Training Construction Management Students about Sustainable and Equitable Infrastructure through Leveraging an Envision-Rating System in a Hispanic-Serving Institution

Miss Rubaya Rahat, Florida International University

Rubaya Rahat grew up in Bangladesh, where she pursued her Bachelor of Science in Civil Engineering at the Bangladesh University of Engineering and Technology (BUET). After graduating she worked for two years in a construction management company in Dhaka, Bangladesh. She was involved in various residential and infrastructure projects. Rubaya now is a Ph.D. student at Department of Civil and Environmental Engineering and Teaching/Research Assistant at Moss School of Construction, Sustainability and Infrastructure, Florida International University. Her research interest includes Sustainable and resilient infrastructure, Engineering Education, and Sustainable transportation system.

Mr. Mohamed Elzomor, P.E., Florida International University

Dr. Mohamed ElZomor is an Assistant Professor at Florida International University (FIU), College of Engineering and Computing and teaches at the Moss School of Construction, Infrastructure and Sustainability. Dr. ElZomor completed his doctorate at Arizona

Training construction management students about sustainable and equitable infrastructure through leveraging Envision rating system in a Hispanic-serving institution

Abstract

As globalization increases, the construction industry must embrace social equity, diversity, and inclusion in every aspect including sustainable infrastructure construction projects. Thus, a diverse workforce can bring innovative ideas and solutions to the table to address various challenges pertaining to sustainable and equitable infrastructure (SEI). However, construction management (CM) education hardly focuses on disseminating knowledge about SEI, particularly to students from historically marginalized communities such as African-American, Hispanic, Native American, and so on. This study argues that all construction professionals must have sufficient competencies to identify infrastructure inequity issues as well as address those issues while working in a project team thus contributing to SEI developments. Therefore, this research introduces the CM students to the existing infrastructure equity challenges and how to address these issues through leveraging Envision infrastructure sustainability rating system. To achieve this objective, the study implemented training in a cross-listed sustainable construction class in a Hispanic-serving institution located in the state of Florida. The training consisted of introductory lectures on key topics including social inequity, gentrification, infrastructure inequity, equitable access to infrastructure, sustainable infrastructure rating system, and Envision rating system. The study conducted a pre-survey to record the pre-established knowledge of the participants about social inequity and the importance of SEI systems. Furthermore, the study conducted a post-survey of the participants following the training. The pre and post-survey data were analyzed using the McNemar test which indicated that such training could help the students to realize the existing infrastructure inequity issues and introduce them to the knowledge and skills to address and mitigate such issues through leveraging Envision rating system. Furthermore, the students presented various practical examples of infrastructure inequity problems which indicated that the training facilitated the students' skills to identify such issues. This study fostered the understanding of the CM students including students from marginalized communities of the importance of infrastructure equity as well as helped them in equipping with the knowledge and guidance needed to create an SEI system.

Background

Infrastructure projects are essential elements of the built environment because they promote public health and personal safety, have an effect on socioeconomic development, provide access to clean water, remove waste, and, most importantly, make it possible for building and industrial projects to connect to all major utilities. The U.S. Senate passed a $1.2 trillion bipartisan infrastructure plan on August 10 by a vote of 69 to 30, with support from all 50 Democrats and 19 Republicans [1] which authorizes $550 billion in new investments in various infrastructure projects around the United States in addition to renewing funding for ongoing efforts. It also involves funding for more traditional infrastructures like roads, bridges, airports, ports, rail, and

transportation in addition to repairing water systems, rebuilding the electric grid, enhancing broadband and internet access, and building a network of electric vehicle chargers to encourage sustainable transportation modes. Additionally, it contains $21 billion for the environmental cleaning of hazardous waste sites and $1 billion to "reconnect communities," especially Black and low-income neighborhoods that were fragmented by earlier highway construction and infrastructure development [2]. Biden's proposal would provide $20 billion for more egalitarian designs for multimodal infrastructure or sustainable green space, as well as neighborhood-driven initiatives to relocate highways and revitalize urban cores [3]. To assist in executing these measures successfully, a diverse project team including engineering and construction professionals would be beneficial which can result in providing effective solutions for various unique challenges. It is critical for all the team members of such projects to be properly knowledgeable and skillful regarding equity and sustainability principles, especially for infrastructure systems. Therefore, the next generation of engineers and construction experts must be trained properly to advance their capabilities in creating sustainable and equitable infrastructure (SEI) systems by mitigating the triple bottom line (TBL) effects of these infrastructure systems.

A set of economic, social, and environmental aspects together referred to as the Triple Bottom Line (TBL) aims to enhance the functionality of the built environment, including the infrastructure systems thus making it more sustainable [4], [5]. Given that most natural resources are finite and that rapid community growth affects the TBL, infrastructure development needs to be both robust and sustainable [6], [7]. Nonetheless, the term "sustainability" is frequently used to refer just to environmental sustainability, avoiding its other two crucial components: social and economic sustainability. As a result, the lack of social justice in infrastructure systems unequally impacts various communities through a variety of processes, including eviction, exposure to environmental danger, and lack of access to essential services. While engineers and politicians base their choices on technical and engineering criteria, stakeholders' decisions—which reflect present economic and political frameworks—exacerbate social and racial inequities [8]. In order to solve these issues and build sustainable, resilient, and equitable infrastructures, project team members must be appropriately qualified with the required competencies. This study advises that all students in construction management (CM) including students from marginalized communities be taught about the issues of infrastructure injustice and given explicit guidance on how to manage them by adopting the Envision infrastructure sustainability rating system. Thus, this study promotes social sustainability and supports the need for CM students to learn about it as a priority in order to equip them with the core skills necessary to contribute to the development of SEI systems.

The engineering and construction industries currently are looking for a more dynamic workforce with expertise beyond the standard technical concepts. According to some studies, a deeper foundation for sustainability knowledge is required among construction professionals for higher contribution to sustainable development [9], [10]. Similar objectives are outlined in The Vision for Civil Engineering in 2025, a publication of ASCE, which highlighted the value of sustainability and its integration into educational institutions [11]. However, efforts to promote

sustainability education frequently neglect the social component, such as issues with infrastructure inequity. This might be because adding social sustainability aspects to an infrastructure project may provide a variety of additional challenges. Nonetheless, previous literature had studied infrastructure equity and related subjects in limited scope. For example, Bolding et al. (2021) evaluated the perceptions of undergraduate students majoring in civil engineering about infrastructure inequities and their support for systemic changes to solve this issue [12]. Oulton et al. (2021) examined the existing understanding of social and environmental justice among civil engineering students and evaluated the effectiveness of a curriculum improvement to increase students' knowledge of the subject [13]. Similar to this, Armanios et al. (2021) incorporated discussions of how civil engineering projects are linked to unequal pollution concentrations, a lack of access, and the displacement of low-income communities into civil and environmental engineering curricula in order to improve understanding and experience of these topics [14]. Other studies emphasized the key difficulties in integrating social sustainability into engineering education [15] and concentrated on teaching about adopting social sustainability during the planning and design phases of construction projects [16]. However, research on CM students' current understanding of infrastructure disparities is limited within the current literature. By utilizing the Envision sustainability rating system, instructors may teach students how to better understand these concerns and how to address them as engineers. As the nation's future workforce is made up of diverse students, the resolution process should start with them in order to build equitable, sustainable, and effective infrastructures.

To this end, the Envision rating system is briefly described in the following section.

The Envision™ Rating System

The Envision rating system provides a structured framework to evaluate sustainability requirements for all types and sizes of infrastructure projects including transportation, water, energy, information systems, and so on [17]. This rating system was developed in partnership with the Institute for Sustainable Infrastructure (ISI) and the Zofnass Program for Sustainable Infrastructure at the Harvard University Graduate School of Design. Within a detailed framework made up of five categories—Quality of Life (QL), Leadership (LD), Resource Allocation (RA), Natural World (NW), and Climate and Resilience—this scoring system incorporates 64 sustainability and resilience indicators, or "credits" (CR). There are subcategories inside each of the five categories, each with a maximum achievable point total. The four certification levels that make up the Envision rating system are based on a percentage of the total Envision points that each criterion receives which include Verified (20% to 30%), Silver (30% to 40%), Gold (40% to 50%), and Platinum (50%) [18].

One of the main driving factors for the Envision rating system is its evaluation of how the project fits with the needs of the community as a whole and enhances the quality of life [19]. This sustainability evaluation tool has several advantages for developing SEI which include fostering social equity and environmental justice principles in project processes and decision-making, assisting communities in becoming carbon neutral, facilitating improved stakeholder engagement

and interagency collaboration, and enhancing the civil infrastructure's resilience, readiness, and long-term viability, among other benefits [20]. Additionally, Envision credits like QL3.1 Advance Equity and Social Justice promote active participation from community stakeholders throughout the project life-cycle and establish open lines of communication between project teams and impacted communities, enabling them to examine a project's impacts from all angles. Similarly, QL1.2 Enhance Public Health and Safety, QL2.1 Increase Community Access and Mobility, QL2.2 Encourage Sustainable Transportation, QL3.2 Preserve Historic and Cultural Resources, LD1.3 Provide for Stakeholder Involvement, LD2.2 Plan for Sustainable Communities, LD3.1 Stimulate Economic Prosperity and Development, and LD3.2 Develop Local Skills and Capabilities support the equitable and sustainable development of infrastructure construction projects [18]. Additionally, research on the compatibility of the Sustainable Development Goals and the Envision rating system has found that goals pertaining to social equity and equitable infrastructure, such as eradicating poverty (SDG 1), promoting good health and well-being (SDG 3), and reducing disparities (SDG 10) are very compatible with the rating system [21]. The CM students' knowledge and skills for creating SEI systems can therefore be improved by demonstrating to them how the Envision rating system can assist in addressing infrastructure equity challenges.

Aligning with this research need, this study provided training to the CM students in a cross-listed sustainable construction class and familiarized them with information and skills, such as utilizing the Envision rating system and its pertinent credits, to alleviate the present infrastructure inequity issues. This research assessed the students' knowledge improvement and examined the students' skills to identify practical examples related to infrastructure inequity. The training was implemented in a Hispanic-serving institution which is a type of minority-serving institution located in the state of Florida. Such implementation supported the notion that students from historically marginalized communities such as African-American, Hispanic, Native American and so on could serve as agents of change to support shifts in the field of CM. Literature has highlighted the low participation of marginalized communities in civil and construction industries as well as in the academic sector [22]. Furthermore, very few studies focused on improving the competencies of Hispanic and other historically marginalized students in CM including communication and presentation skills and other professional skills, while other studies assessed their preferences for sustainability and relevant career choices [23]–[25]. In order to support the skilled labor shortage in the CM industry as well as to preserve the economical success of the US, marginalized professionals must be involved in infrastructure construction projects. The findings of this study would contribute to increasing awareness of infrastructure inequality and preparing the forthcoming construction workforce including marginalized construction professionals with the skills required to ensure the SEI system.

Methodology

This research introduced the students from CM backgrounds to the importance of developing and integrating infrastructure equity within a sustainable community through implementing a workshop. The participants of this research were enrolled students in a cross-listed Sustainable

Approach to Construction course under the CM program in a Hispanic-serving institution. The participants included registered students for the course from architecture, engineering, and construction majors in the Summer 2022 semester. The workshop centered on assisting students in determining their level of knowledge on issues including social equity, gentrification, environmental racism, and so on. The training also introduced the students to the infrastructure sustainability rating system, i.e., Envision rating system and its credits, and how the CM professionals can leverage the credits to address infrastructure inequity issues. According to the presurvey results, 35 CM students from various backgrounds took part in the training. Among them, 77% of the participants identified as Hispanic, while 23% of the participants identified as non-Hispanic students.

The study employed an online surveying application called Qualtrics to prepare and send the surveys to the participants before and after the training. The pre-survey consisted of multiple-choice, and sociodemographic questions. The multiple-choice questions were designed to capture students' prior understanding of the Envision rating system, gentrification, social equity, and scenarios of infrastructure inequity. The demographic inquiries captured the individuals' social and academic backgrounds. During the training, the students were provided with a video developed by ISI that explained infrastructure inequity issues and relevant topics as well as how Envision rating system can address these issues. To conduct a comparative study and record the variations in the students' responses as a result of the training, the post-survey had the same multiple-choice questions as the pre-survey. Additionally, the post-survey included an open-ended question that asked the students to provide practical examples of infrastructure inequity problems to examine their understanding of the topic as well as to assess the efficacy of the training. Lastly, the post-survey asked the students to share feedback about the training and how it helped them to understand the existing critical issues within the construction industry. Figure 1 presents some examples of multiple-choice survey questions. The complete pre and post-survey are included in appendices A and B respectively.

1. ___ occurs when everyone has access to the same level of services. *a*. Social Equity *b*. Need *c*. Demand *d*. Market-based equity	*2. A* distribution of infrastructure services that shows differences correlated to race or class is referred as: *a*. Infrastructure Inequity *b*. Infrastructure Equity *c*. Infrastructure Demand *d*. Infrastructure Need

Figure 1. Sample multiple-choice questions from the survey

The McNemar test was used in the study to examine the pre- and post-survey data collected through multiple-choice questions. The most appropriate statistical analysis for the provided data is the McNemar test because it looks for differences in a dichotomous dependent variable (i.e., a categorical variable with just two categories) between two related groups [26]. With a maximum desired P-value of 0.1 and a 90% confidence interval, the McNemar test was carried out using SPSS for this study. Furthermore, the study used qualitative analysis to analyze the open-ended question and descriptive statistics to assess the feedback question that was collected through the post-survey.

Results and Analysis

This section presents the analysis and results of the participating students' pre and post-survey responses regarding infrastructure inequity issues and addressing these issues through leveraging Envision infrastructure sustainability rating system and its credits that are relevant to equity. The 35 total survey respondents were from various socio-demographic backgrounds as shown in Figure 2. The participants included both male and female students of different ethnicity, age, and races such as Asian, White, African American, and mixed race.

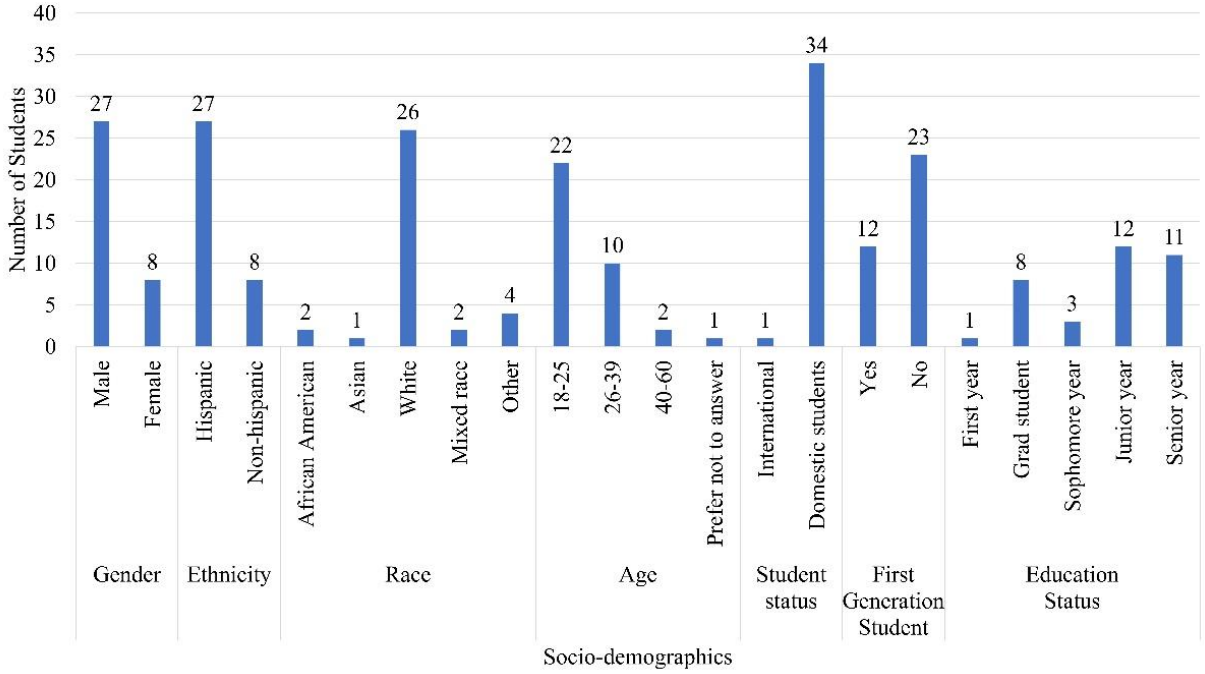

Figure 2. Students' socio-demographic background (n=35)

Through a pre-and post-survey, the study evaluated the students' capacity to understand terms associated with social injustice, gentrification, infrastructure inequity, equitable access to infrastructure, sustainable infrastructure rating system, and Envision rating system. The survey responses were analyzed using the McNemar test, as demonstrated in Table 1 which included serial number, variables, the mean difference between pre and post-responses, standard deviation, and P value. The results indicated a significant difference between the means of the two datasets for variables 3 and 6 indicating that the training was effective in improving the students' understanding of environmental racism and infrastructure rating systems. However, the remaining variables had higher P values indicating that the students had sufficiently higher levels of understanding before the training as suggested by the pre-survey responses. This could be because the students are increasingly more aware of socially relevant challenges such as infrastructure inequity problems that have had negative impacts on people's everyday lives.

Table 1. Results for McNemar Test of Pre-and Post-survey data

Sl.	Variables	Mean Difference	Std. Deviation	P-value
1	Pre and Post training answers for social equity.	0.08	0.355 0.236	0.453
2	Pre and Post training answers for gentrification.	0.03	0.497 0.49	1.000
3	Pre and Post training answers for environmental racism.	0.23	0.497 0.49	0.039
4	Pre and Post training answers for infrastructure inequity.	0.03	0.382 0.355	1.000
5	Pre and Post training answers for displacement.	0.03	0.502 0.505	1.000
6	Pre and Post training answers for infrastructure sustainability rating systems.	0.25	0.443 0.507	0.064
7	Pre and Post training answers for Envision rating system to address social inequity.	0.02	0.323 0.323	1.000

Additionally, the survey questionnaire asked the participating students an open-ended question about existing infrastructure inequity issues that they had identified in their practical life. The authors manually assessed the responses and listed several inequity issues found within the responses as shown in Table 2. This indicated that the training helped the students to improve their understanding of the existing infrastructure inequity issues and enhance their competencies in identifying and addressing these problems during their sustainability careers.

Table 2. Infrastructure inequity issues collected through the survey

Serial	Existing infrastructure inequity examples
1	Less access to public transportation
2	Poor maintenance of public transportation
3	Accommodations located close to factories and waste management or disposal facilities
4	Poor drainage, poorly built homes, and bad services near refugees' and immigrants' residences
5	Roads and sidewalks receive fewer repairs
6	Lack of commercial development in a particular area
7	Lack of large grocery stores in marginalized or low-income areas
8	Poor sanitation
9	Low-quality education

Furthermore, the students were requested to provide feedback on the training. The training received positive feedback from nearly 91% of the students, who said things like, "It gave us a wider perspective on the issues and solutions to solve these infrastructure issues", and “Because

of the exercise and video I was truly able to understand the concept and how Envision can play a major role in finding solutions for these infrastructure inequity issues," and " The training helped provide a more practical outlook on the issue". Although there were no unfavorable or neutral comments, 9% of students chose not to answer the question.

Limitations and Future Work

This study aimed to show how crucial infrastructure equity training is for CM students including students from marginalized communities and facilitate increasing their proficiency in developing SEI systems. The research does, however, admit some limitations which include the biases and subjectivity of the survey responses. Future studies may therefore focus on integrating training across other minority-serving institutions and conduct a comparative analysis with this research in order to evaluate the effectiveness of the intervention. Moreover, critical SEI concepts training along with case studies can be included every semester along with extensive evaluation, participation, and monitoring in order to achieve a long-lasting impact on future construction experts.

Conclusion

Construction professionals including historically marginalized workforces in the CM industry must acquire proficiency in how to tackle challenges and implement SEI systems in order to strengthen the social dimension of sustainability as well as support a diverse workforce in the industry. CM educators must include the right training and workshops that increase future workers' competence and understanding of such issues and their solutions if they are to achieve this goal. This study familiarized the CM students who were studying in a Hispanic-serving institution with the value of SEI and how strategies like utilizing the Envision sustainable infrastructure rating system may be able to help with challenges related to implementing infrastructure inequity. Additionally, the study evaluated the participants' knowledge improvement and captured their feedback regarding the effectiveness of the training. The pre and post-survey results showed that although prior to the training the students had a higher level of understanding of several infrastructure inequity topics, the training helped to improve students' knowledge about environmental racism and sustainable infrastructure rating systems, as evidenced by the statistical analysis. Furthermore, the positive remarks and feedback from the participants indicated that the training was helpful to provide them with a greater perspective on the infrastructure inequity issue and introduced them to some effective solutions to address these problems. The findings of this study contributed to advancing social sustainability education by encouraging CM students which also include students from marginalized communities to incorporate equity in infrastructure projects during their careers thus implementing sustainable and equitable developments.

References

[1] White House, "President Biden's Bipartisan Infrastructure Law | The White House," 2021.

[Online]. Available: https://www.whitehouse.gov/bipartisan-infrastructure-law/. [Accessed: 31-Jan-2022].

[2] J. Norman, “Biden ’ s $ 1 . 2 trillion infrastructure bill is good policy – and good politics.” pp. 1–2, 2021.

[3] L. Carey, S. J. Naimoli, and M. Higman, “The American Jobs Plan Gets Serious about Infrastructure and Climate Change.” 2021, doi: http://119.78.100.173/C666/handle/2XK7JSWQ/321229.

[4] J. Elkington, “Accounting for the Triple Bottom Line,” *Meas. Bus. Excell.*, vol. 2, no. 3, pp. 18–22, 1998, doi: 10.1108/eb025539.

[5] R. Rahat, V. Ferrer, P. Pradhananga, and M. ElZomor, “Assessing pedagogical paradigm for coupling FEP and sustainability practices.” Ann Arbor, MI: Inter-university Consortium for Political and Social Research [distributor], 2021, doi: https://doi.org/10.3886/E152102V1.

[6] ISI, “Envision Rating System for Sustainable Infrastructure.” Washington, DC, 2015.

[7] M. Elzomor, R. Rahat, P. Pradhananga, and C. C. Müller, “A step towards nurturing equitable and sustainable infrastructure systems,” in *ASEE 2022 Annual Conference*, 2022.

[8] H. Pearsall *et al.*, “Advancing equitable health and well-being across urban–rural sustainable infrastructure systems,” *npj Urban Sustain.*, vol. 1, no. 1, pp. 1–6, 2021, doi: 10.1038/s42949-021-00028-8.

[9] N. D. McWhirter and T. Shealy, “Teaching decision-making for sustainable infrastructure: a wind energy case study module,” *Int. J. Sustain. High. Educ.*, vol. 19, no. 5, pp. 893–911, 2018, doi: 10.1108/IJSHE-10-2017-0183.

[10] N. McWhirter and T. Shealy, “Case-based flipped classroom approach to teach sustainable infrastructure and decision-making,” *Int. J. Constr. Educ. Res.*, vol. 16, no. 1, pp. 3–23, 2020, doi: 10.1080/15578771.2018.1487892.

[11] ASCE, “The Vision for Civil Engineering in 2025,” *Am. Soc. Civ. Eng.*, vol. 18, no. 4, pp. 651–660, 2007.

[12] C. W. Bolding, J. H. Ogle, and L. J. Rapa, “Exploring Undergraduate Civil Engineering Students’ Perceptions of Infrastructure Inequities: A Pilot Study,” *ASEE Annu. Conf. Expo. Conf. Proc.*, 2021.

[13] R. Oulton, T. G. Gallagher, and C. K. Anovick, “Efficacy of Curricular Enhancements to Address Social and Environmental Injustice in Civil Engineering,” *ASEE Annu. Conf. Expo. Conf. Proc.*, 2021.

[14] D. E. Armanios *et al.*, “Diversity, Equity, and Inclusion in Civil and Environmental Engineering Education: Social Justice in a Changing Climate,” *ASEE Annu. Conf. Expo. Conf. Proc.*, 2021.

[15] R. Valdes-Vasquez, A. Pearce, and C. Clevenger, “Teaching social sustainability in

Sustainable Construction and Infrastructure courses: A collaborative approach," *Constr. Res. Congr. 2012 Constr. Challenges a Flat World, Proc. 2012 Constr. Res. Congr.*, pp. 2129–2138, 2012, doi: 10.1061/9780784412329.214.

[16] K. E. Björnberg, I. B. Skogh, and E. Strömberg, "Integrating social sustainability in engineering education at the KTH Royal Institute of Technology," *Int. J. Sustain. High. Educ.*, vol. 16, no. 5, pp. 639–649, 2015, doi: 10.1108/IJSHE-01-2014-0010.

[17] R. Rahat, V. Ferrer, P. Pradhananga, M. Elzomor, and S. Practices, "A Pedagogical Paradigm to Support Infrastructure Projects through Coupling Front-End Planning Techniques with Sustainability Practices," *Int. J. Constr. Educ. Res.*, vol. 00, no. 00, pp. 1–23, 2022, doi: 10.1080/15578771.2022.2096156.

[18] ISI, "Envision: Sustainable Infrastructure Framework Guidance Manual." Institute for Sustainable Infrastructure, Washington, DC, p. 192, 2018.

[19] M. B. Reiner, S. Fisher, and J. Sperling, "Evaluation of sustainable infrastructure: Development context matters," *ICSI 2014 Creat. Infrastruct. a Sustain. World - Proc. 2014 Int. Conf. Sustain. Infrastruct.*, pp. 420–433, 2014, doi: 10.1061/9780784478745.037.

[20] ISI, "The Blueprint for Sustainable Infrastructure." 2021.

[21] C. Contreras, "Creating a Common Language: How Does the Sustainable Infrastructure Criteria Compare to the SDGs?," *Int. Conf. Sustain. Infrastruct.*, no. Zimmerman 2014, pp. 14–25, 2019.

[22] S. N. Manesh, J. O. Choi, and P. Shrestha, "Critical Literature Review on the Diversity and Inclusion of Women and Ethnic Minorities in Construction and Civil Engineering Industry and Education," in *Construction Research Congress*, 2020, vol. 007, no. 1994, pp. 809–818.

[23] R. Rahat, P. Pradhananga, and M. Elzomor, "A Problem-Based Learning Approach To Develop Minority Students' Sustainability Knowledge and Professional Skills," in *ASEE Annual Conference and Exposition, Conference Proceedings*, 2022.

[24] T. Shealy *et al.*, "Career Outcome Expectations Related to Sustainability among Students Intending to Major in Civil Engineering," *J. Prof. Issues Eng. Educ. Pract.*, vol. 142, no. 1, 2016, doi: 10.1061/(ASCE)EI.1943-5541.0000253.

[25] P. Pradhananga, M. ElZomor, and G. Santi Kasabdji, "Advancing Minority STEM Students' Communication and Presentation Skills through Cocurricular Training Activities," *J. Civ. Eng. Educ.*, vol. 148, no. 2, pp. 1–16, 2022, doi: 10.1061/(asce)ei.2643-9115.0000060.

[26] M. Q. R. Pembury Smith and G. D. Ruxton, "Effective use of the McNemar test," *Behav. Ecol. Sociobiol.*, vol. 74, no. 11, 2020, doi: 10.1007/s00265-020-02916-y.

Appendix A

Pre-survey

Equitable Infrastructure Concepts Training

Please select the response that best matches the statements below.

Q1 _____ occurs when everyone has access to the same level of services.

a) Social Need
b) Social Equity
c) Social Demand
d) Social Inequity

Q2 _____ is often perceived as an inequitable process rooted in class conflict, in which investing in metropolitan areas predominantly favors in-moving members of the middle or higher classes at the expense of pre-existing lower-income people.

a) Discrimination
b) Categorization
c) Gentrification
d) Individuation

Q3 Building a waste water treatment plant in a low income neighborhood is an example of _____.

a) Failure to differentiate
b) Environmental justice
c) Environmental Racism
d) Microaggression

Q4 A distribution of infrastructure services that shows differences correlated to race or class is referred as:

a) Infrastructure Inequity
b) Infrastructure Equity
c) Infrastructure Demand
d) Infrastructure Need

Q5 _____ is a community risk in Public-Private Partnership procurement method for infrastructure development.

a) Capital
b) Displacement
c) Funding
d) Tax

Q6 A widely used infrastructure sustainability rating system is:

a) LEED (Leadership in Energy and Environmental Design)
b) Envision rating system
c) Energy Star
d) Green Globes

Q7 Following Envision credits can support to improve social equity.

a) Improve Community Mobility and Access
b) Advance equity and Social Justice
c) Enhance Public Health and Safety
d) All of the above

Socio-Demographic Background

Q1 Please specify your Gender.

a) Male
b) Female
c) Non-binary/gender fluid
d) Other

Q2 Please specify your ethnicity

a) Hispanic
b) Non-Hispanic

Q3 Please specify your Race

a) African American\Black
b) Asian
c) White
d) Native American
e) More than one race
f) Other

Q4 Please specify your age

a) 18-25
b) 26-39
c) 40-60
d) Above 60
e) Prefer not to answer

Q5 Are you an international student?

a) Yes
b) No

Q6 Are you a first-generation student (first in your family to attend college)?

a) Yes
b) No

Q7 Please specify your Educational Status.

a) First Year
b) Sophomore
c) Junior
d) Senior
e) Grad Student

Appendix B
Post survey

Equitable Infrastructure Concepts Training

Please select the response that best matches the statements below.

Q1 _____ occurs when everyone has access to the same level of services.

e) Social Need
f) Social Equity
g) Social Demand
h) Social Inequity

Q2 _____ is often perceived as an inequitable process rooted in class conflict, in which investing in metropolitan areas predominantly favors in-moving members of the middle or higher classes at the expense of pre-existing lower-income people.

e) Discrimination
f) Categorization
g) Gentrification
h) Individuation

Q3 Building a waste water treatment plant in a low income neighborhood is an example of _____.

e) Failure to differentiate
f) Environmental justice
g) Environmental Racism
h) Microaggression

Q4 A distribution of infrastructure services that shows differences correlated to race or class is referred as:

e) Infrastructure Inequity
f) Infrastructure Equity
g) Infrastructure Demand
h) Infrastructure Need

Q5 _____ is a community risk in Public-Private Partnership procurement method for infrastructure development.

e) Capital
f) Displacement
g) Funding
h) Tax

Q6 A widely used infrastructure sustainability rating system is:

e) LEED (Leadership in Energy and Environmental Design)
f) Envision rating system
g) Energy Star
h) Green Globes

Q7 Following Envision credits can support to improve social equity.

e) Improve Community Mobility and Access
f) Advance equity and Social Justice
g) Enhance Public Health and Safety
h) All of the above

Q8. Please share some of the infrastructure inequity problems that you have seen/experienced directly/indirectly in your surroundings.

Q9. Do you think the Equitable Infrastructure Training was helpful in understanding infrastructure inequity issues? Please explain your answer.