly, teaching sustainability in construction programs is of great importance to the industry. Moreover, the encouragement for university students to engage with and reflect on sustainability can shape their self-identity and their position within broader social, cultural, and ethical perspectives [13].

Research on effective methods for sustainability education remains an active academic discussion due to the challenges posed by global warming and population growth. This effort offers diverse perspectives and highlights the potential of various educational approaches to address and mitigate the sustainability crisis [14]. The increasing focus on programs dedicated to urban sustainability highlights the vital role cities play in both resource consumption and conservation [15], making it essential for construction students to engage with these issues.

For example, Tarrant and Lyons [6] highlighted the importance of study abroad programs for transformative sustainability knowledge development. The authors have shown that study abroad programs have significant potential for students at U.S. universities to develop global citizenship attitudes, as indicated by self-reported scores across three

measures: ecological conscious consumer behaviors, support for environmental policies, and environmental citizenship. In a nutshell, as Reilly et al. ([4], p. 30) noted that “study abroad programs provide an opportunity to explore sustainability beyond the classroom, offering a broader perspective of the triple bottom line.”

Despite the growing importance of sustainability in construction, there is a lack of research on the role of study abroad programs in enhancing students' understanding of sustainability within construction programs. As a result, this study seeks to explore how these programs contribute to students' comprehension of sustainability concepts and practical solutions, with a particular focus on their impact within built environment programs. By examining these contributions, the research aims to highlight the potential of international experiences in shaping more sustainable future professionals in the construction industry.

### III. METHODOLOGY

This research employed a case study approach to examine the impact of a 5-week study abroad program on students' understanding of global sustainability practices. The program included visits to European cities and Dubai, providing exposure to diverse sustainability practices. Data were collected through student projects on sustainable development and a post-program survey, offering insights into their learning experiences and how these influenced their understanding of sustainability. The following sections provide brief information about the study design and associated methodology.

#### *A. Case Study: Building Science Study Abroad Program*

In this study, we conducted a case study involving 19 Building Science students from Auburn University, who participated in a 5 week-long study abroad program that included visits to several European countries (Austria, Czech Republic, Germany, UK, Greece, Netherlands, and Switzerland) and Dubai. The program provided students with firsthand exposure to diverse urban environments, construction practices, and sustainability initiatives across different cultural and geographic contexts. During their travels, students visited various sites that showcased examples of sustainable development, allowing them to observe real-world applications of innovative practices in construction and urban planning.

The site visits were guided by 2–3 company representatives and faculty members, including one safety manager, one sustainability professional, and one project manager. Before the visit, students received a presentation about the project, and afterward, a discussion was held where they asked questions and reflected on their observations. Including the presentation and discussion sessions, each visit lasted between 3 and 5 hours in total.

Specifically, students visited projects that implemented advanced sustainability strategies such as green roofs, rainwater harvesting systems, and energy-efficient building envelopes in European cities. In Dubai, they observed large-scale solar

energy initiatives and state-of-the-art waste recycling facilities, illustrating region-specific sustainability approaches. Students also learned about company-level sustainability practices, including the use of sustainable materials, circular economy initiatives, and construction waste reduction strategies.

Figure 1 presents two photographs taken by students during their site visits in Europe. These images illustrate participants visiting various locations to observe and learn about diverse sustainability practices.



a) 3D printed bridge in Eindhoven b) Green roof application in Berlin  
Fig. 1 Examples of sites visited in Europe.

As part of their class responsibilities, students were tasked with developing and presenting a comprehensive project focused on sustainable development and carbon footprint analysis. The carbon footprint of each city was analyzed utilizing online open-source tools such as ClimateHero® and Ecological Footprint®. Students conducted assessments by inputting data related to energy consumption, transportation patterns, and local sustainability initiatives, allowing them to quantify and compare emissions across cities.

This project not only required them to integrate their observations from the study abroad experience but also to apply their knowledge in meaningful analyses of sustainability challenges and solutions across different contexts. Students critically assessed how urban planning decisions, such as public transportation infrastructure and building codes, contributed to differences in carbon footprints across these urban environments. The comparison included an in-depth look at sustainability incentives, policies, and carbon footprint generation, allowing students to critically assess the effectiveness of these practices and their implications for global sustainability efforts.

### B. Data Collection and Analysis

To document student experiences in detail, upon completing their projects, students participated in a detailed survey aimed at capturing their specific insights related to sustainability activities encountered during site visits. The survey combined multiple-choice and open-ended questions, specifically prompting students to identify concrete sustainability practices, such as sustainable construction and maintenance methods, green infrastructure, energy-efficient building technologies, and waste management initiatives they

directly observed. Additionally, students were asked to elaborate on how these observed practices explicitly informed their project analysis and the integration of sustainability elements into their final projects.

The collected data yielded detailed qualitative descriptions along with quantitative evaluations, offering precise examples and concrete insights into students' interactions with sustainability practices. This allowed for a clearer demonstration of how the study abroad experience tangibly enhanced their understanding and practical knowledge of construction sustainability, moving beyond abstract generalizations to specific, actionable observations.

Figure 2 illustrates the research methodology, detailing the steps involved in the case study, from program participation to data collection and analysis.

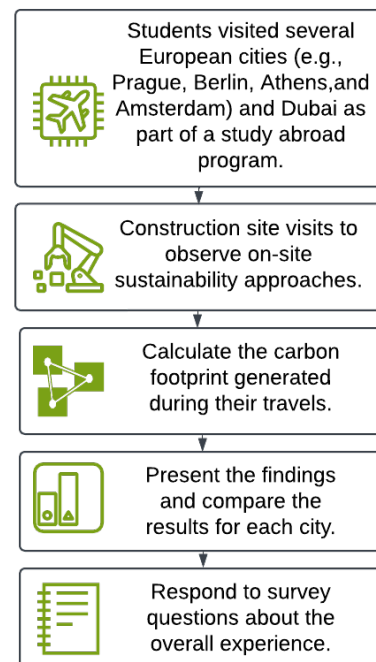


Fig. 2 Data Collection Process.

Data collected through the survey was analyzed using a mixed-methods approach, combining qualitative and quantitative techniques to ensure a comprehensive understanding of the findings. Specifically, two approaches were employed: (i) thematic analysis of open-ended questions and (ii) quantitative analysis of multiple-choice questions.

Thematic analysis was conducted using Taguette®, a free and open-source tool for qualitative research that streamlines coding and categorization, enabling researchers to identify patterns and themes effectively. This approach allowed for a nuanced exploration of participants' perspectives, capturing rich, detailed insights that may not emerge through quantitative methods alone.

On the other hand, the quantitative analysis of multiple-choice questions provided structured, measurable data, facilitating statistical comparisons and trend identification.

Together, these complementary approaches offered a robust framework for analyzing the data, ensuring both depth and breadth in the interpretation of the results.

#### IV. RESULTS

The cities selected by students to compare with Dubai are shown in Figure 3. Amsterdam, Netherlands was the most preferred city included in the student projects, and it was followed by Zurich, Switzerland, Santorini, and Athens in Greece. Figure 3 illustrates the distribution of cities featured in the final projects. Students discussed several cases that contributed to the sustainability of the selected cities, which they learned about during the site visits. For example, students who chose London discussed the EQUANS Carbon Reduction Plan, while those who selected Munich highlighted the BMW Group Plant Landshut, which uses electrically powered logistics, production vehicles, and transport systems.

The carbon footprint of each city was analyzed utilizing online open-source tools such as ClimateHero® and Ecological Footprint®. The students were asked to rigorously evaluate the tool used for carbon footprint calculations. While most participants mentioned the ease of use for both tools, some stated that using such tools for short-term visits is not very feasible. As one participant remarked, “It was very hard to be specific about living practices when you don't permanently live in that area.” Figure 4 shows examples from student projects.

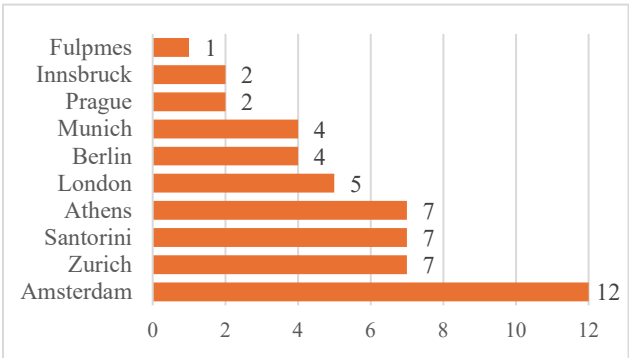


Fig. 3 Selected cities for the final project.

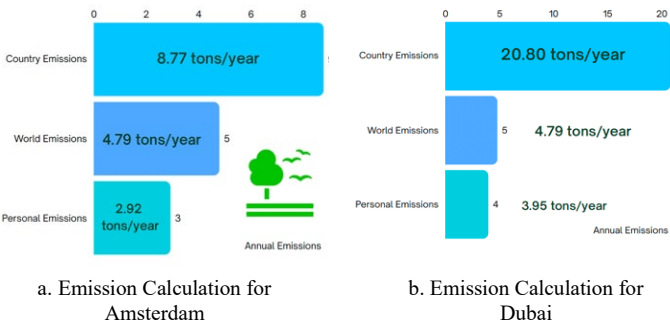


Fig. 4 Emission calculation examples from student projects.

Students also discussed the results of the carbon footprint analysis comparing European countries and Dubai. In their reports, they combined their observations during the study abroad program with qualitative data analysis. Some noted that “European cities generally benefit from established sustainability practices and lower emissions but still face challenges like population density and dependence on certain fossil fuels,” while stating that “Dubai faces significant challenges with high emissions due to rapid growth and reliance on fossil fuels but is making strides with innovative sustainable projects and infrastructure.”

Subsequently, students compared selected cities in terms of different criteria. Figure 5 shows various criteria considered by the students. As the figure shows, energy efficiency, transportation sustainability, and waste management effectiveness are the most preferred factors when comparing different cities’ sustainability development.

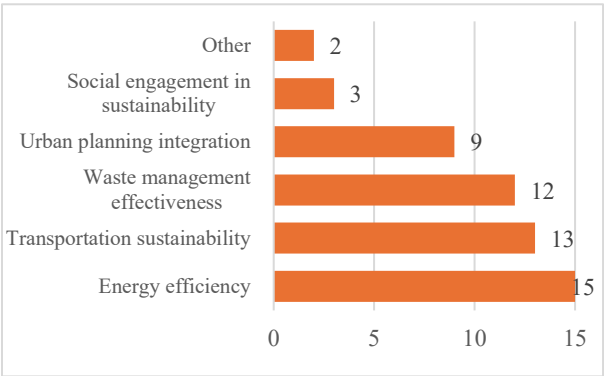


Fig. 5 Sustainability comparison criteria.

Students also rated overall sustainability practices on a scale of 1 to 5 (1 being least effective and 5 being most effective) in three regions: the United States, Europe, and Dubai. These ratings were based on their direct observations and evaluations of factors such as the presence and effectiveness of sustainability policies, the implementation and visibility of sustainable construction and maintenance methods, energy efficiency in buildings, waste management initiatives, public transportation infrastructure, and general urban sustainability practices observed during their visits.

As Figure 6 indicates, Europe had the highest sustainability rating, with an average score of 3.83. Dubai ranked second with an average score of 3.17, while the United States ranked last with an average score of 2.78.

Then, students provided further explanations for their evaluations through open-ended questions. They discussed the contribution of the site visits to their understanding of sustainability. The most emphasized theme was the importance of observing real-life sustainability cases in person.



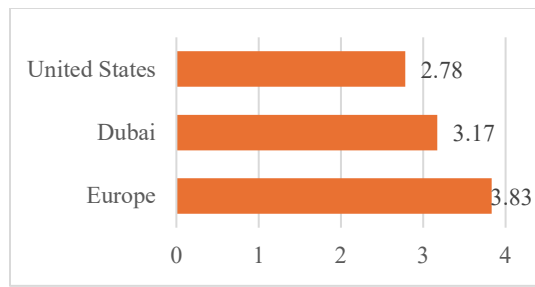


Fig. 6 Overall sustainability comparison.

One participant explained this by stating, *“It helped me to see how the city is actually implementing their sustainability practices and how we can apply it back in the U.S. Visiting actual sites gave me a better idea than just researching or looking at pictures.”* Additionally, they frequently mentioned that visiting different sites helped them to learn about diverse methods and materials, and how they may vary depending on the city’s characteristics. Another one explained, *“It helped out a lot when trying to understand how each city approaches sustainability practices within different methods of accomplishing it.”* Table I shows the top themes mentioned by participants regarding the advantages of site visits during their study abroad program.

TABLE I  
SITE VISITS’ CONTRIBUTION TO UNDERSTANDING OF SUSTAINABILITY PRACTICES

Theme	Frequency	Rank
In-person real-life case observations	8	1
Knowledge development on sustainability methods and materials	5	2
Observing different sustainability practices in different places	4	3
Comparison between Europe and the U.S.	3	4

Next, they discussed the factors contributing to disparities in sustainability practices among the analyzed cities. Geographical location and its impact on climate were the most frequently mentioned reasons influencing these differences. Participants reflected that various regions possess unique advantages and challenges that shape their approaches to sustainability. In addition to geographical factors, they highlighted the significance of policies, development levels, and financial considerations: *“The main factors influencing disparities in sustainability practices between the analyzed regions include differences in economic development levels, cultural values, climate conditions, government policies, and urban planning priorities. European cities typically emphasize systemic, community-oriented approaches and gradual integration of green technologies, while Dubai focuses on rapid, high-tech, large-scale projects driven by its unique climatic challenges and rapid urban growth.”* Others noted, *“European cities focus on strict environmental regulations, efficient public transportation, and community involvement in*

*sustainability efforts.”* Table II shows the results regarding the reasons for differences in sustainable practices.

TABLE II  
MAIN FACTORS INFLUENCING THE DISPARITIES IN SUSTAINABILITY PRACTICES

Theme	Frequency	Rank
Geographical location and climate	10	1
Government policies and level of development	7	2
Financial factors	5	3
Culture and Community support	5	4

The following questions focused on more personal experiences. Participants discussed the most surprising insights they gained from their projects. The majority mentioned that construction companies and cities are making significant efforts to increase their sustainability levels and achieve net-zero targets by 2050: *“Companies are trying to improve sustainability”, “I was surprised by how much Europe’s strict rules shape their sustainability efforts.”* and *“Everyone plans to be net zero by 2050.”* Additionally, they noted that their carbon footprints were much higher than expected: *“I was surprised by how much I impacted these regions during our stay.”* Participants also highlighted Dubai’s creative technological solutions as a surprising discovery: *“Dubai’s creative ways to manage water and use solar energy in the desert stood out, and its top-down initiatives were also eye-opening.”* Table III shows the themes that appeared most frequently.

TABLE III  
MOST SURPRISING INSIGHTS OR DISCOVERIES

Theme	Frequency	Rank
Effort and commitment of companies and cities	8	1
Personal carbon footprint	5	2
Dubai’s creative solutions	4	3
Waste management’s importance	2	4

Finally, the participants were asked how the study abroad program influenced their perceptions of sustainable development. They shared their insights on the opportunities and challenges regarding carbon footprint reduction. The most reported opportunity is their introduction to already existing methods and materials used for sustainability efforts. They also stated their perception of individual contributions to sustainability. Table IV presents the most important opportunities and challenges. As the table shows, almost half of the students mentioned that they realized the variety of methods and materials available for sustainability. As one mentions *“There are always multiple ways to construct and can be pulled from different places around the world to implement into one design to create new design and construction practices that can enhance the industry and skill sets.”* Opportunities for the U.S.

were also discussed: *“This project has revealed to me the possibilities for sustainability in America, as there are plenty of opportunities to apply sustainable practices.”*

Moreover, they mentioned that this study abroad program and their final project led to an increase in their awareness regarding their parts for sustainability. In this context, they mentioned some challenges they might face too. One of the challenges was the 100% percent involvement and buy-in, and the geographical challenges: *“I think I realized that for me it can be hard to minimize your carbon emissions, especially in the United States and driving a truck every day that is not electric.”*

TABLE IV  
CHALLENGES AND OPPORTUNITIES RELATED TO SUSTAINABLE DEVELOPMENT  
AND CARBON FOOTPRINT REDUCTION

Theme	Frequency	Rank
<b>Opportunities</b>		
Abundance of existing and possible methods and materials can be used	9	1
Awareness of carbon footprint and individual contributions	7	2
Sustainability is easier to apply than it seems	4	3
Opportunities in the U.S.	3	4
<b>Challenges</b>		
100% percent involvement and buy-in.	4	1
Car dependability in the U.S.	2	2

## V. DISCUSSION AND CONCLUSION

This study highlights the value of study abroad programs in enhancing students’ understanding of sustainability concepts in the construction industry. While previous research has demonstrated the potential of such programs to foster global citizenship attitudes, this study specifically explored their contributions to sustainability education for students in construction-related disciplines, addressing a gap in the literature.

The program allowed Building Science students from Auburn University to engage with diverse urban environments, construction practices, and sustainability initiatives across Europe and Dubai. Through site visits, students observed real-world applications of innovative sustainable practices, gaining a deeper understanding of the complexities of sustainable development in various cultural and geographic contexts. Their analysis of carbon footprints and sustainability practices, using criteria such as energy efficiency, transportation, and waste management, revealed regional differences and challenges, while also highlighting opportunities for improvement.

The study also aligns with the broader goals of Education 5.0, which emphasizes the integration of experiential learning, innovation, and sustainability into education to prepare students for global challenges [16], [17]. This research contributes to the field of construction education by demonstrating the unique

role study abroad programs can play in bridging the gap between theoretical knowledge and practical applications. It emphasizes the importance of experiential learning for fostering critical thinking and equipping students with the skills needed to address sustainability challenges in the construction industry. Furthermore, the study provides insights into how students perceive and evaluate sustainability practices across regions, offering valuable perspectives for future program design and curriculum development.

However, this study has some limitations. The reliance on self-reported data introduces potential bias, as students’ evaluations and reflections may be influenced by personal experiences and subjective perceptions. Another limitation of this study is the absence of a control group or pre-program diagnostic assessment, which limits our ability to directly attribute the observed learning outcomes to the study abroad experience alone. Additionally, the short-term nature of the program limits the depth of understanding students can gain about sustainability practices in each region. The use of carbon footprint analysis tools, while valuable, also posed challenges, as students noted difficulties in accurately assessing practices during brief visits. Future research could address these limitations by incorporating longer-term programs, expanding sample sizes, and exploring more robust tools for evaluating sustainability practices.

In conclusion, this study demonstrates that study abroad programs provide a unique opportunity for students to link theoretical knowledge with real-world applications. These experiences not only enhance students’ academic understanding but also contribute to their ability to address sustainability challenges in their future careers. The findings underscore the importance of incorporating experiential learning opportunities into construction education and suggest that future research should examine the long-term impacts of such programs while further integrating principles of Education 5.0 into their design.

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