SDG LENS TO ASSESS INTERDISCIPLINARY SUSTAINABLE DESIGNS FOR INFRASTRUCTURE SYSTEMS

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Interdisciplinary and sustainable solutions are the long-awaited response to the multifaceted problems of the contemporary world. Multiple investigations suggest that the interaction of the medley of disciplines promotes sustainability thanks to its solutions, since there is a direct relationship between the interdisciplinary level of the team and the impact that the proposed solution and its development will have. The qualitative approach of this article helps to better understand the importance of developing interdisciplinary teams in sustainable solutions that compete with the Sustainable Development Goals (SDGs). Two different sustainable design proposals are examined and compared. Both designs specifically address SDGs 3, 7, 8, 9, 10, 11, 12, 13 and 17. The results allude to the fact that interdisciplinary designs promote and maximize sustainability in multiple SDGs through the same solutions, making it a more efficient design with a greater impact on society and the world. The significance of this research and the practice of it will focus on understanding the individual contributions of each disciplinary member and their different observations in their area of study.

Keywords: Sustainable infrastructure systems, Interdisciplinary designs, Sustainable built environment, Climate change.

1 INTRODUCTION

Interdisciplinary teams are working together to address the world's multiple and complex problems using sustainable design. The United Nations Sustainable Development Goals (SDGs) give these teams a clear set of guidelines. By following these guidelines, teams can identify key sustainability challenges and propose solutions that take the environment, economy, and society into account.

The integration of diverse fields of knowledge goes beyond the limits of a single discipline, offering innovative and sustainable solutions to address current and future challenges (Power and Handley 2019). The concept of interdisciplinarity involves using the expertise of different disciplines to address problems with a multifaceted approach (Ashby and Exter 2019). Furthermore, engaging in multifaceted and interdisciplinary activities fosters the development of robust and sustainable solutions. By promoting the exchange of knowledge from several fields, participants can further enrich their skills and competencies, leading to a more comprehensive understanding and approach to challenges (Guerra et al. 2020, Murzì et al. 2021, Acosta and Guerra 2022, Acosta et al. 2022, Mariño et al. 2022, Ubidia et al. 2022).

By combining knowledge from different areas, it is possible to better address problems that don't fit neatly into one category (Youngblood 2007). When diverse and interdisciplinary methods are integrated into education, it is possible to develop a broader perspective in students. This comprehensive approach enhances the ability to create more effective and sustainable designs and

This article aims to evaluate the impact of the development of interdisciplinary teams and measure the sustainability of their solutions and proposals using the SDG approach. Specifically, two sustainable design proposals are being examined: one focuses on the integration of optical fibers in autoclaved cellular concrete and the other explores the inclusion of textiles in thin reinforced concrete slabs. In both scenarios, subject matter experts will evaluate the sustainable designs and the analyzes will be based on the context of the SDGs.

2 BACKGROUND

The ideal response to the challenges of the contemporary world is innovative and sustainable solutions. However, these solutions should be derived from diverse disciplines (Guerra and Shealy 2018a, Ashby and Exter 2019). Since complex and innovative solutions emerge from multifaceted development, interdisciplinarity draws on diverse academic areas and fields of knowledge to achieve comprehensive understanding (Raento 2009). This implies that groups emphasizing interdisciplinary development and adopting a multifaceted approach harness knowledge and skills from different disciplines to develop sustainable, innovative, and intricate solutions (Power and Handley 2019). In this way, interdisciplinary practices allow for the integration of multiple fields of study, leveraging their collective strengths to address current global challenges. This innovative and educational process paves the way for completely new approaches to problem solving. Thanks to professionals from diverse disciplines, the boundaries of traditional areas of knowledge are crossed, new connections are formed and promising solutions to global problems are offered (Gruenwald 2014). There are five categories into which the advantages and benefits of interdisciplinary studies with multifaceted approaches can be classified (Power and Handley 2019): i) Sustainable solutions to crucial problems must be provided. ii) Current research problems must be improved from the root. iii) You need to stimulate a specific disciplinary area. iv) It is encouraged to face and challenge modern knowledge and understand the real world. v) It is required to promote the development of new methodical approaches (Pan and Katrenko 2015).

If education persists with the traditional learning process, based on the "common core" concept where students work towards the same goal and cover similar topics, they will inevitably exchange similar ideas (Misiewicz 2016). If interdisciplinarity is embraced and multiple fields of knowledge are integrated, it will present a significant opportunity within engineering and will be applied more frequently. However, one challenge of introducing interdisciplinarity in education is the antagonistic nature of knowledge between professionals and students (Lawrence and Lorsch 1967). This prevents diverse disciplines from converging organically, creating a barrier that isolates them. To achieve integration among these disciplines, knowledge must be shared and connected across areas to ensure sustainable, creative, and innovative outcomes (Stember 1991). In this way, academic communities will emerge from interdisciplinary teams that share similarities in specific fields of research. Interdisciplinarity is strongly related to sustainability (Guerra and Shealy 2018a). In September 2015, the United Nations agreed on the requirement of a more sustainable world, for which they proposed 17 Sustainable Development Goals (SDGs) (Stember 1991). These goals deal with topics such as climate change, sustainable production and consumption, and its essential objective, sustainable development, focusing on qualitative education as the best way to disseminate it (UNESCO 2014). To fully harness sustainable development, we need contributions from different disciplines, including science, engineering, medicine, architecture, history, and
environmental studies. This underscores the importance of an interdisciplinary group taking a multifaceted approach focused on the SDGs (Annan-Diab and Molinari 2017). Professionals, teachers, and students must commit to interdisciplinary development to formulate sustainable solutions to current challenges and achieve their goal of transforming society. It is important to remember that in an interdisciplinary group, no hierarchy should exist between the participating areas of knowledge (Bedón et al. 2022), instead, respect and mutual benefit should prevail, leading to new results, diverse approaches, and further questions to answer (Donnelly and Fitzmaurice 2005).

3 METHODOLOGY

This case study employs qualitative methodology (Yin 2003, Creswell 2013) to investigate the contributions of interdisciplinary teams to sustainable solutions. Two sustainable design proposals are being examined: one focuses on the integration of optical fibers in autoclaved cellular concrete and the other explores the inclusion of textiles in thin reinforced concrete slabs. In both scenarios, subject matter experts will evaluate the sustainable designs and the analyzes will be based on the context of the SDGs. The study raises two proposals: i) the solution devised by the interdisciplinary team will be reflected in the characteristics of the final design, and ii) the sustainability of the solutions proposed by the interdisciplinary team will be based on the Sustainable Development Goals (SDGs). For both sustainable designs, the interdisciplinary team was made up of university students trained in different academic disciplines.

The audiovisual material showing the sustainable design proposed by the interdisciplinary teams is reviewed several times to discern how each idea correlates with the 17 SDGs. In addition, a reference table is built that links the main ideas with the SDGs. This table lists the idea, its timestamp (in minutes and seconds of the videos), and its association with specific SDGs. Using this data, additional analyzes are conducted to identify ideas that resonate with multiple goals and determine which ones have a stronger connection to particular SDGs. Through this two-dimensional matrix, the results are presented in such a way that the relationship between the sustainable ideas proposed by the interdisciplinary team and the SDGs is dynamically illustrated.

4 RESULTS AND DISCUSSION

After analyzing the data, the results presented here reflect the responses generated by sustainable designs formed by interdisciplinary teams through the lens of the proposed UN-SDGs. The first sustainable design focuses on the advantages of incorporating Textile Reinforced Concrete (TRC) into built environments and infrastructure systems. The second addresses the integration of translucent autoclaved aerated concrete into masonry units (TAACM). Both designs received validation from experts and professionals.

The first part of Table 1 will detail the number of ideas related to each sustainable design, indicating their associations with each SDG. For this case, the TRC layout will be blue, while the TAACM layout will be orange. This table shows how the ideas in sustainable designs relate to 9 of the 17 goals, specifically aligning with the following SDGs: 3) Good Health and Well Being, 7) Affordable and Clean Energy, 8) Decent Work and Economic Growth, 9) Industry Innovations and Infrastructure, 10) Reduced Inequalities, 11) Sustainable Cities and Communities, 12) Responsible Consumption and Production, 13) Climate Action, and 17) Partnership for the Goals. The rest of the SDGs did not have a significant participation. Since the designs are related to construction and engineering, it is logical that the SDGs highlighted include good health and well-being, infrastructure innovation, sustainable cities and communities, and climate action. By performing an in-depth analysis of each design, we obtained the following tables. These tables provide a
granular view, highlighting the degree of correlation each design has with the proposed sustainable ideas. When viewed through the lens of the SDGs, it is understood that not all ideas will align with all goals. However, multiple goals can resonate with several ideas at different intensities. This variation is represented in the tables by color intensity. In addition, the importance of each SDG has been evaluated, categorizing them as having high or low impact depending on the number of ideas associated with each goal.

Figure 1. Design traits according to SDGs lens.

Interdisciplinary input requires collaboration between several disciplines to devise sustainable solutions that meet user needs and improve quality of life (Annan-Diab and Molinari 2017). The work between the different areas of knowledge, which was made up of engineers, architects, scientists, economists, and graphic designers, promoted the exchange of knowledge to generate a proposal that can be guided by the SDGs (Bedón et al. 2022). The presentations of proposals
stimulated a participatory process that culminated in a collective result. Each student contributed crucial ideas, imagining a new approach to construction that suggests the creation of innovative architectural spaces and engineering solutions. The combination of several disciplines produces efficient results aligned with the United Nations sustainable development goals, promoting the well-being of both people and the planet.

Lack of communication poses a major barrier to interdisciplinarity. Without it, innovative ideas and collaborative opportunities to address universal problems risk going unnoticed or underutilized. To promote a rich exchange of ideas, it is essential to foster an open and collaborative environment between professionals and students (Weller 2021). Collaboration within an interdisciplinary team is essential to obtain results that span an interactive medium, offering a structural solution, a unique design experience and cost balance (Annan-Diab and Molinari 2017). The result not only promotes sustainable development but also emphasizes caring for the environment for future generations. This approach improves project profitability by addressing current and future challenges.

5 CONCLUSIONS

To safeguard our natural resources and improve our quality of life, it is imperative to find sustainable, innovative and viable solutions to address current global challenges. The combination of knowledge from various disciplines is called "interdisciplinarity". This approach has the potential to advocate for sustainable solutions, particularly through the lens of the United Nations Sustainable Development Goals (SDGs). In this case study, two sustainable designs, proposed by interdisciplinary groups, were examined. Since these designs were vetted and endorsed by experts at the American Concrete Institute (ACI), they were further analyzed in the context of the SDGs. It was noted that, due to the important influence of the UN goals, teams involved in the development of sustainable solutions often foster high-level collaborations that span environmental, social and economic spheres. Both designs specifically address SDGs 3, 7, 8, 9, 10, 11, 12, 13 and 17.

References


